

HB - 103



Moving Metrology into the 21st Century

Surtronic 3+

OPERATING INSTRUCTIONS



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WHAT IS SURFACE TEXTURE MEASUREMENT ?

Before reading the description of the instrument, the user should understand what it is for and what it measures.

What surface texture is and why it is necessary to measure it are subjects covered in the book Exploring Surface Texture. The user is advised to read this book to obtain background information on surface texture in general and on stylus-type measuring instruments in particular. It also gives useful information on parameters: their derivation and use.

A general guide is as follows:

A surface which is nominally flat and smooth, thus:

may be afflicted with waviness, thus:



In any case, it can never be perfectly smooth and will always have some roughness texture



which may vary from fine to coarse according to the finishing process used.

Some surfaces may exhibit both roughness and waviness, as shown in Figure 1.

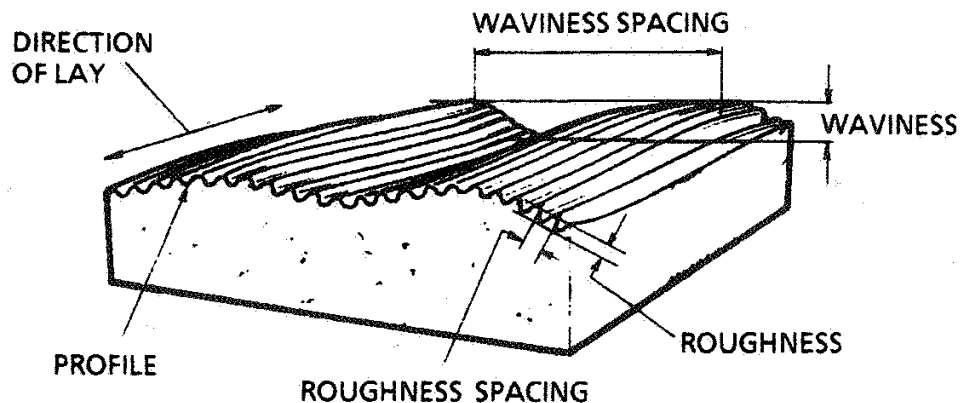


Figure 1 Surface characteristics

INTRODUCTION

A number of terms used in the following chapters may require some explanation.

Lc This is the Cut-off length (or Sampling length) and is the length of the reference line used for identifying the irregularities characterising the surface.

Surtronic 3+ measures the surface irregularities due to roughness and is made unresponsive to the more widely spaced irregularities caused by waviness or curvature. Even in the roughness range, the spacing of irregularities varies. For example, a surface may (depending on the method of finishing) have a profile like this:



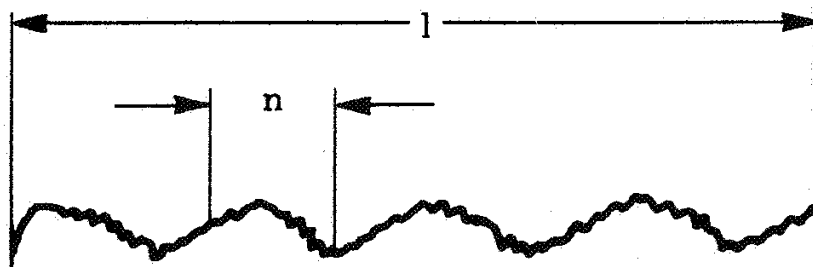
or this



or this



Some surfaces may exhibit both the closely spaced and widely spaced irregularities:



On a surface like this, sampled over length "l", the Ra value would be largely determined by the more prominent wider spaced irregularities. If as is often the case, it is desired to measure the value of the closely spaced irregularities, it is necessary to shorten the sampling length (to n, for example): this is called the cut-off length. The cut-off length must not be confused with the traverse length.

Ln This is also known as the Evaluation length and is the length over which the values of surface analysis parameters are assessed. It may contain one or more sampling lengths.

Traverse length This is also known as the assessment length and is the complete length of the pick-up movement along the surface being measured. It is normally greater than the evaluation length, due to the necessity to make an allowance at either end to ensure that mechanical and electrical transients are excluded from the measurement.

$$\text{Surtronic 3+ traverse length} = \frac{1}{4}L_c + L_n.$$

PARAMETER DEFINITIONS

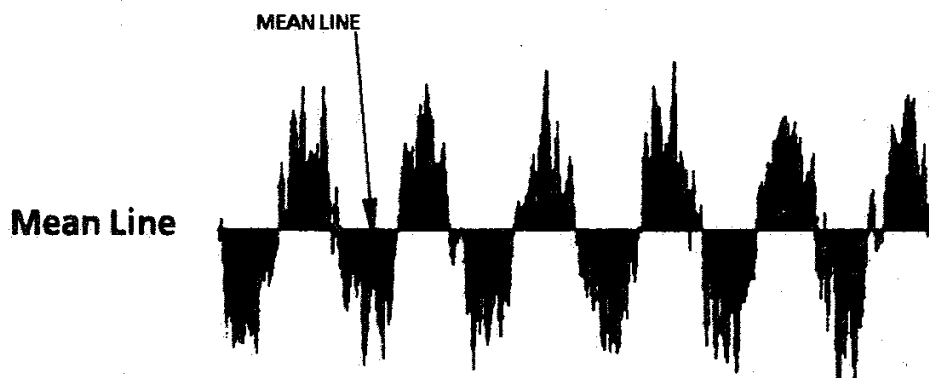
Surface texture is quantified by parameters which relate to certain characteristics of the texture. These parameters can be classified in three groups, according to the type of characteristic that they measure:

Amplitude parameters Are measures of the vertical displacements of the profile.

Spacing parameters Are measures of irregularity spacings along the surface, irrespective of the amplitude of these irregularities.

Hybrid parameters These relate to both the amplitude and spacing of the surface irregularities.

Mean line The Mean Line is commonly used in surface texture measurement and it is based on a least squares method. In basic terms it is a line which bisects the profile such that the area above it and below it are equal and a minimum., as shown below.



INTRODUCTION

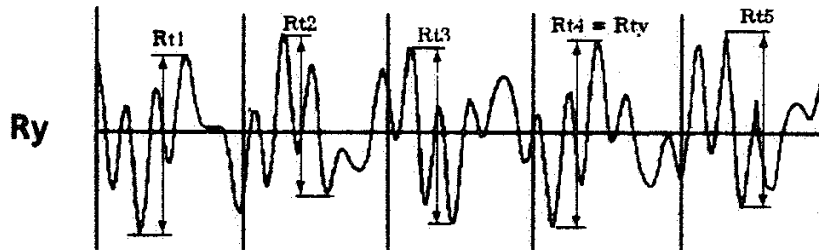
Ra Ra is the universally recognised, and most used, international parameter of roughness. It is the arithmetic mean of the departures of the profile from the mean line.

$$Ra = \frac{1}{L} \int_0^L |y(x)| dx$$

Rq Rq is the rms parameter corresponding to Ra.

$$Rq = \sqrt{\frac{1}{L} \int_0^L y^2(x) dx}$$

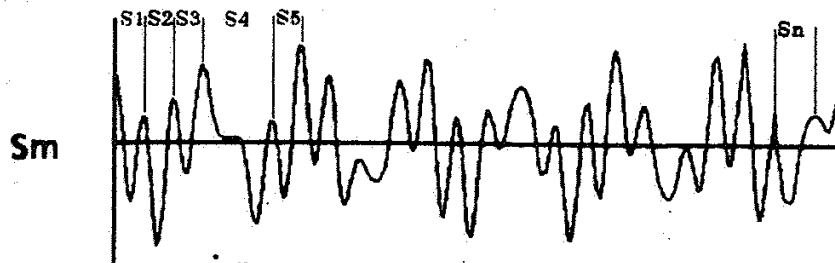
Ry The largest peak to valley heights within each cut-off length (known as the R_{ti} values) are determined. The R_y value is the largest R_{ti} value of the assessment.



Rz (DIN) The R_z (DIN) parameter, also known as R_{tm} , is the average of all the R_{ti} values (peak to valley heights) in the assessment length.

$$R_z \text{ (DIN)} = \frac{(R_{t1} + R_{t2} + R_{t3} + \dots + R_{tn})}{n} = \frac{1}{n} \sum_{i=1}^{i=n} R_{ti}$$

Sm S_m is the mean spacing between profile peaks at the mean line, measured over the assessment length. (A profile peak is the highest part of the profile between an upwards and downwards crossing of the mean line).



$$S_m = \frac{1}{n} \sum_{i=1}^{i=n} S_i = \frac{(S_1 + S_2 + S_3 + \dots + S_n)}{n}$$

FILTERS

The filters provided are 2CR (ISO) and Gaussian (phase corrected). These do not give a sharp cut in response to irregularities of widths greater than the cut-off length. Instead there is a gradual fall-off in response, as shown in the graphs on the following pages.

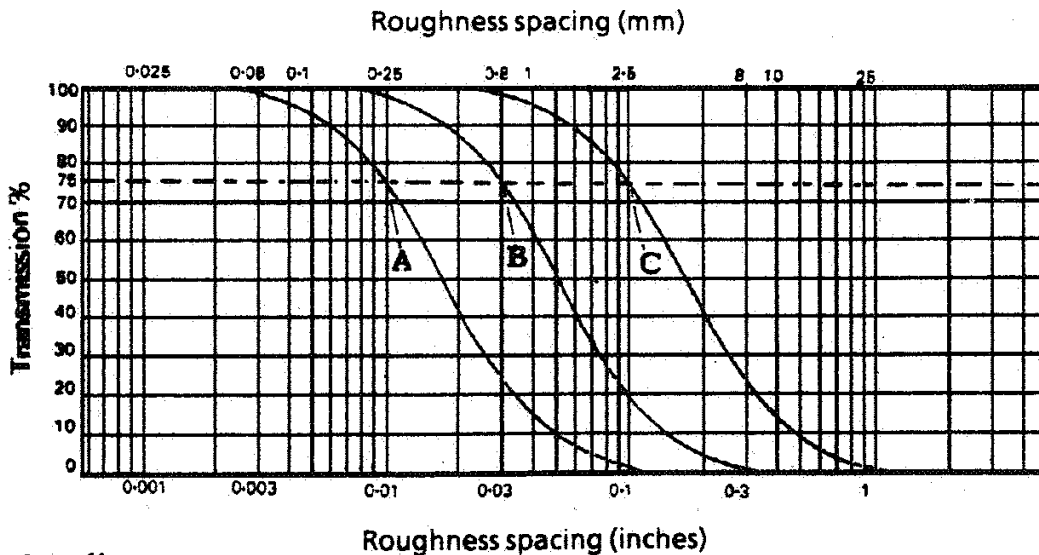
2CR The 2CR (ISO) filters have been standardised to have a transmission of 75% at the selected cut-off. This means that the amplitudes of the irregularities having a spacing equal to the cut-off length are reduced to 75% of their true value. For roughness analysis, the amplitudes of shorter wavelength irregularities will be almost unchanged. The amplitudes of longer wavelength irregularities are progressively reduced.

Filter details for 2CR (ISO) filter are as follows:

Amplitude transmission ratio for a sinusoidal waveform:

$$\text{Amplitude transmission ratio} = \frac{\text{output}}{\text{input}} = \frac{3}{3 + \alpha^2}$$

$$\text{where } \alpha = \frac{\lambda \text{ input}}{\lambda \text{ cut-off}}$$



Cut offs	
mm.	in.
A 0.25	0.010
B 0.80	0.030
C 2.5	0.10

**FILTER TRANSMISSION CHARACTERISTICS
(Roughness Profile)**

INTRODUCTION

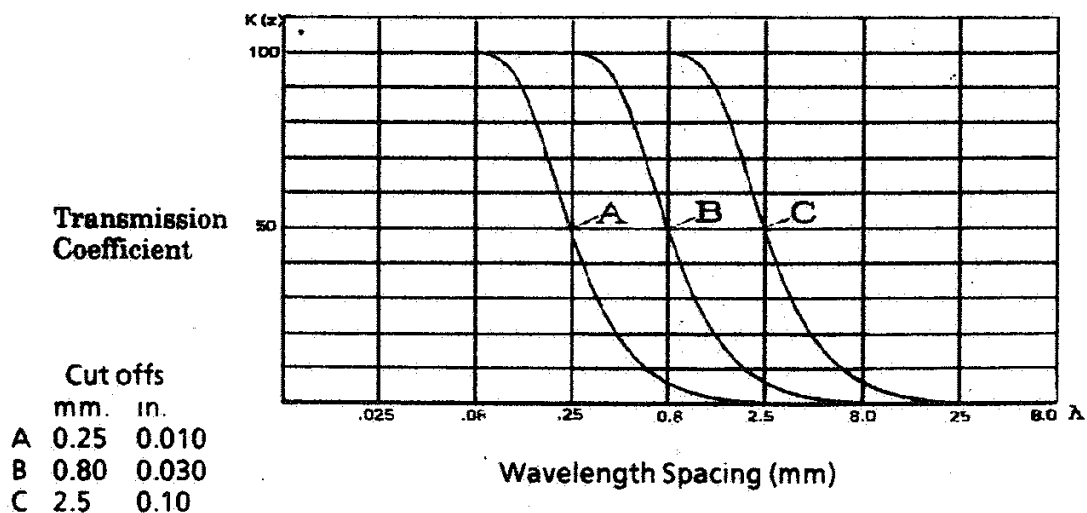
GAUSSIAN Gaussian filtering does not simulate a specific electronic filter, but is a mathematical function that is applied to the profile data. The filter is a weighted mean of the profile, where the weights have a gaussian (bell) shape. Since this shape is symmetrical, the resulting filter is phase corrected.

A property of a Gaussian filter is the ability to take account of data before and after the effective stylus position. The response at the cut-off value is 50% of the maximum transmission within the band.

The weighting function for the Gaussian filter has the equation of the Gaussian density function.

The transmission characteristics are made up of two components, these are: (a) the transmission characteristics of the mean line and (b) the wavelength characteristics of the roughness profile.

- a. The filter characteristic is determined from the weighting function, by means of the Fourier transformation.
- b. The roughness profile is the difference between the actual profile and the mean line. The filter characteristic is, therefore, the difference between the wavelength characterisation of the roughness profile.



FILTER TRANSMISSION CHARACTERISTICS (Roughness Profile)

The Surtronic 3+ is a portable, self contained instrument for the measurement of surface texture and is suitable for use in both the workshop and laboratory. Parameters available for surface texture evaluation are: Ra, Rq, Rz(DIN), Ry and Sm.

An explanation of the surface texture parameters evaluated by this instrument is given in the section **Parameter Definitions** in chapter 1 of this handbook.

The parameter evaluations and other functions of the instrument are microprocessor based. The measurement results are displayed on an LCD screen and can be output to an optional printer or another computer for further evaluation.

The instrument is normally powered by an Alkaline non-rechargeable battery. If preferred, a NiCad rechargeable battery can be used (in this case, a charger will be necessary).

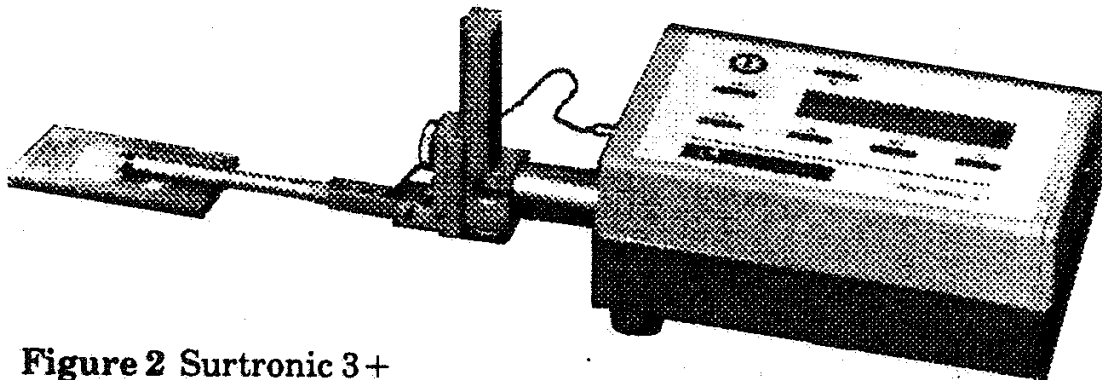


Figure 2 Surtronic 3+

THE EQUIPMENT

The standard Surtronic 3+ includes :

1 Measurement Unit	112 / 1590
1 Standard pickup	112 / 1502
1 Reference specimen	112 / 1534
1 Pickup cable	112 / 1257
1 Screwdriver	QA 0001
1 Battery	QB 0016

NOTE Certain items described in this handbook are optional and may not form part of your particular system.

DETAILED DESCRIPTION

DISPLAY-TRAVERSE UNIT

The top panel, of the display- traverse unit, carries a membrane type control panel and a liquid crystal display. The unit houses the electronics for controlling the measurement sequence, computing the measurement data and outputting the results to the display, or to the RS 232 port for use with a printer (when included) or to a computer, for further analysis.

The unit also contains a drive motor which traverses the pickup across the surface to be measured. The measuring stroke always starts from the extreme outward position. At the end of the measurement the pickup returns to this position ready for the next measurement. The traverse length is determined from selections of cut-off (L_c) or length (L_n).

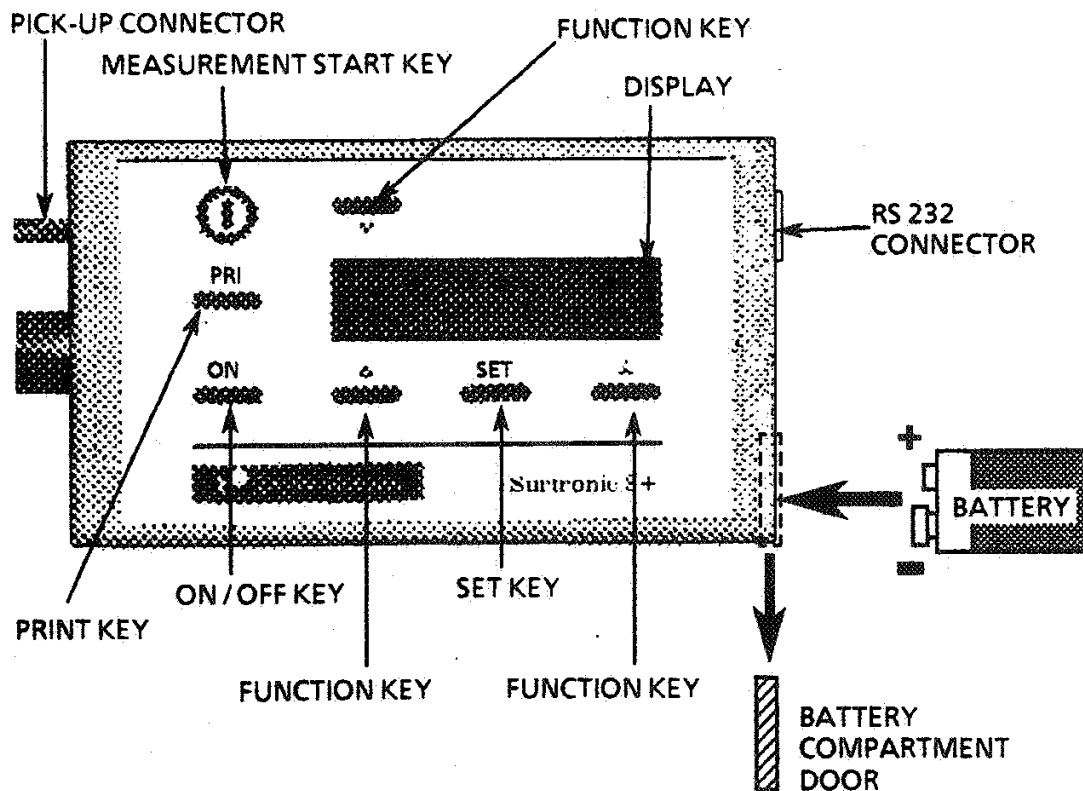


Figure 3 Display traverse unit

Battery To insert a battery, open the compartment by sliding the door to the left and remove the door from the unit. Insert the battery, with the terminals positioned as

shown in the diagram on the floor of the battery compartment (see also Figure 3).

ON key Pressing the ON key brings the display on and the previously selected setup is displayed (providing power has been continuously present). Activating the ON key when the display is already on and the processor not busy, takes the display OFF (sleep mode).

The display is automatically turned off if the instrument is not used for approximately 20 seconds.

If the battery is dead or has been removed, the previously selected setup is lost. When the battery has been replaced and the ON key is pressed, the message *Welcome to Surtronic 3+* is displayed for two seconds and the default settings are restored, these are:

Parameter	:	Ra
Lc	:	0.8mm
Ln	:	4.0mm
Range	:	- - . - 2
Vv	:	x1000
Vh	:	x100
Data dump Ln	:	4.0mm
Data dump range	:	100µm
No parameter / graph selected for printout		

If the traverse unit was not at the stop position when power was removed, then on pressing the ON key, the traverse is completed and the message *Motor returning* is displayed during the return. On completion, the ON key response returns to normal.

**ⓘ key
(START)**

Pressing this key starts the traverse and on completion the selected parameter is evaluated and results are displayed.

A connected printer can be used to print out selected parameters. All the parameters selected in Pre-set print state will be printed out in the results.

When Start is activated from the pre-set menu state, the Main menu-state is restored before the traverse begins.

DESCRIPTION

If Start is pressed during a traverse, a stop and reversal without measurement will occur and *Measurement cancelled* is displayed.

SET key The SET key is used in conjunction with the three function keys (indicated by ∇ or Δ), to make selections relating to the measurement conditions and the parameters evaluated. The operation of the SET key and the ∇ Δ keys is described in the METHOD OF USE section of this handbook.

PRI (print) Pressing this key causes the evaluated measurement data to be output to the RS 232 port. When a printer is connected, a printout of all the parameters selected in Pre-set print state is made.

If PRI is activated when the instrument is not in its Main Menu state or after Main-state has been switched out and then back in (i.e. SET key pressed twice), the print heading is included.

If DIP-switch S8 (SPC) is on, the heading is disabled (see page 13 for DIP switch settings).

With 'Graphic' selected in Pre-set print state, the profile will be printed out in accordance with the selected V_v and V_h value.

Where the curve is longer than 80cm the printout will stop after 80cm. The next 80cm can be printed by pressing PRI. The printout will start from the beginning of the profile if SET is activated.

If no legal surface data is stored, the error message *Measure before print* is displayed.

If no parameter is selected in Pre-set print state, the error message *No parameter selected* is displayed.

If no printer is connected when PRI is activated, *Printer not connected* is displayed.

During printout *Printing* is displayed.

After printout the instrument is in the Main-state.

Activating PRI during printout (before display is updated to Main-state) stops the printout and *Printing*

cancelled is displayed for two seconds. The normal update to Main-state then continues.

To clear an error message, press the SET key.

PICK-UP MOUNTING COMPONENTS

The pick-up is fastened to the drive shaft by the following means:

Mounting bracket This is clamped to the drive shaft by means of a knurled knob. Although normally used upright, as shown in Figure 4, it can be turned to angle the pick-up or to take it off the centre line, as shown in Figure 4A. It can also be mounted sideways on the drive shaft, when the right-angle pick-up is in use (Figure 4B).

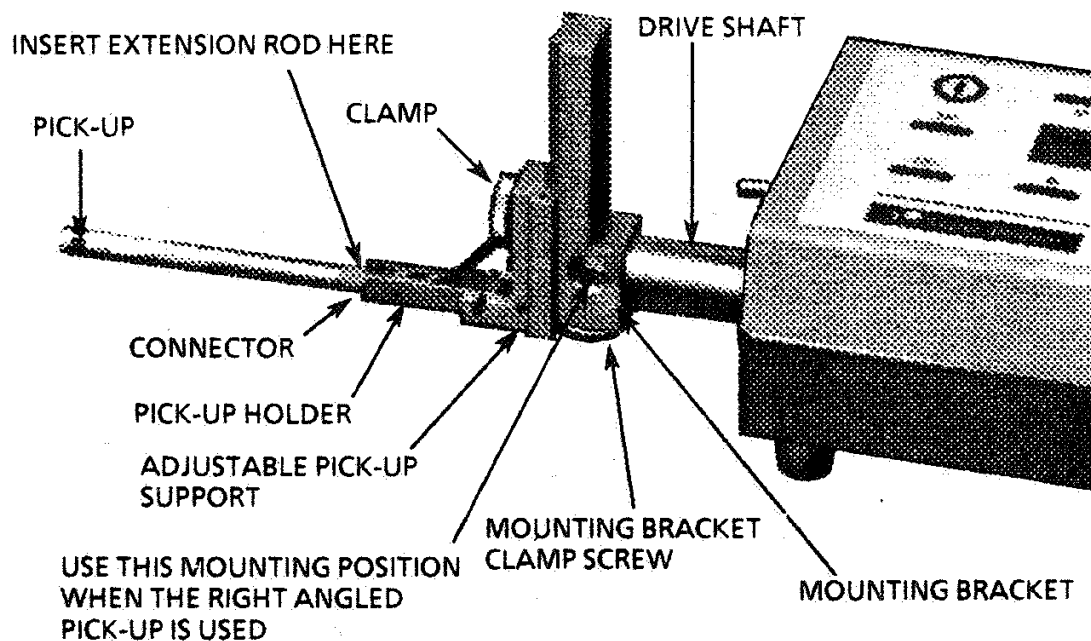


Figure 4 Pick-up mounting

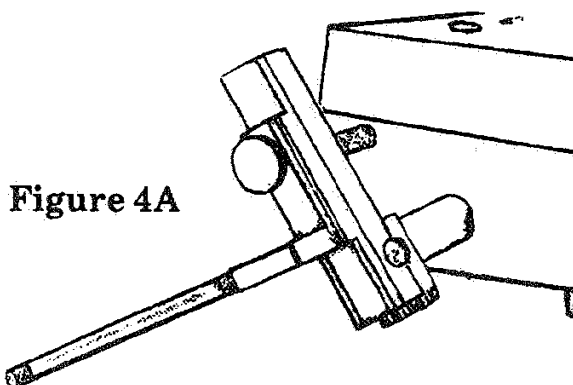


Figure 4A

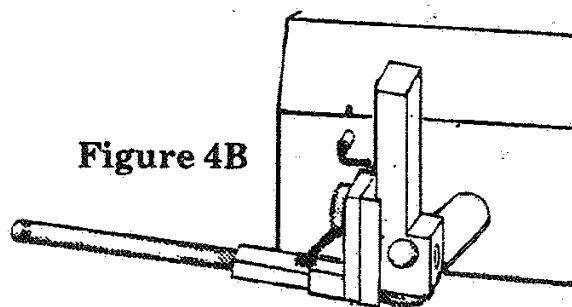


Figure 4B

DESCRIPTION

Adjustable support This can be clamped at any position on the slide of the mounting bracket to provide pick-up height adjustment.

Pick-up holder This fits into the crutch of the pick-up support and is held in place by a spring plunger.

A biased holder, when used as shown in Figure 4, exerts a biasing force on the pick-up (depending on which way the holder is inserted into the support crutch). It can also be used to position the pick-up directly underneath the display unit, as shown in Figure 5.

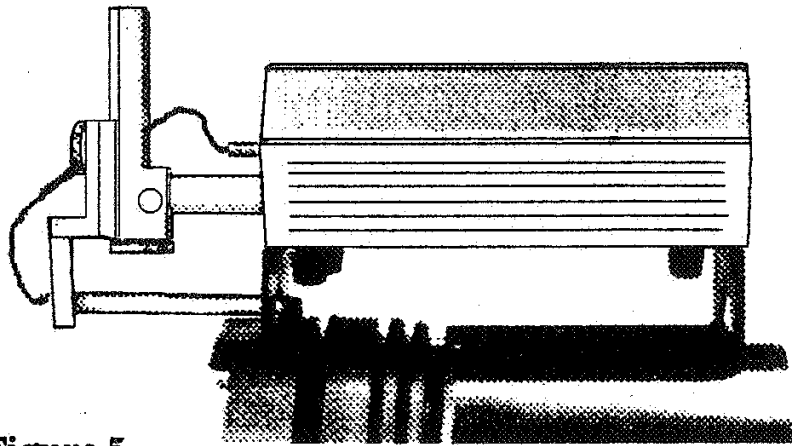


Figure 5

The holder will hold the pick-up at right angles to the drive shaft when it is pivoted away from the surface (e.g. while changing the workpiece).

Connector The connector of the pick-up lead is screwed into the end of the pick-up and is then inserted into the end of the pick-up holder, with the lead coming out through the slot in the holder. It is advisable to connect the lead to the display-traverse unit first and then to the pick-up.

When the extension rod is used, the short pick-up lead is not required and the end of the rod itself is inserted into the holder.

DIP switch settings The instrument default settings, when powering up with a new battery, are set via DIP switches housed inside the display-traverse unit. The selections can be changed by menu/pushbutton operation. The DIP switches are accessed by unscrewing the three feet from the base of the display-traverse unit, then removing the three screws which were partly covered by the feet.

Gently lift the top half of the display-traverse unit from the bottom half. A short ribbon cable connects the two halves, so place the halves close together (see Figure 6) and do not pull on the ribbon cable.

The location of the DIP switch settings is shown in Figure 6. The settings are as follows:

Measurement units:	S1	
Metric	0	
Inch	1	
	S2	S3
Printer type: Impact printer (RTH printer)	0	0
Epson compatible printer	0	1
Seiko DPU 411	1	0
Seiko DPU 201	1	1
Language of display and printout:	S4	S5
English	0	0
German	0	1
Italian	1	0
French	1	1
Filter type:	S6	
Digital Gauss-filter	0	
Digital CR-filter	1	
Not used.	S7	
Statistic Process Control (SPC) on/off	S8	
SPC on	0	
SPC off	1	

DESCRIPTION

CAUTION

Electronic components can be damaged by a discharge of static electricity. Therefore, when setting the DIP switches, do not touch any of the other components.

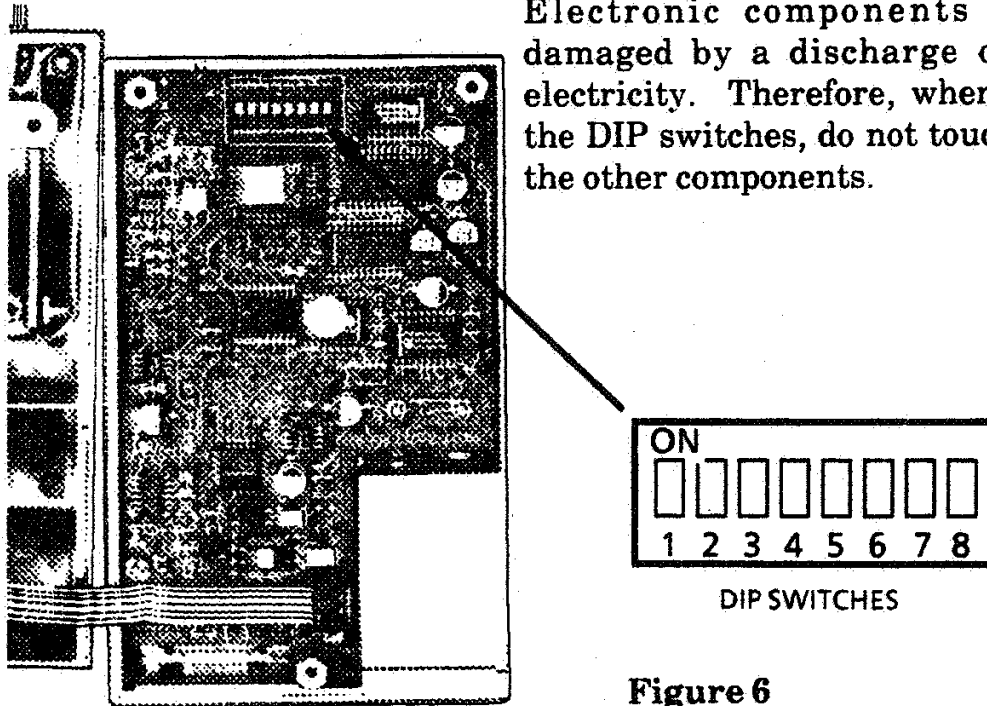


Figure 6

PICK-UP

The pick-up is a variable reluctance type transducer which is supported on the surface to be measured by a skid, a curved support projecting from the underside of the pick-up in the vicinity of the stylus. As the pick-up traverses across the surface, movements of the stylus relative to the skid are detected and converted into a proportional electrical signal. The radius of curvature of the skid is much greater than the roughness spacing. This enables it to ride across the surface almost unaffected by the roughness, and provide a datum representing the general form of the surface. Even so, where the waviness is widely spaced it will be necessary to use the pick-up with shoe, in conjunction with the 2.5mm (0.1 in) cut-off.

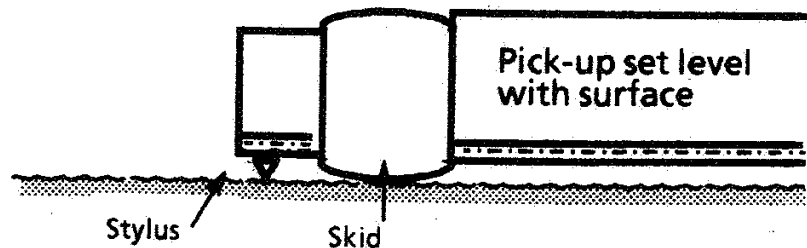


Figure 7 The pick-up is supported on the workpiece by the skid

There are several different types of pickup available designed for different applications, details are given in the **Accessories** section of this handbook. They differ only in the stylus tip radius, the dimensions of the housing or position and shape of the skid. The stylus material in all the pickups is diamond for low wear.

The skids of the standard pickups are of red ruby.

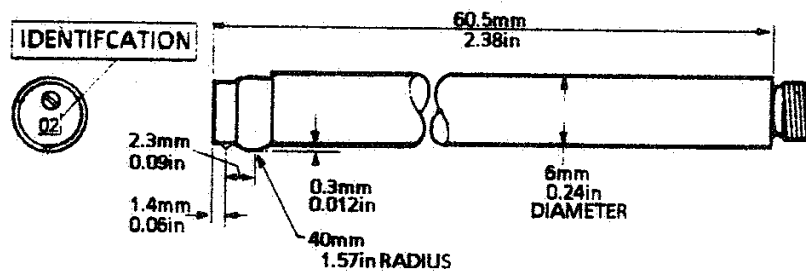


Figure 7A Standard pick-up dimensions

Successful use of Surtronic 3+ will only be possible if it is operated on a surface free from external vibration.

Display-traverse unit

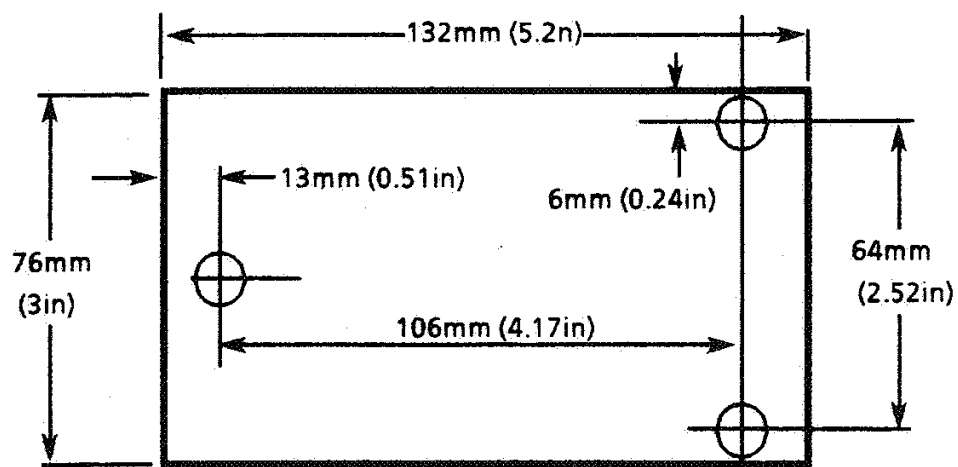
Plug the lead into the socket on the front of the unit and mount the pick-up as illustrated in Figure 4. Rotate the pick-up to bring the stylus vertical, this can conveniently be done with reference to the identity number engraved on the end of the pick-up.

If the pick-up has been changed or the instrument is being used for the first time, check and adjust the sensitivity (Page 52).

Mounting

On a flat surface the display-traverse unit can be supported on its three feet. If the unit is to be used on a roll or in a large bore, unscrew the three feet and use them to fasten an optional roll and bore plate to the bottom of the unit; make sure that the feet are correctly located within the holes in the plate.

If a user wishes to make his own mounting bracket for the unit, the dimensions of the fixing holes are shown in Figure 8.



Diameters of clearance holes:
 8.2mm (0.32in) for feet
 3.2mm (0.13in) for screw
 Foot screws M3 thread.

Figure 8

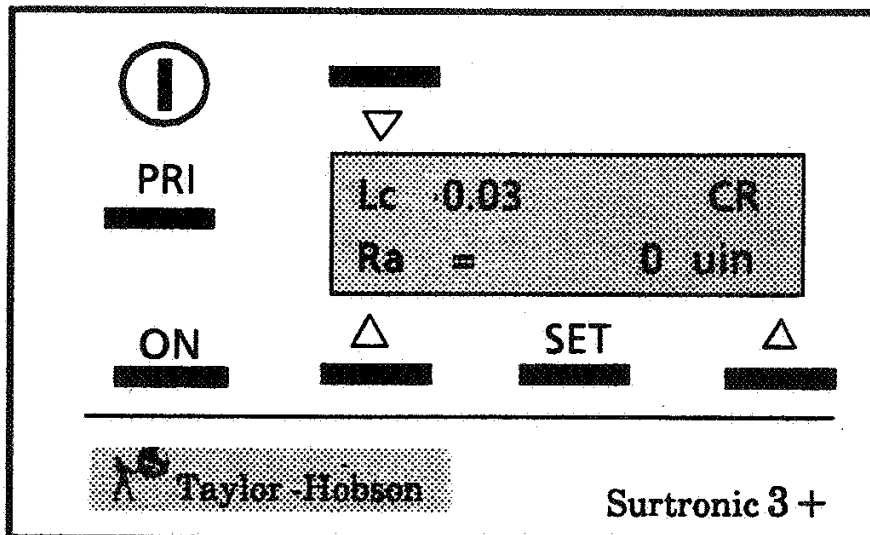
OPERATION

The operation of Surtronic 3+ is based on making selections from menus presented on the liquid crystal display. Two principal menu states exist, these are the Main Menu and the Pre-set Menu. Switching between menu states is done by pressing the SET key

Selections are made by pressing the three keys indicated by an arrow (∇ or Δ). The functions of the arrow keys change according to the menu state, the other keys are independent of state. The current function of the three arrow indicated keys is shown in the display just above or below the arrow. The method of making selections is as follows;

MAIN MENU STATE

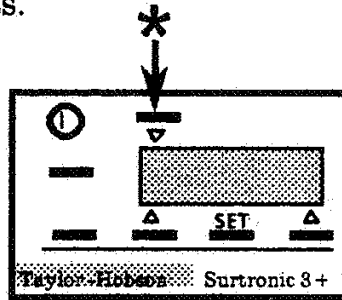
The main menu is used to select the cut-off length (Lc), the parameter for evaluation and the pick-up range. Except when in the DUMP mode, this menu is displayed on pressing the START key and, when the measurement has been completed, the results are displayed on the main menu. When in the dump mode or the pre-set menu state, pressing the SET key restores the main menu.



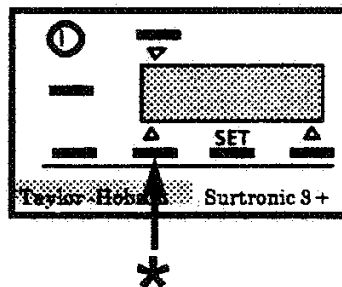
Lc To select the cutoff required, repeatedly press the TOP arrow key (∇) until the required cut-off is

displayed. The cut-offs available depend on the measurement units selected. When metric units are selected, then the cut-offs available are: 0.25mm, 0.8mm, 2.5mm. When inch units are selected, then the cut-offs available are: 0.01in, 0.03in, 0.1in.

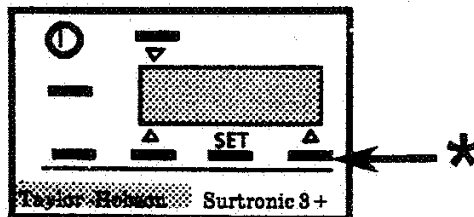
When the Lc value is changed, the Ln value will go to the standard ISO n=5 to ensure standard measurements.



PARAMETERS To select the parameter required for evaluation, repeatedly press the arrow key (Δ) which is to the *LEFT* side of the SET key, until the required parameter is displayed.

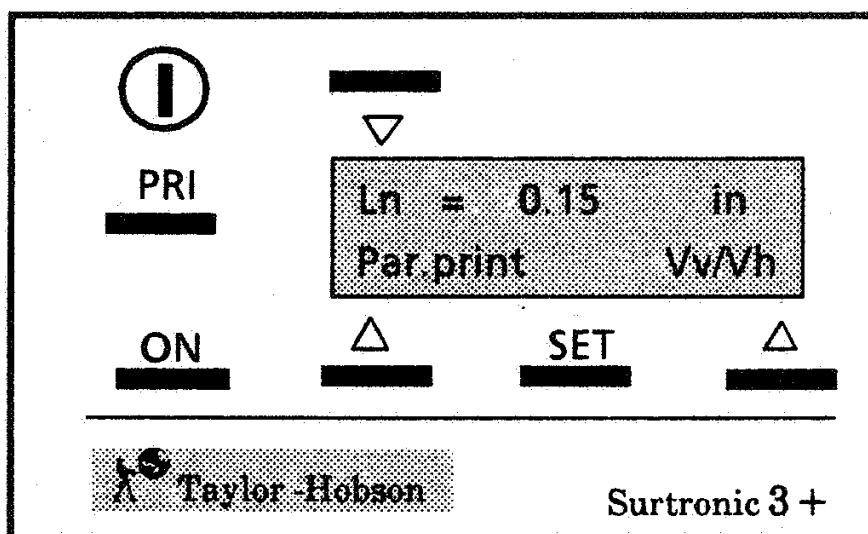


RANGE To select the pick-up range required for the measurement, repeatedly press the arrow key (Δ) which is to the *RIGHT* side of the SET key, until the required range is displayed. The ranges available depend on the parameter selected for evaluation (see table on page 24).



PRE-SET MENU STATE

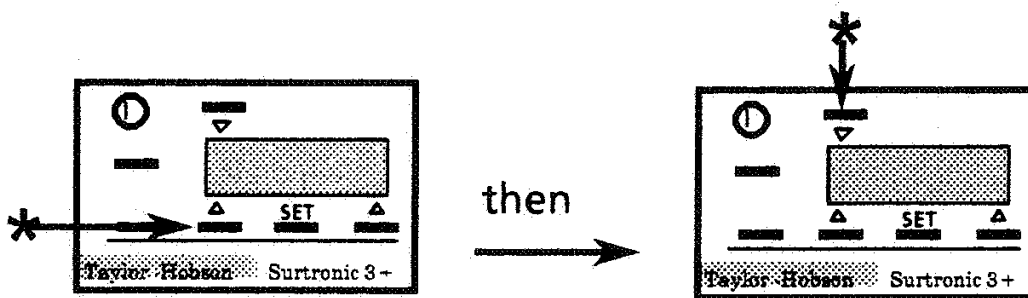
The Pre-set menu is displayed, from the main menu state, by pressing the **SET** key. This menu state is used to pre-set various functions which are then implemented when the start key is pressed. The pre-set functions include the evaluation length, the parameters and or graph for results printout, the vertical and horizontal magnifications for graph printout and the data DUMP mode.



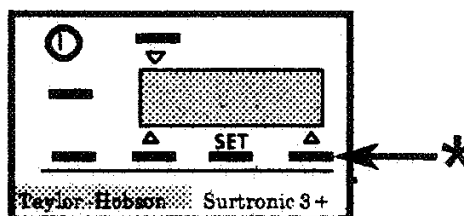
Ln To select the evaluation length (Ln) required, repeatedly press the *TOP* arrow key (∇) until the required length is displayed. The Lc value is a x1, x3, x5 or x10 multiple of the cut-off length (Lc) selected from the main menu state.

Par.print To select the parameters or graph required for results printout, press the arrow key (Δ) which is to the *LEFT* side of the **SET** key, this will select the par.print mode. To select a parameter for results printout, repeatedly press the arrow key (Δ) to move the pointer > to the required parameter (or G if a graph is required) then press the *TOP* arrow key (∇). An asterisk (*) then indicates that the parameter is selected. Pressing the *TOP* arrow key again deselects the parameter and removes the asterisk.

Select all the parameters required for results printout by the above method.



Vv/Vh To select the horizontal (Vh) and vertical (Vv) magnifications for graph printout, press the arrow key (Δ) which is to the *RIGHT* side of the **SET** key.



Then press the *TOP* arrow key (▽) to select the Vh (the horizontal scale) required and then the arrow key (Δ) which is to the *LEFT* side of the **SET** key, to select the Vv (the vertical scale) required.

The Vh values *toggle* through the options: x20, x50, x100, x200, (IEC standard).

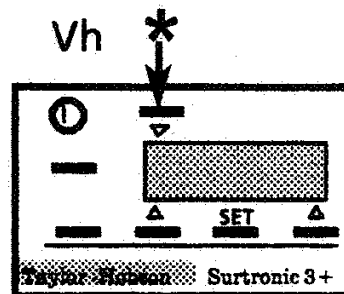
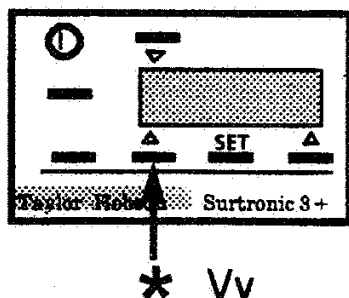
The Vv values *toggle* through a selection which is dependent on the pick-up range selected:

If range = Range 1 : x5000, x10000, x20000.

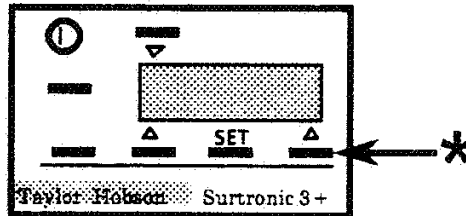
If range = Range 2 : x500, x1000, x2000.

If range = Range 3 : x100, x200, x500.

(See range table on page 24).



Dump Menu To select the Dump menu the procedure is as follows:
Press the arrow key (Δ) which is to the *RIGHT* side of the **SET** key (as for Vv/Vh selection),

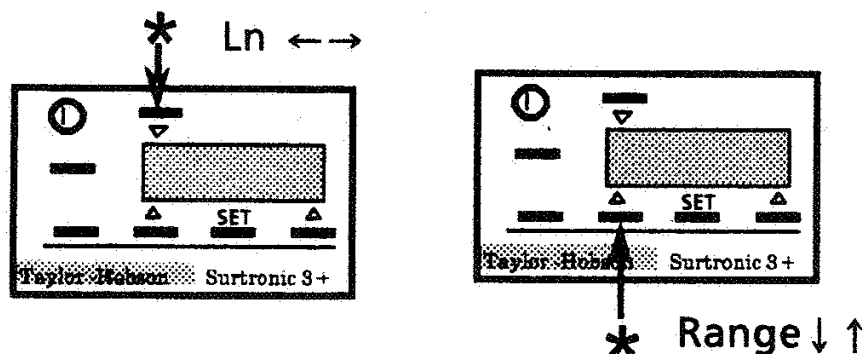


The option **Dump Menu** is displayed, press the same key again to select the menu. This allows selections of Ln, gauge range and measurement units to be made prior to a measurement for data dumping being made.

Note The measurement units selected at this menu, override the DIP switch selection and remain as the units for all measurements until changed from the same menu.

To select an evaluation length (Ln), press the *TOP* arrow key (∇) repeatedly to toggle through the options until the required length is displayed.

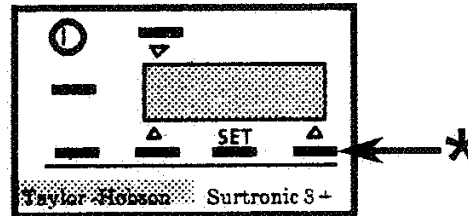
To select a gauge range, press the arrow key (Δ) which is to the *LEFT* side of the **SET** key, Repeatedly press the key to toggle through the options until the required range is displayed.



Units The measurement units selected at this menu, override the DIP selection and remain as the units for all measurements until changed from the same menu.

METHOD OF USE

To change units, press the arrow key (Δ) which is to the *Right* side of the SET key. Pressing this key *toggles* the selection between Metric and inch units, the selection is indicated by *.



DATA DUMP OPERATION

1. Setup the instrument to make a measurement of a surface.
2. Select the Dump menu and make the required selections of Ln, gauge range and measurement units.
3. Place the instrument into contact with the surface and press START key, to make a measurement.
4. When the measurement is completed, the data is dumped to the PC. During dumping the message Data dumping is displayed.
5. If no legal surface data is stored, the error message *Measure before data dump* is displayed.

When the data dump is completed, the dump menu still remains active. From the displayed menu, values of Ln and range can be changed and further measurements for data dump can be made,

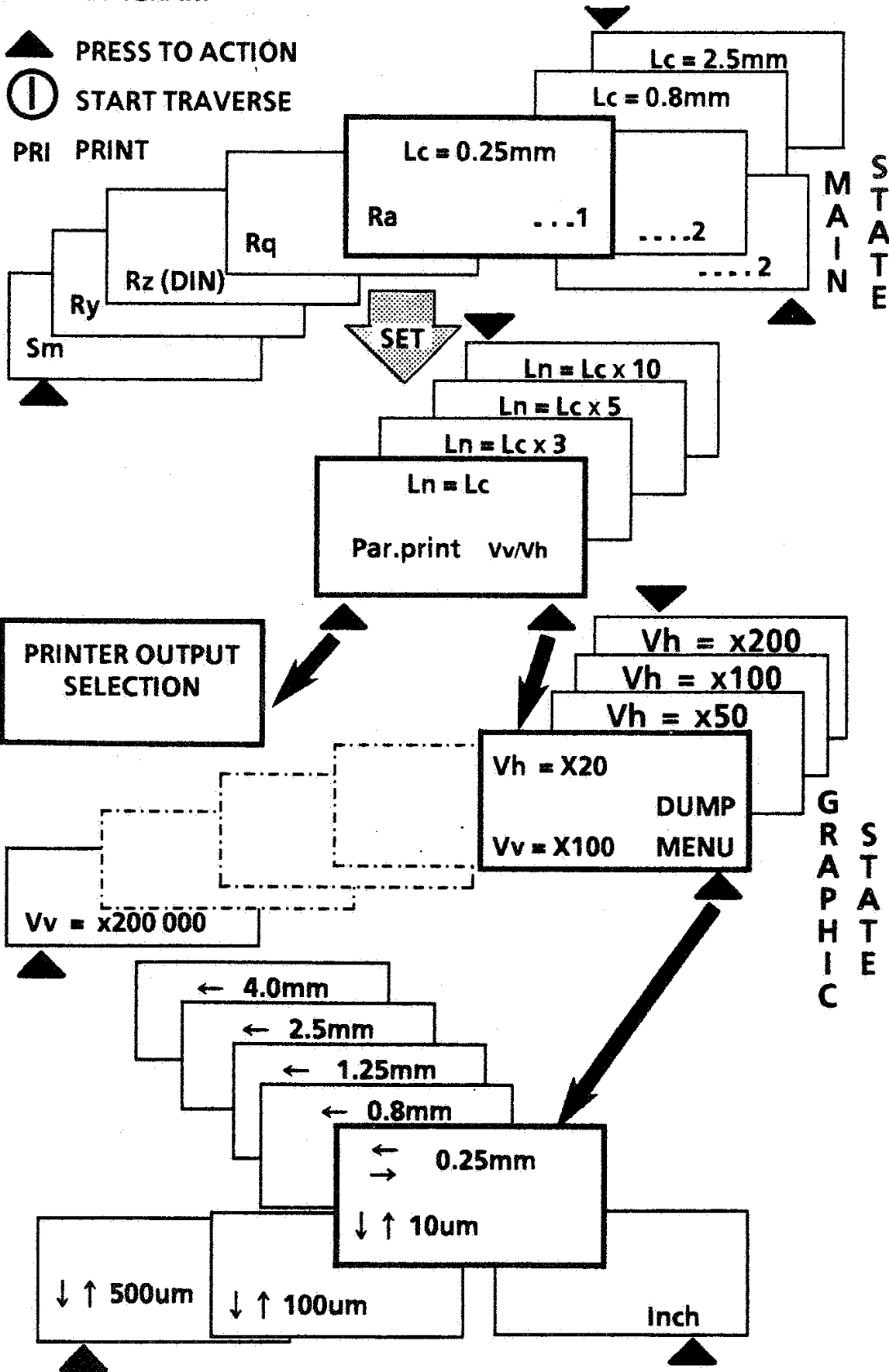
Press the SET key to return to the main menu state.

STATE DIAGRAM

▲ PRESS TO ACTION

ⓘ START TRAVERSE

PRI PRINT



RANGE SELECTOR TABLE

Metric units

Range	Display ind. Range	Parameter	Calculation resolution	Display ind. Min value	App. max value
1	— . — 1µm	Ra / Rq	0.01µm	0.01µm	5.00µm *
1	— — . — 1µm	Ra / RzDIN	0.01µm	0.01µm	10.00µm
		Values ###.## um			
2	— — . — 2µm	Ra / Rq	0.02µm	0.02µm	50.0 µm *
2	— — — . 1µm	Ry / RzDIN	0.1µm	0.1µm	100.0µm
		Values Ra / Rq : ###.## µm	values above 19.8µm :	###.##µm	
		Ry / RzDIN : ###.##µm			
3	— — — . 2µm	Ra / Rq	0.2µm	0.2µm	150µm *
3	— — 1µm	Ry / RzDIN	0.5µm	1.0µm	300µm **
		values Ra / Rq : ###.##µm			
		Ry / RzDIN : ###µm			

Parameter Sm (Range independent) : ####µm

Sm discriminator : Range (Ry — — . — 1) : ± 0.03µm

Range (Ry — — — . 1) : ± 0.1µm

Range (Ry — — 1) : ± 0.5µm

Inch units

Range	Display ind. Range	Parameter	Calculation resolution	Display ind. Min value	App. max value
1	— — 1µin	Ra / Rq	0.01µm	1µin	200µin *
1	— — 1µin	Ry / RzDIN	0.01µm	1µin	400µin
		values ####µin			
2	— — — 1µin	Ra / Rq	0.02µm	1µin	2000µin *
2	— — — 2µin	Ry / RzDin	0.1µm	2µin	4000µin
		values ####µin			
3	— — 10µin	Ra / Rq	0.2µm	10µin	5000µin *
3	— — 20µin	Ry / RzDIN	0.5µm	20µin	9990µin ***
		values ###0 µin			

Parameter Sm (Range independent): #### µin or
###.## min or
min

* Max Ra value determined by max Ry of surface under measurement. Often Ra is less than 1/5 Ry.

** 300µm is the typical level of stylus below the skid of the pickup. Instrument capability is max 500µm.

*** Limited by software to 9990µin.

MAKING MEASUREMENTS

OPERATING NOTES

Before measurements are made, there are a few general points of procedure which should be observed.

1. The surface to be measured must be free from vibration, and the instrument must be completely steady during a measurement.
2. Always turn the pick-up so that the stylus is visibly perpendicular to the surface to be measured.
3. Set the display-traverse unit so that the traverse is made parallel to the surface being measured.
4. After a measurement, the traverse unit can be removed from the surface as soon as the pick-up commences its return stroke.
5. Where the texture of a surface has a predominant directional character (LAY), it is important to traverse across the lay, not along it.

On a horizontal surface

1. Use the biased pick-up holder on the display-traverse unit.
2. Clean the surface to be measured, so that it is free from abrasive material, grease, suds etc. This is necessary to ensure accurate readings and to reduce wear on the skid.
3. Make the cut-off / length and parameter selections required.
4. Position the display-traverse unit and pick-up so that the stylus contacts the surface and the pick-up is approximately parallel to the surface. Make sure that the length of surface is sufficient for

measurement, remembering that the traverse motion is inwards towards the display-traverse unit.

5. Press the ① start key. When the traverse is completed, the results are displayed and the pick-up returns to its extreme outward position.
6. If an error message is displayed, identify the cause, correct it and repeat the measurement.

On other surfaces

On a cylindrical surface: Fit the optional roll and bore plate.

In a bore: Fit the optional roll and bore plate.

On a vertical surface: If necessary, hold the display-traverse unit by hand on the surface, making sure that it does not move during the measurement.

In a small deep bore: Fit the optional extension rod between pick-up and holder.

Cut-off (lc)

A few trial measurements made on different surfaces will soon demonstrate that on some, the results obtained are very dependent upon the cut-off selected. This shows that it is important to choose the cut-off to suit the surface. In general, fine surfaces require short cut-offs and rough surfaces a longer one. The table on the following page gives some guidance on suitable cut-offs.

A long cut-off is mainly for use on sheet metal and similar materials, where a longer surface is required to be representative of the material being examined.

Table of cut-off values

Finishing Process	Approx. range of Ra values		Suitable cut-off values		
	μm	μin	0.25mm 0.01in	0.8mm 0.03in	2.5mm 0.1in
Superfinishing	0.05-0.2	2-8	✓	✓	
Lapping	0.05-0.4	2-16	✓	✓	
Honing	0.1-0.8	4-32	✓	✓	
Grinding	0.1-1.6	4-63	✓	✓	✓
Diamond turning	0.1-0.4	4-16	✓	✓	
Turning	0.4-6.3	16-250		✓	✓
Boring	0.4-6.3	16-250		✓	✓
Drawing	0.8-3.2	32-125		✓	✓
Broaching	0.8-3.2	32-125		✓	✓
Extruding	0.8-3.2	32-125		✓	✓
Milling	0.8-6.3	32-250		✓	✓
Shaping	1.6-12.5	63-500		✓	✓

OPERATING ERROR INDICATIONS

During a measurement a message may be displayed which indicates that an error condition has occurred. The messages and the probable causes for their display are as follows:

Display	Reason for message
<i>Motor Error</i>	Motor fault.
<i>Pick-up Error</i>	Response at pick-up level error or faulty connection.
<i>Overrange</i>	Selected range too small.
<i>E</i>	Can occur in front of a measured value due to excessive slew rate for a single data point (large spike).
<i>Data transmit error</i>	Printer connected at start of transmission but later detected as not connected (printer off line).

<i>Battery low</i>	When battery Voltage < 6.4V : key push operations are disabled and display is off. When battery Voltage < 6.7V : current operation is stopped and 'Battery low' is displayed for 30 sec. then display ceases. State is changed to main state or preset data dump state. Stored surface profile is erased. Renew or recharge battery.
<i>Measure before print</i>	Activating PRI before measurement.
<i>No parameter selected</i>	Activating PRI before selecting printout parameters.
<i>Printer not connected</i>	Activating PRI when printer not connected or no computer connected to receive dump data.
<i>Printing cancelled</i>	Activating PRI during data transmission to printer, (stop printing). Message displayed for 2 sec.
<i>Measurement cancelled</i>	Activating START during traverse, (stop traverse).
<i>Measure before data dump</i>	Attempted data dump before measurement.
Other messages	
<i>Welcome to Surtronic 3 +</i>	Power-up with a new battery.
<i>Motor returning</i>	The traverse position is not at stop point
<i>Printing</i>	During printing, (data transmission).
<i>Data dumping</i>	During data dumping, (data transmission)

Battery	Alcaline: minimum 600 measurements of 4mm measurement length. NiCad : minimum 200 measurements of 4mm measurement length. Size : 6 LR 61 (USA/Japan), 6 F 22 (IEC) Fixed battery / External charger. External charger (Nicaid only): 110/240V RTH No. 112/1591 50/60 Hz
Traverse unit	Traverse speed : 1mm/sec.
Measurement units	Metric/Inch preset by DIP-switch, deselect by menu.
Cut-off values	0.25mm, 0.80mm, and 2.50mm (0.01in, 0.03in and 0.1in)
Traverse lengths	$\frac{1}{4}$ Lamda + n Lamda; n = 1, 3, 5, 10, or 25.4 + 0.2mm at 0.8mm cut-off.
Display	LCD-matrix. 2 lines \times 16 characters, alphanumeric. Language: English, German, Italian, French, internally selected by DIP-switch.
Keyboard	Membrane switch panel tactile.
Filter	Digital Gauss filter or 2CR filter (ISO) selectable by DIP-switch.
Parameters	Ra, Rq, Rz(DIN), Ry and Sm.
Calculation time	Less than reversal time or 2sec whichever is the longer.
Accessory socket	9 pin D-connector female. Containing: RS 232 hardwired handshake (RS 232 level). Receive function only hardware implemented. <u>Remote start (5V logic)</u> Remote start : short to ground. <u>Constant power on instrument (5V logic)</u> When connected to Ground, constant power is on.

RS 232 OUTPUT

Printer configuration

If SPC is on then,
Baud rate : 4800 Bauds
Parity: Even
Data bit length : 7 bits
Printer head disabled.

If SPC is off then,
Baud rate : 9600 Bauds
Parity: Odd
Data bit length : 8 bits
Printer head enabled.

Output to printer (in ASCII characters) of preselected parameters and provided that *G* is preselected, a readout of d.c. corrected surface profile.

Language of printout same as language of display.

Graph $V_h = x20, x50, x100, x200$.

Range (R_y)	Selectable V_v
-- .- 1 μ m	x5000 x10000 x20000
--- .1 μ m	x500 x1000 x2000
-- 1 μ m	x100 x200 x500

The printout heading is shown below.

Rank Taylor Hobson Limited

Surtronic 3+

Operator : -----

Date : -----

Object : -----

Cutoff = xxx mm

Evaluation length = xxx mm

Filter = xxx

To obtain a heading on the printout, press SET prior to PRI or START each time a printout is required.

Specification for data dump

The following format is used for data dump from Surtronic.3+ to a PC.

Transmission set up (regardless of the DIP switch settings) is as follows,

Baud rate : 9600 bits
 Number of data bits : 8
 Start bit : 1
 Stop bit : 1
 Parity : None

Resolution: Horizontal Vertical
 1.0 μ m 10 nm

Evaluation length selectable : 0.25mm, 0.8mm, 1.25mm, 2.5mm, 4.0mm, 8.0mm, 12.5mm, 25.0mm.

Range selectable : 10 μ m, 100 μ m, 500 μ m.

Transmission : RS232

Transmitted data is unfiltered.

No parameters are calculated.

Transmitted data:

Data type	Function	Comments
2 bytes	Number of data values	Total number of transmitted data values.
1 byte	Ordinate spacing	Number of data values per μ m.
1 byte	First data value	Resolution 10nm.
1 byte	Diff. data value	Difference between this and the previous data value.
#80	Stop byte	2 stop bytes are sent making it possible to test for all data values received.
#80	Stop byte	

The total number of transmitted data bytes are, number of data values + 5.

The data value can be calculated from,

data value (n) = data value (n - 1) + diff. data value (n), $n \geq 1$.

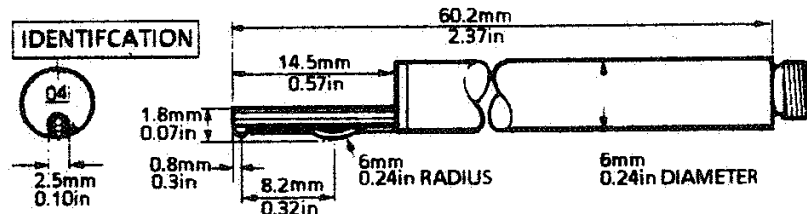
Alternative standard pick-up (112/1503)

Details as the standard pick-up, but with 10 μm (400 μin) stylus tip radius. Conforms to U.S. specifications (ANSI B46.1).

Small bore pick-up (112/1504)

For general use in small bores, on narrow surfaces and in grooves, or with the skid supported independently of the surface being measured. On this pick-up the skid is integral with the stylus arm housing and is set further back from the stylus. This enables the pick-up to be used in short bores with the skid supported independently of the surface being measured, e.g. by the datum Support Stand.

Figure 9
The Small
bore pick-up

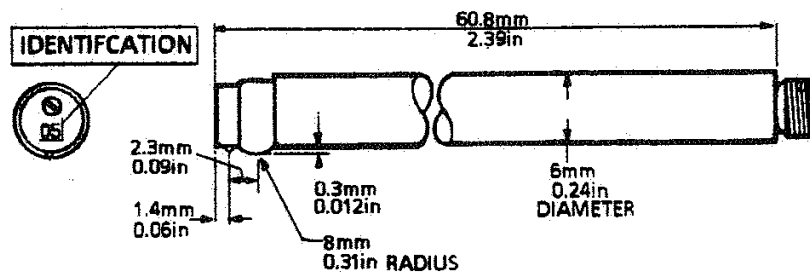


Stylus tip radius: 5 μm (200 μin).

Right angle pick-up (112/1505)

This pick-up is used at right angles to the direction of traverse. Accordingly the skid is set at right angles to its normal position.

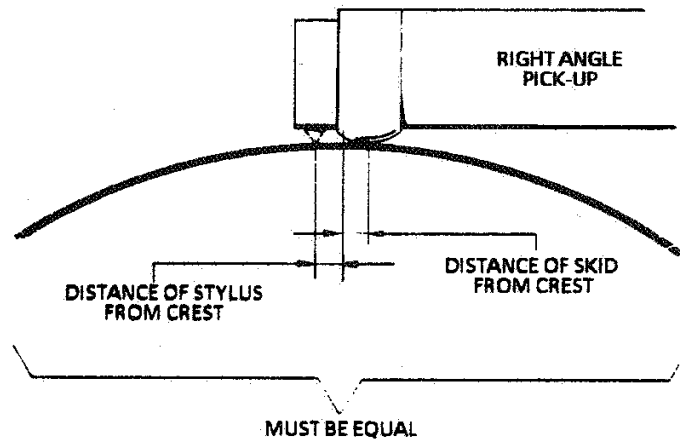
Figure 10
The Right angle
pick-up



Stylus tip radius: 5 μm (200 μin).

It is particularly useful in grooves or slots where the lay of the surface texture makes it unsuitable for measurement with a standard or small bore pick up. When used on cylindrical workpieces it is important that the stylus and skid should be equidistant from the crest (see Figure 14), and that the workpiece is positioned so that the crest is parallel to the line of traverse.

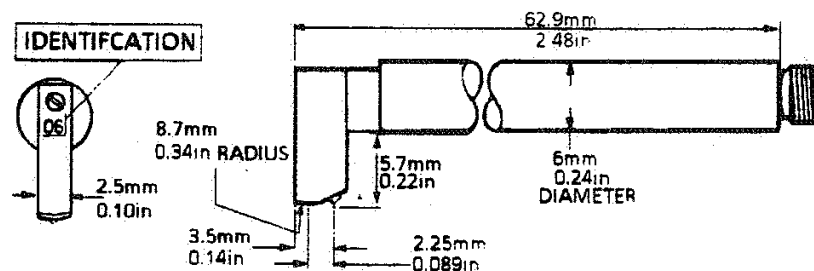
Figure 11
Conditions to be observed when the Right angle pick-up is used on a cylindrical workpiece.



Recess pick-up (112/1506)

This pick-up has an extended stylus and skid for measuring at the bottom of a recess, or between shoulders and flanges up to 5.7 mm deep. A special deep recess pick-up is available for measuring up to a depth of 25 mm.

Figure 12
The Recess pick-up

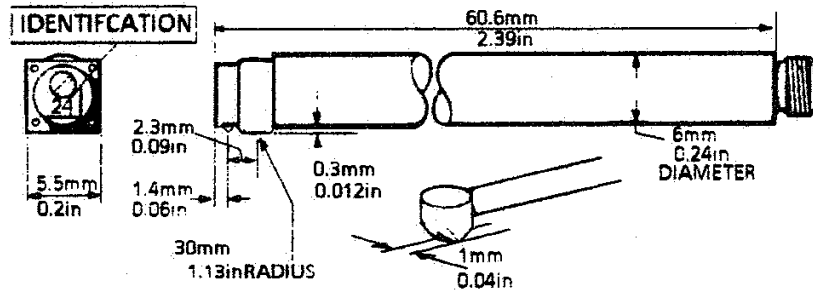


Stylus tip radius: 5 μ m (200 μ in).

Chisel-edge pick-up (112/1524)

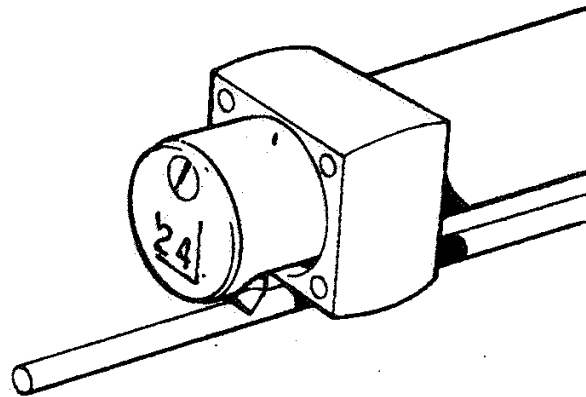
For measuring along a sharp edge or a wire which cannot be traversed with a normal stylus. The pick-up has a rotatable square skid. Not for use on flat surfaces.

Figure 13
The Chisel-edge pick-up



Stylus tip radius: 5 μ m (200 μ in).

Figure 14
Use of the chisel edge stylus.



Side-skid pick-up (112/1531)

For use on curved surfaces such as gear teeth. The skid surrounds the stylus and the line of contact with the component moves relative to the stylus as it traverses over the crest of the curve.

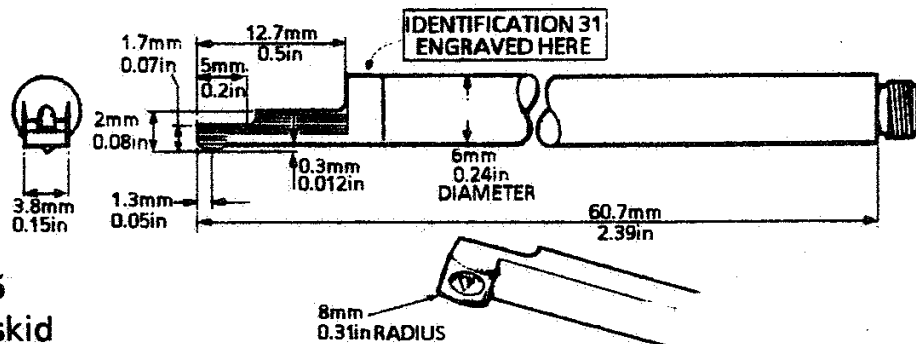


Figure 15
The Side skid pick-up

Stylus tip radius: 5 μ m (200 μ in).

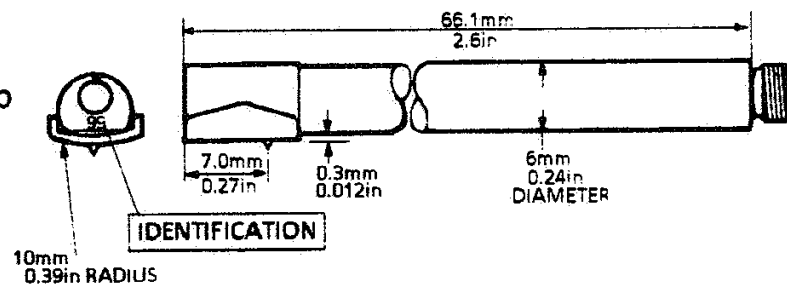
It is very important to position this pick-up so that contact with the surface is made on the centre line (parallel to the axis of the pick-up) of the skid, i.e.

the stylus must be perpendicular to the surface when the pick-up is viewed from the end. This is particularly necessary when the pick-up is used on a concave surface such as a bore, but owing to the form of the skid, this condition is not easy to check. This pick-up cannot be used on concave surfaces having a radius of less than 8mm (0.03in). It must not be used as a right-angle pick-up nor must it be traversed axially along a cylinder.

Shoe pick-up (112/1599)

This pick-up has a pivoted flat shoe which will ride across the top of comparatively widely spaced irregularities of a rough surface. Particularly necessary when measurements are made with the 2.5 mm (0.1 in) cut-off.

Figure 16
The Shoe pick-up



Stylus tip radius: 5 μ m (200 μ in).

This pick-up should never be used on a smooth surface because the shoe would tend to wring to the surface.

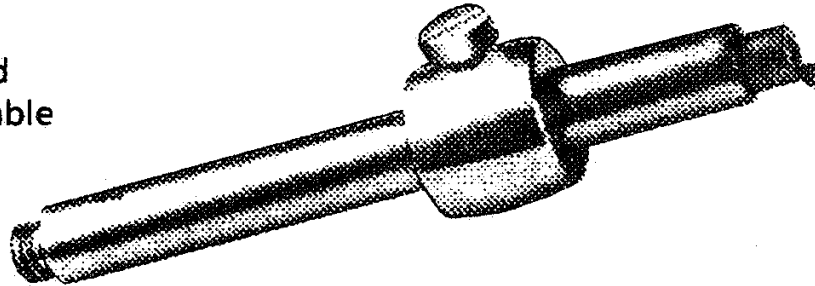
Ideally the pick-up should be parallel to the surface being measured, but in any case, the inclination must not exceed $\pm 10^\circ$ to ensure that the shoe rides flat on the surface.

Detachable skid (112/1191)

This accessory can be clamped to the pick-up body, to enable the Datum Support Stand to be used with the standard, recess, right angle and chisel edge stylus pick-ups. The normal skid should be removed by undoing the small screw in the end of the pick-up and taking off the end cap. Take care that the pin next to the skid does not fall out.. as it will now be loose. After the end cap has been removed, there will be no protection for the delicate stylus beam, so be very careful particularly

when measuring in blind bores, do not allow the beam to foul the workpiece.

Figure 17
Pick-up fitted
with detachable
skid.



Extension Rod (112/1533)

100mm long extension with integral lead, fits between the pick-up and carriage.

1. The extension rod is fitted to the pick-up in the following manner:
2. Disconnect the pick-up lead from the traverse unit and remove the pick-up from the traverse unit carriage.
3. Remove the lead from the pick-up.
4. Carefully locate the centre pin of the extension rod with the hole in the pick-up and screw the rod and pick-up together.
5. Thread the lead from the extension rod through the hole provided in the back plate of the traverse unit and connect it to the traverse unit socket.
6. Fit the pick-up into the traverse unit carriage, positioned as required

Datum support stand (112/865)

This accessory provides an independent straight datum where the surface to be measured is too short to accommodate both stylus and skid of the small bore pick-up. It can also be used with some of the other pick-ups when they are fitted with the detachable skid.

Insert the arm carrying the datum block (Figure 18) into the front of the clamping block (i.e. the face carrying the index line A). Clamp with knob B. Raise the assembly to approximately the correct height and clamp with knob F, ensure that knob D is free and use ring E to obtain the height adjustment. Finally clamp by means of knob D. Adjust the position of the stand and the datum block to position the block as near to the workpiece as possible. The block must be level in the direction of the pick-up traverse and this condition is shown by the line C on the arm which should be aligned with the line engraved at A. It must be appreciated that this line indicates the correct attitude of the datum block only if the arm is assembled as shown; if the arm is reversed and inserted into the clamp assembly from the other side, the line cannot be used to indicate the correct setting. It may, however, sometimes be necessary to use the Datum Support in this manner. In order to prevent the knobs fouling the workpiece. In this case level the datum block so that the surface is parallel to the pick-up.

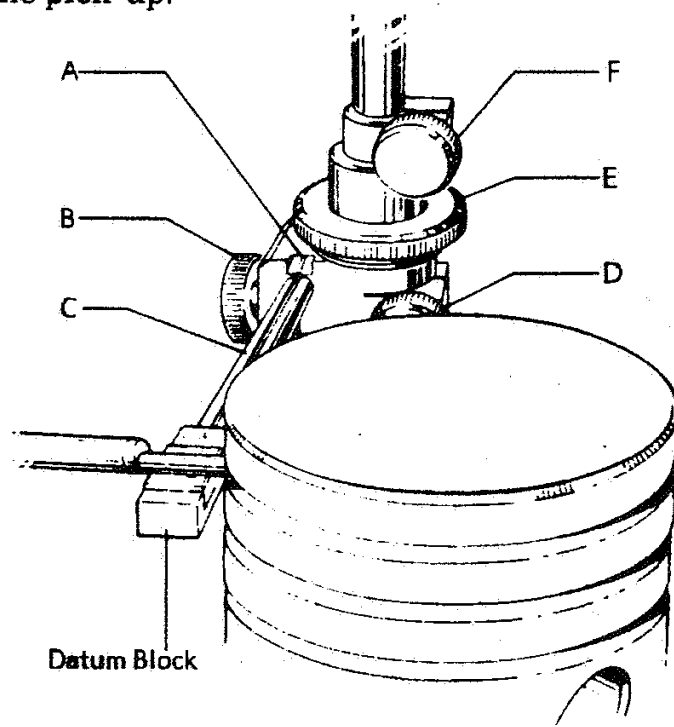


Figure 18
Datum Support Stand

ACCESSORIES

Portable Printer (112/2390)

DESCRIPTION

A permanent record of selected parameter results and profile graphs can be obtained when this printer is connected to the Surtronic 3+.

The unit contains a rechargeable battery and is fully portable.

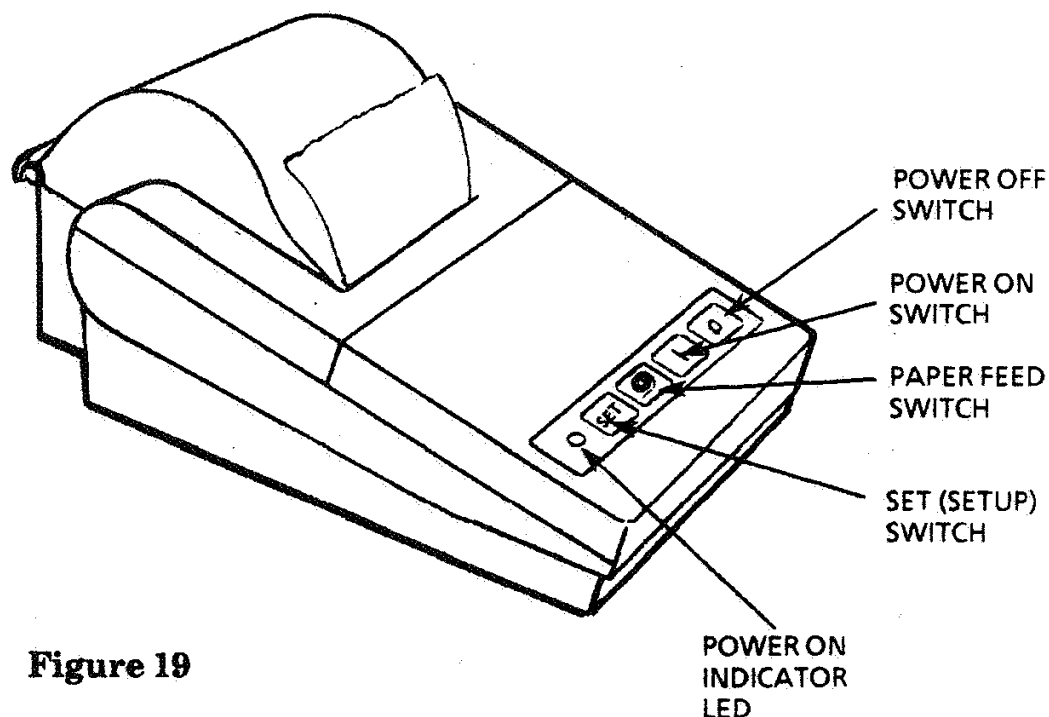


Figure 19

INSTALLATION

1 portable printer	112/2390
1 paper roll	112/2391
1 ribbon	112/2397
1 interconnecting cable	112/2392
1 charger	Part of 112/2390

The printer is dispatched from the factory with no charge in the batteries, this is for safety and storage reasons.

Interface

The connector is a 25 way D type socket (see Figure 20). The interfacing cable for the printer to Surtronic 3+ is part number 112/2392.

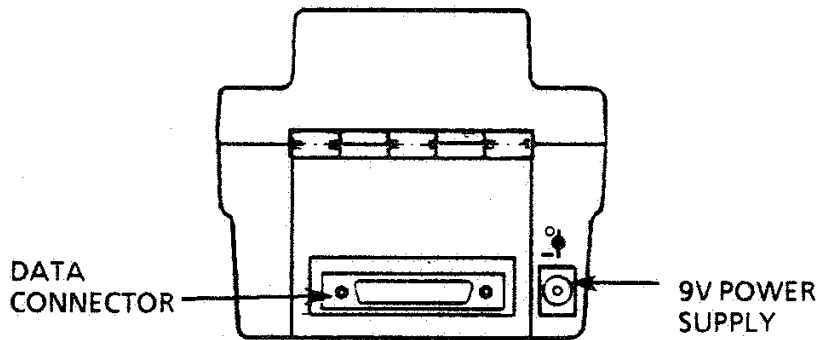


Figure 20

Power Supply

Internal Ni-Cad batteries. A supply of 9V d.c. at 0.6A is sufficient to power the printer and recharge the batteries. Maximum off-load terminal voltage must be limited to 12V which will take 14 hours to totally recharge the batteries. A power saving feature automatically switches the printer off when it has not been used for a 1 or 5 minute (programmable) period. This feature can be turned off if required (see *Programme Mode following*).

Power On procedure

Check that the batteries are sufficiently charged or that the power adaptor is connected correctly. Open the lid and check that paper and ribbon are present and that there are no foreign objects inside the paper well or mechanism. Close the lid, ensuring the paper is guided through the paper exit slot. Switch on the printer by pressing the symbol 'I' on the switch panel. The power-on indicator will light and the mechanism will reset.

Paper Loading

If the paper roll needs replacing open the lid and remove the old paper, use the feed switch to feed out any excess paper left in the mechanism. Do not pull the paper out of the back of the mechanism. Reel off a few centimetres from a new paper roll and check that the paper end is square. Sit the new roll in the paper well with the paper end coming from the bottom of the roll. Make sure the power is on and offer the paper into the back of the

mechanism while pressing the feed switch. Keep the switch depressed until enough paper is fed through the mechanism to be inserted through the paper exit slot in the lid. Feed the paper through the exit slot and close the lid. (see Figure 21)

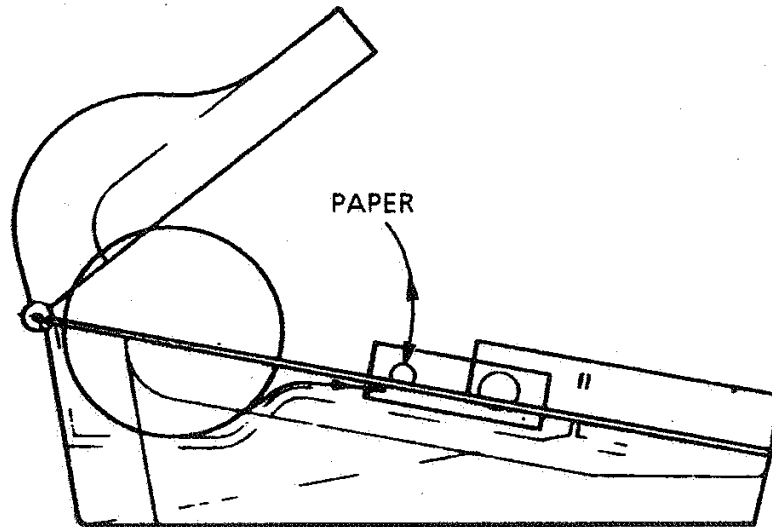


Figure 21

Ribbon Change

Ensure that the power is off and open the lid. The cassette will clip off one side (press down on the word marked push) and can easily be removed. Check the new ribbon is taut. Clip the cassette into position making sure the paper still feeds correctly between the ribbon and the cassette body. Wind the knob as shown in Figure 22 to take up any slack in the ribbon. Close the lid (see Figure 22).

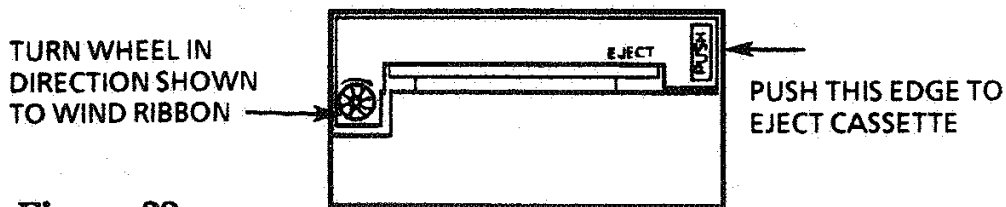


Figure 22

Paper Feed

For a single line paper feed press and release the paper feed switch. For continuous line feed keep the switch depressed. The power indicator switches off when the feed switch is depressed.

Default settings

The printer is supplied as follows :

Data bits : 8
Parity: Odd
Baud rate : 9600
Country : UK
Print mode : Text
Auto -off : 5 min
Interface: serial
Mechanism : M192
Emulation: Standard
DTR: normal.

Self Test

To initiate self test, press the power on and feed switch together until the test starts. This will check all the mechanics and a large proportion of the software and hardware (except that dealing with the data interface) without the need for a connection to a host. The software issue is printed in double height, and double width text, followed by the character set in normal text and a list of the current settings of the user selectable options. If the settings are correct for your host, you are ready to connect the printer to your system, otherwise you will need to reprogram the printer. The self test is repeated until the power is switched off. Power on again for normal operation.

Program Mode

The front of the unit displays a power on indicator and four switches. The program switch is SET.

Press the set and power-on switch together to initiate the set-up mode. The power-on indicator will flash every second until set-up mode is turned off. The current parameter status will then be printed.

Press and release the feed switch to print each parameter status.

Example - Number of data bits : 8 bit data. Pressing the program switch will change the status of a parameter. Each status table rotates, so 'no parity' follows on from 'even parity', '300 baud' follows on from '19200 baud' and so on.

ACCESSORIES

Examples;

Serial Baud Rate: 300, 600,1200, 2400, 4800, 9600,
19200, 300,.....

Serial Parity: No parity, Odd parity, Even Parity,
No parity,.....

When all the necessary changes to the parameters have been made, press the set and the feed switch together to update the status of the printer. If no switches are pressed for 15 seconds the set-up mode is terminated without changing the original parameters.

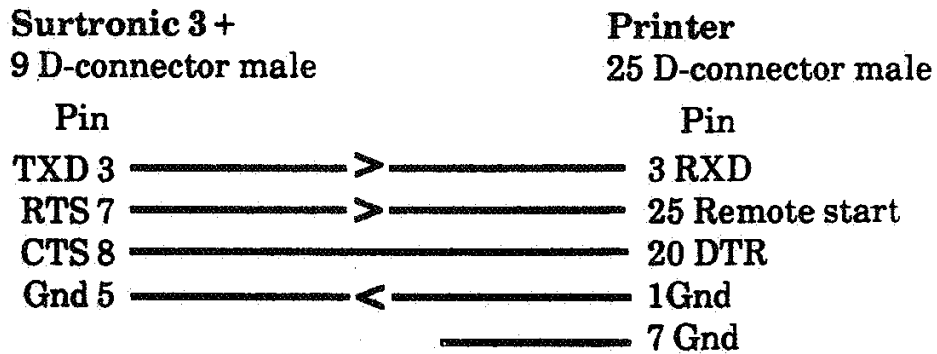
Accessories

Paper and ribbons can be obtained from RTH.

Paper roll ; RTH order number 112/2391.

Ribbon ; RTH order number 112/2397

CABLE CONNECTION BETWEEN SURTRONIC 3+ AND PRINTER 112/2390



Seiko DPU-411 (112/1529)**DESCRIPTION**

This unit provides an alternative printer for the provision of permanent records of selected parameter results.

The unit contains a rechargeable battery and is fully portable. A mains input adapter is also provided

The manual detailing specifications and operation is provided by the manufacturer. However, brief details of its operation with the Surtronic 3+ are included here.

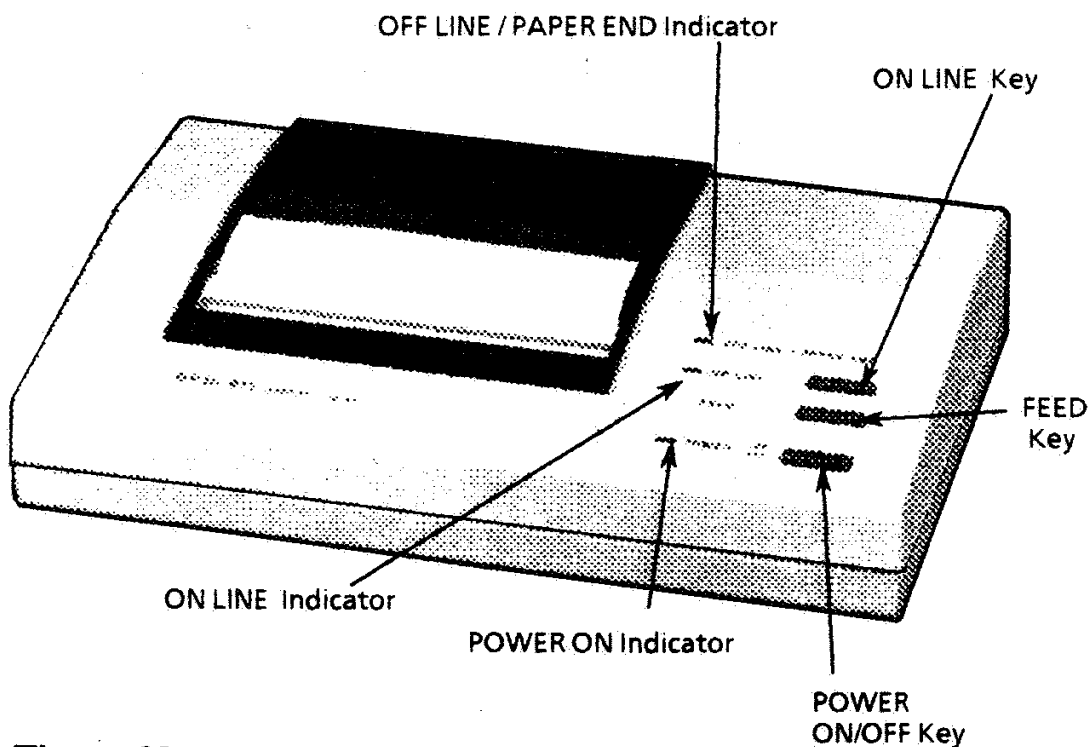


Figure 23

- Power** Power ON/OFF slide switch. When moved to the ON position, power is supplied to the printer and the POWER and OFF LINE indicators light. If no paper is present, then the OFF LINE indicator will flash on and off.
- Feed** Paper feed key. Pressing this key causes the paper to feed through the printer. Paper feeding stops when the key is released. **Paper feed is only operative when the printer is off line.**

ACCESSORIES

On line The printer must be On Line in order to receive data from the Surtronic 3+. The printer cannot be switched to On Line, if paper is not present and correctly set.

Off line / paper end When On Line, the printer can be taken Off Line by pressing the ON LINE key. This facility can be used if a preset printout is not required or to stop printing temporarily. Press the key again to switch the printer On Line and restart printing.

The OFF LINE / PAPER END indicator light will flash on and off when the paper is about to run out.

INSTALLATION

There are two sets of switches (DIP01, an 8 bit switch and DIP02, a 6 bit switch) on the base of the printer.

Switch setting details are as follows:

DIP01 This switch is used to set the input data format, the number of columns and international characters

Switch (SW)	Function
SW1 OFF	Serial input
SW2 OFF	Auto line feed
SW3 ON	No of printing columns (40)
SW4 ON	Normal Character Selection
SW5 ON	zero = 0
Switches SW6 to SW8 - Printout Language	
SW6 SW7 SW8	Language
OFF OFF ON	English
ON OFF ON	German
ON OFF OFF	Italian
ON ON OFF	French

DIP02 This switch is used to set the serial input parameters.

Switch (SW)		Function
SW1	ON	Data length (8 bits)
SW2	OFF	Parity Setting = Yes
SW3	ON	Parity Condition = Odd

Switches SW4 to SW6 - Baud Rate selection (9600)

SW4	OFF
SW5	OFF
SW6	OFF

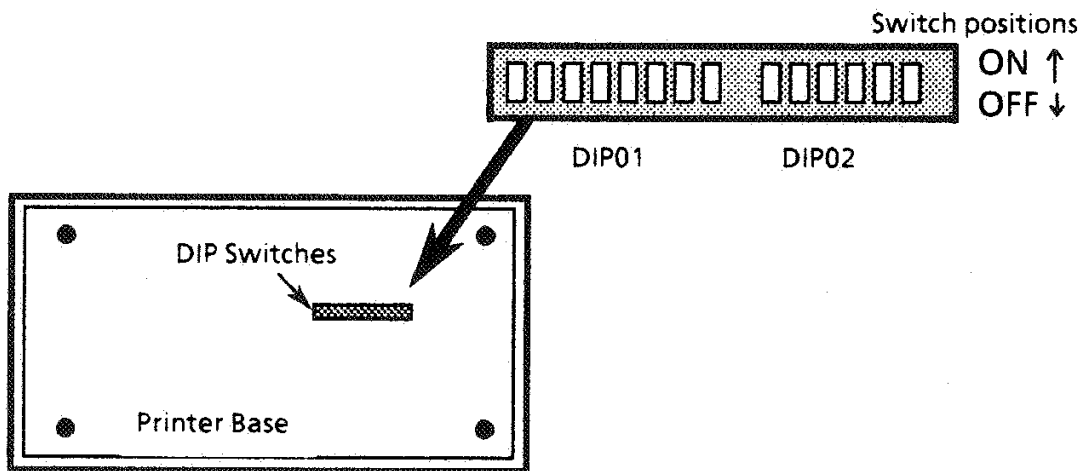


Figure 24 Location of the DIP Switches

BATTERY CHARGING

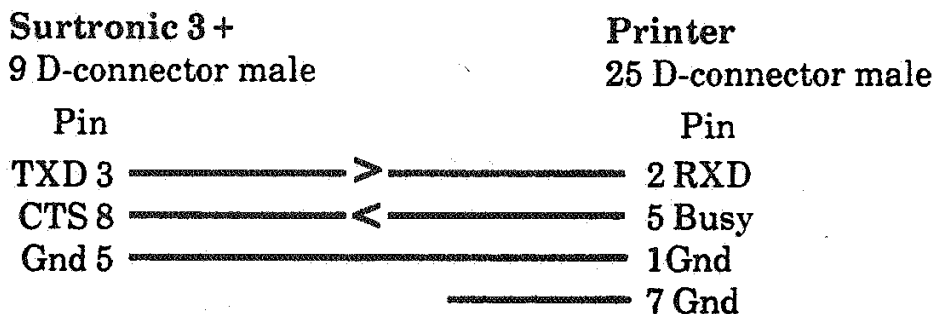
Initially, the internal battery may be in a discharged condition. Therefore connect the a.c. adaptor (with the mains power OFF) and switch on the mains power. A full recharge will take approximately 10 hours **DO NOT RECHARGE THE BATTERY FOR MORE THAN 48 HOURS.** This will cause deterioration of performance and may cause damage to the printer. The printer should be stored with the battery fully charged.

INTERCONNECTIONS

The printer is connected to Surtronic 3+ using a lead with 25 way 'D' type connectors on each end. The cable is marked (either with a black sleeve or the word Surtronic) indicating which end is to be connected to the Surtronic 3+. The connectors must be locked in position.

The connections are as shown following:

Cable - 112/2393



Mains adaptor

A mains input adapter is provided. When connected, this unit provides power for battery charging and running the printer.

Connect a suitable plug to the mains lead wired as follows:

- Brown to Line Conductor
- Blue to Neutral Conductor

CHART PAPER

The printer has a thermal print head, which requires paper of a specific type for correct operation. The paper is supplied in rolls with a heat sensitive surface on the outside of the roll.

To install a new roll of paper:

1. Open the paper holder cover. This is done by pressing down on the centre front of the cover (indicated by an arrow on the cover) and pulling the cover towards the back of the printer. The cover will unlock and swing open (see Figure 29).
2. If the end of the previous roll still remains in the printer, press the FEED switch to feed it out. **Do not pull the paper backwards out of the paper inlet.**
3. Cut a point on the end of the new roll of paper. Hold the new roll so that the paper is unwinding from the bottom and feed the end into the paper inlet.
4. Hold down the paper FEED switch until the paper emerges from the paper outlet. Place the paper roll into the well.

5. Close the paper holder cover, pushing it gently forward to engage the catch.

Self test To run the printer self test, hold down the FEED key and turn on the power to the printer. The printer will then print out all the characters and fonts in its memory and end by printing a dotted test pattern and a print out of the current DIP switch settings.

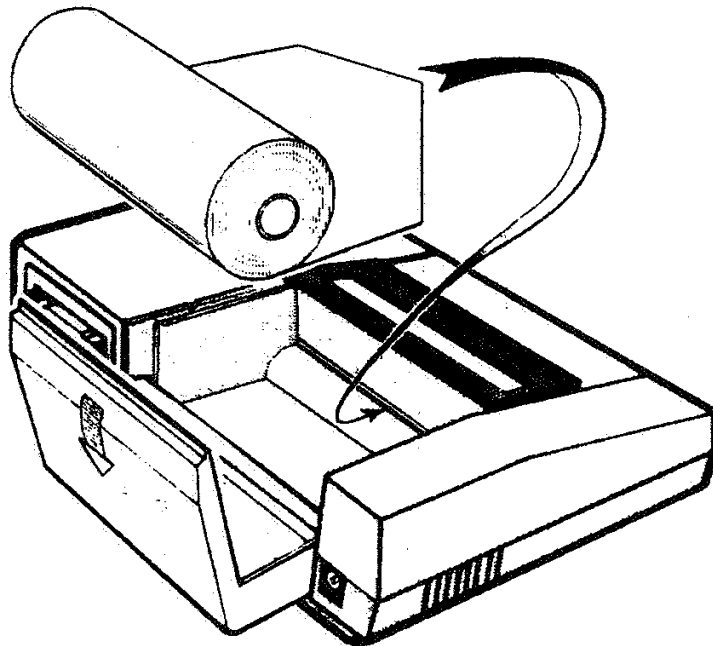


Figure 25
Installing the paper roll

ACCESSORIES

Seiko DPU-201 GS Printer (112/2310)

DESCRIPTION

This unit provides a further alternative printer for the provision of permanent records of selected parameter results.

The unit contains a rechargeable battery and is fully portable. A mains input adapter is also provided.

The manual detailing specifications and operation is provided by the manufacturer. However, brief details of its operation with the Surtronic 3+ are included here.

POWER ON/OFF SWITCH (3 position)
and POWER SUPPLY CONNECTION
located on back of unit.

DIP SWITCHES
(behind cover)

LOW BATTERY
POWER INDICATOR

CONNECTOR FOR LEAD
TO SURTRONIC 4+

PAPER FEED KEY

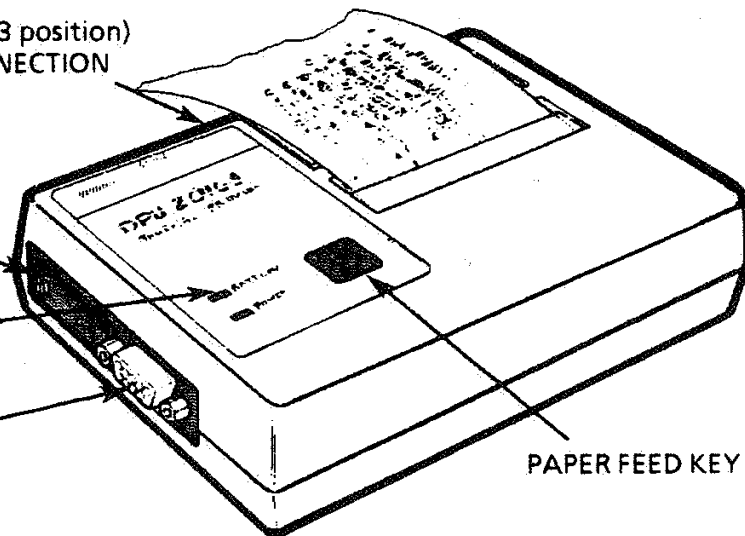


Figure 26 Seiko DPU-201GS Printer

Power Power ON/OFF switch has one OFF and 2 ON positions. To operate the printer from its internal batteries, set the switch to position ON 1. For printer operation from the mains adaptor or to charge its batteries, set the switch to position ON 2.

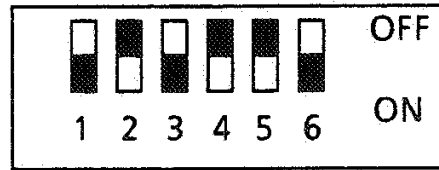
Paper Feed Paper feed key. Pressing this key causes the paper to feed through the printer. Paper feeding stops when the key is released.

INSTALLATION

A set of DIP switches is located behind the cover next to the connector for the printer/Surtronic 3+ lead.

Open the cover and set the switches as follows:

- 1 DOWN ON
- 2 UP OFF
- 3 DOWN ON
- 4 UP OFF
- 5 UP OFF
- 6 DOWN ON

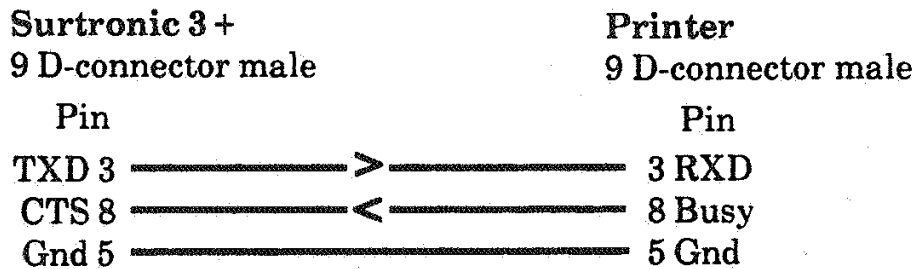


BATTERY CHARGING

Initially, the internal battery may be in a discharged condition. Therefore connect the a.c. adaptor (with the mains power OFF) and switch on the mains power. Set the printer power switch to the ON 2 position. A full recharge will take approximately 15 hours DO NOT RECHARGE THE BATTERY FOR MORE THAN 24 HOURS. This will cause deterioration of performance and may cause damage to the printer. The printer should be stored with the battery fully charged.

INTERCONNECTIONS

The printer is connected to Surtronic 3+ using a lead with 25 way 'D' type connectors on the Surtronic 3+ end and a 9 way connector on the printer end. The connectors must be locked in position. The connections are as shown below:



Mains adaptor

A mains input adapter is provided. When connected, this unit provides power for battery charging and running the printer.

Connect a suitable plug to the mains lead wired as follows:

- Brown to Line Conductor
- Blue to Neutral Conductor

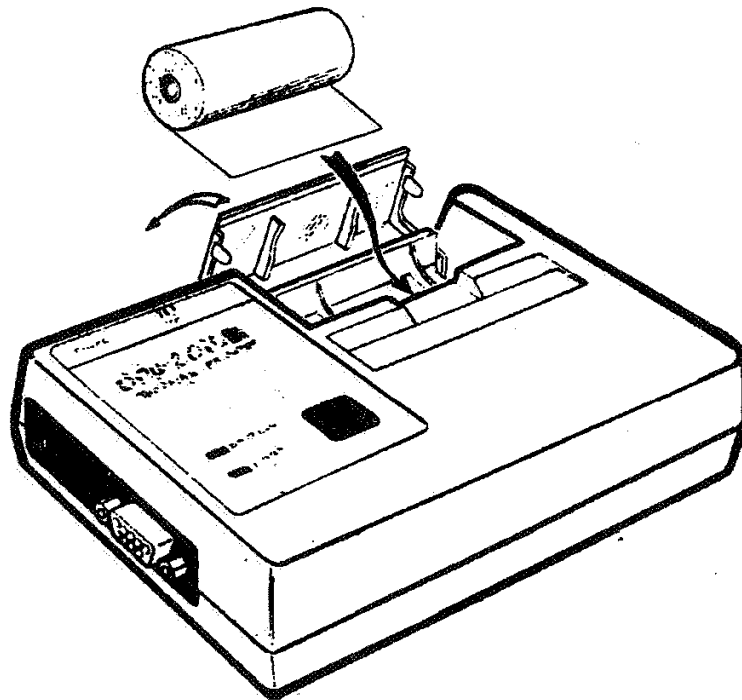
CHART PAPER The printer has a thermal print head, which requires paper of a specific type for correct operation. The paper is supplied in rolls with a heat sensitive surface on the outside of the roll. Fitting a new roll of paper is as follows:

1. Turn on the power to the printer and open the paper holder cover (see Figure 27)
2. If the end of the previous roll still remains in the printer, press the FEED switch to feed it out.
3. Cut a straight end to the new roll of paper. Hold the new roll so that the paper is unwinding from the bottom and feed the end into the paper inlet.
4. Hold down the paper FEED switch until the paper emerges from the paper outlet. Place the paper roll into the well.
5. Close the paper holder cover

Self test

To run the printer self test, turn off the power to the printer, hold down the FEED key and turn the power back on. The printer will then print out all the characters and fonts in its memory and end by printing a dotted test pattern and a print out of the current DIP switch settings..

Figure 27
Installing the
paper roll



Replica kit (112/727)

Surfaces inaccessible to the Surtronic pick-up can be measured indirectly if a replica of the surface is made. The Replica Kit provides prepared quantities of materials for making a replica. On surfaces having an Ra of less than $0.2\mu\text{m}$ ($8\mu\text{in}$), the Ra of the replica is likely to be higher than that of the original surface, while for surfaces having an Ra greater than $4\mu\text{m}$ ($160\mu\text{in}$) the roughness of the replica is likely to be lower.

Detailed instructions are included with the kit but briefly the procedure is as follows. An area not exceeding 400mm^2 ($\frac{3}{4}\text{in}^2$) is enclosed by a thin wall of the 'Plasticine' provided. The solution is then poured on to the area and allowed to harden, which takes about 12-15 minutes. The replica is then removed from the surface and measured with the Surtronic in the usual way. No difficulty is experienced in removing the replica from the surface as this is facilitated by the application of the release agent.

Note: Because the surface has been obtained by a replica, the profile will be inverted, however this will not affect the Ra value.

Portable base (137/1734)

The Surtronic 3+ can be mounted on a portable base for use in measuring large components in situ. The base is fitted with 3 feet which can be positioned at a number of places on the base, enabling it to be steadied on a variety of components.

CALIBRATION

THE REFERENCE SPECIMEN

The sensitivity of the instrument is checked with the reference specimen supplied. This comprises a ruled surface having an Ra value accurate to within 4% of the value marked on its mount.

A NAMAS calibration certificate can be supplied for this standard

SENSITIVITY CHECK AND ADJUSTMENT

The procedure for checking and adjusting the pick-up sensitivity is as follows: (For the chisel-edge stylus type, see the note at the end of this section).

1. Place the reference Specimen on a flat surface and set up the instrument to make a traverse across it. Make sure that the traverse unit body is parallel to the surface of the standard and that the stylus traverses at right angles to the lay of the grooves.
2. Select the 0.8mm or 0.03 inch cut-off and the Ra parameter.
3. Make a measurement of the Reference Specimen and compare the Ra value from the display with that marked on the specimen.
4. If it differs by more than 2%, use the small screwdriver to turn the sensitivity adjuster. This is located through the hole which is located in the front panel of the Display Unit, just above the pick-up connector.
5. Repeat the measurement and adjustment, until the measured value is within 2% of the value marked on the specimen.

Pick-up with Chisel Edge Stylus

The shape of the stylus limits the ability to check the sensitivity of this pick-up with the reference specimen, to an accuracy of $\pm 10\%$. To obtain this accuracy, it is essential that the stylus is tangential to the curved ruling of the specimen so that the traverse is made along a radius.

Take several readings, repositioning the specimen between each, and take the highest reading as the Ra value.

CLEANING THE STYLUS

Occasionally clean the stylus with a camel hair brush moistened with a proprietary cleaning agent.

PICK-UP SKID

To reduce the effect of wear, on pick-ups with a rotatable skid, occasionally turn the skid round to present a new contact surface. The skid is clamped by the screw in the front of the pick-up. When loosening this screw, take care not to let the retaining pin next to the skid fall out. When retightening the screw, ensure that the end cover is correctly positioned with respect to the stylus and that the stylus is free to move.

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