Type S

Performance

Simplicity

# Single-point laser scanner

## Non-contact measuring device

The Type S module is a single-point measuring device. It pushes the limit of the technology further ahead. The laser point is analysed by two separate optical systems. Taken alone, each module reads the dimensions of an object with accuracy and performance. Stacked together, they become a transverse profiling system suitable for trimmer and grade optimizer applications.

This scanner allows data acquisition to be independent of the color of the object. Can be mounted as a single unit or as multiple units connected in Daisy-Chain (up to 32 modules) or on a Backplane (at 1-inch center) for fast ethernet data transfer. Mounting two units facing one another provides a differential measurement system for thickness. The Type S scanner, with its visible laser beam and easy viewing status L.E.D. is simple to install, interface to a PC or PLC, understand, and work with.

Available in three different configurations: Stand alone, Daisy-Chain or Backplane


- **Status L.E.D.**
- **Visible laser beam**
- **Flexible configuration**
- **Accurate up to +/- 0.005"**
- **Daisy-Chain up to 32 modules**
- **Built-in wane detection mode for board turners**
- **Measurement not susceptible to color variation**
- **Two cameras, leading and trailing measurement system (the only scanner that reads steep wane)**


**ScanMeg**

4444 Blvd. Grande Allee,
Suite 101, Boisbriand, QC
Canada, J7H 1R9
Tel.: (450) 419-4555
Fax: (450) 419-4542
E-mail: info@scanmeg.com
Web: www.scanmeg.com

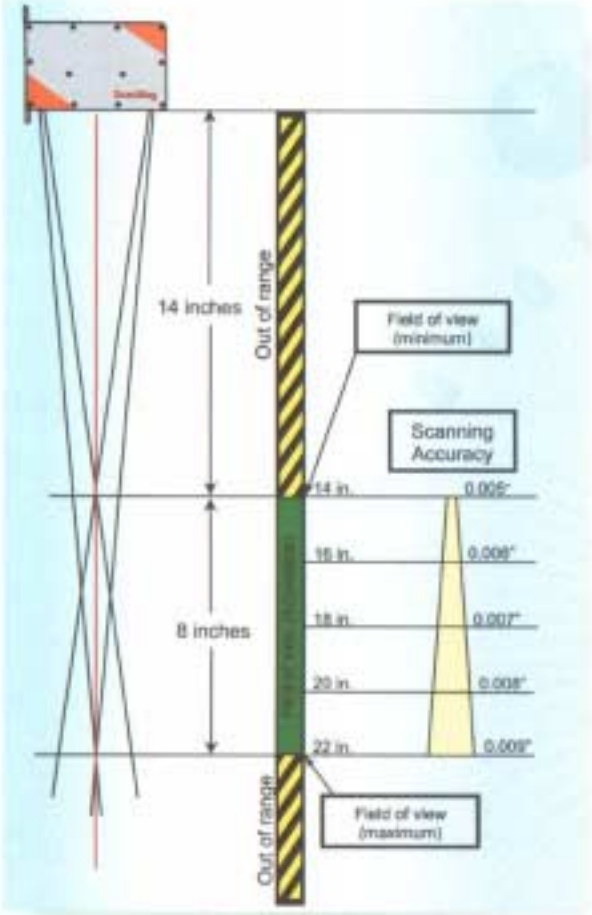
**Western Representative**

John Wilby
10972 Swan Crescent
Surrey, BC, V3R 5B6
Tel.: 604-582-2157
Fax: 604-582-2105
Cell.: 604-290-6595
E-Mail: jwilby@scanmeg.com


*Sensors for optimal solutions*

Type P Type D Type MD Type BBS Type Ultra S Type SE **Type S** Type RC Type L Type T Type TL Type TS

## Stand-Alone and Daisy-Chain Configuration

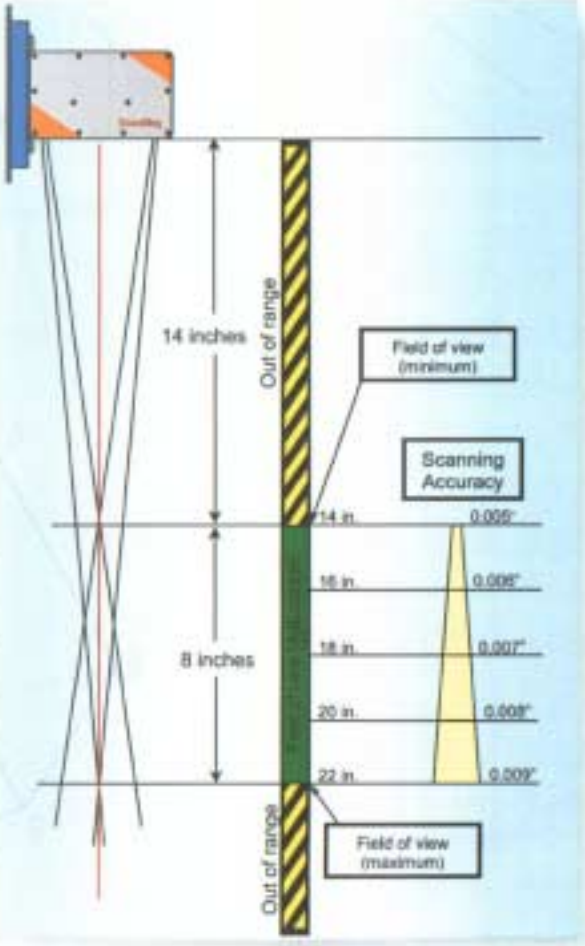



- Visible laser to simplify operation
- Wane mode directly outputs % of wane
- Value in 0.001" increments
- For each side of a board, wane accuracy is increased due to physical position of the two cameras (looking from outside of the board)
- Link up to 32 modules in a Daisy-Chain
- RS-485 Serial output
- Built-in Direct, Average or Median scanning mode

| | |
|---|---|
| Scan rate : | 1250 Scans/Sec. |
| Beginning of field of view: | 14 inches |
| Field of view: | 8 inches |
| Accuracy: | 0.005 inch to 0.009 inch |
| Communication interface: | RS-485 |
| Power supply: | 12 to 24 volts |
| Current: | 275 mA |
| Operating temperature range: | 0°C to +50°C |
| Dimensions (L, W, H) | 10.625" x 0.980" x 6.500" |

## Backplane Configuration (MS)

- Visible laser to simplify operation
- Field of view of 8 inches
- Value in 0.001" increments
- For each side of a board, wane accuracy is increased due to physical position of the camera (outside the board)
- Link up to 16 Backplanes (with a maximum of 24 modules per backplane) with only one ethernet link
- Keeps the entire data of a board in memory
- Encoder interfaces directly to the Backplane




| | |
|---|---|
| Scan rate: | 1250 Scans/Sec. |
| Beginning of field of view: | 14 inches |
| Field of view: | 8 inches |
| Minimum module center distance: | 1 inch |
| Accuracy: | 0.005 inch to 0.009 inch |
| Communication interface: | "Fast Ethernet" (RJ-45) |
| Power supply: | 12 to 24 volts |
| Operating temperature range: | 0°C to +50°C |
| Dimensions (Backplane MS (L, W, H)) | 23.950" x 1.625" x 11.500" |

# 1 Wane Mode

Type S devices offer a wane mode in which the quantity of wane on a board is estimated. This mode can be used to determine whether or not a board should be turned over before planing, or to estimate the board's grade. This application note explains how the wane mode works and how it can be used. It also reviews the Type S commands used to get wane data, set and get wane analysis parameters, and finally some methods to estimate wane percentage on a board.

## *1.1 What is the wane mode?*

The wane mode, instead of outputting each height readings acquired, produces a digest of this information that tells you where the wane starts and ends on a board. This information can be used in a simple formula, ie. (1), to give the percentage of wane at the location of the scan line.

In normal output mode, for each tach signal the Type S device receives, a height is read. This usually results in a great number of data points that one must transfer to a host computer (or industrial control unit) and process. If one were only interested in the overall wane percentage, rather than exact board shape, wane mode should be used. The wane analysis is done by the Type S module and not in the host computer, and very little data is outputed, making daisy chaining a number of Type S modules possible.

Consider **fig. 1**. In this figure, the wane mode's general operation is shown. Starting at a lug, the Type S device accumulates height readings, up to 500 points, at a rate determined by the tach signal. When the next lug signal is received, it starts computing the wane locations using the algorithm and user-configurable parameters described in section 2. The details of the wane data output is described in section 1.2.2, but it corresponds to **fig. 2.**, where the board always starts at a zero offset, and where the numbers A, B, and C are, respectively, the end point of the left wane, the end point of the face and the end point of the board. The numbers A, B, and C are expressed in tach units,

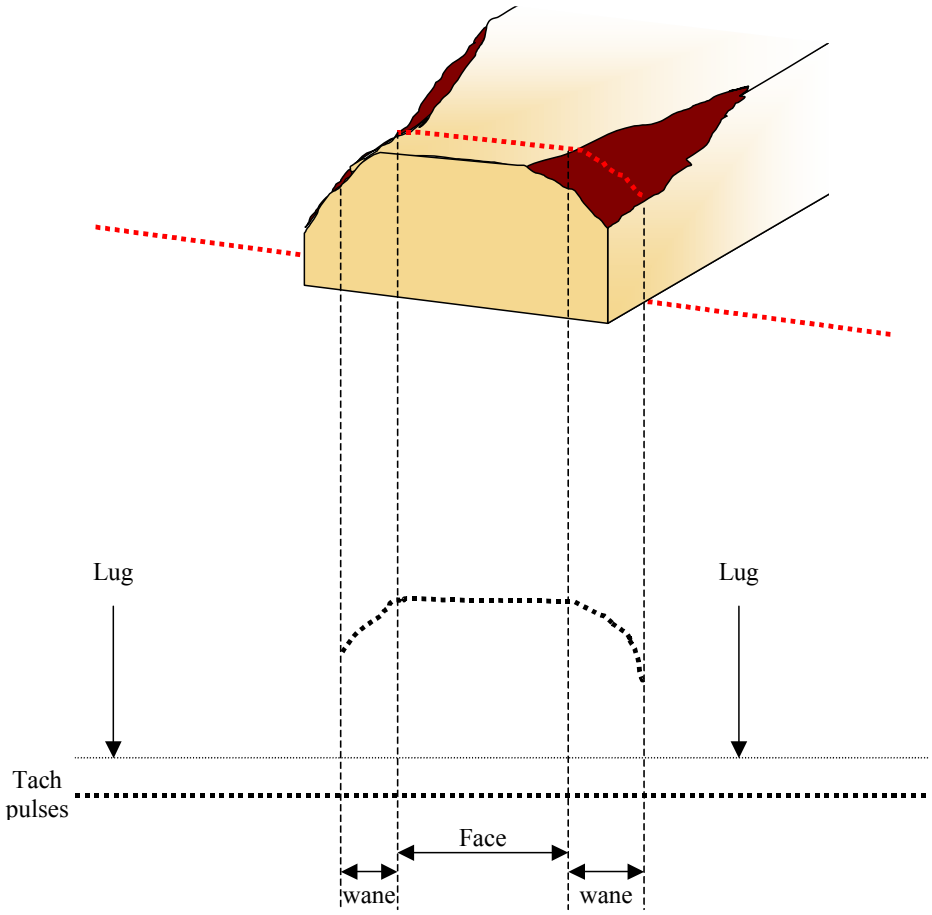



**Fig. 1**. Profile analysis. The Type S module reads heights starting at a new lug signal, and each tach pulse triggers a new reading. Combining a position (encoded by the tach count) and height one can reconstruct the board's profile. This profile is analyzed to find three regions: left wane, face, and right wane.

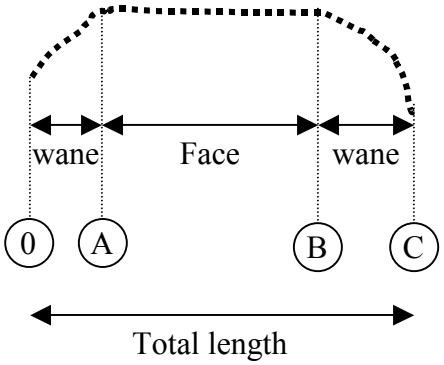



**Fig. 2.** Profile regions encoding. The region 0 – A is the left wane. The region A – B is the board's face. Finally, the region B – C is the right wane. The board, in wane mode, always starts at 0, regardless of where it actually starts relative to the lug signal. Positions A, B, and C are encoded relative to the beginning of the board. Computing the wane percentage is explained in text.

Once the quantities A, B, and C are available, the percentage of wane, *W*%, on that board, at that location, is given by

$$W\% = \frac{C-(B-A)}{C}\times 100 \quad (1)$$

The percentage of face, *F*%, is given by

$$F\% = \frac{B-A}{C}\times 100 \quad (2)$$

The accuracy of the algorithm can be controlled by user-configurable parameters that we explain in section 2.

## 1.2 Wane mode commands

In this sort section, we refresh one's memory about output mode selection commands. This information is also found in the manual " Type S Specifications. "

### 1.2.1 Wane mode activation

To activate wane mode from monitor mode, send the following output mode command:

| Field | Header | Command | Wane Mode | Reserved | Head # | Footer |
|---|---|---|---|---|---|---|
| Value | 0x0A | 0x4F | 0x31 | 0x30 | 00 | 0x0D |

As soon as you return to normal scan mode, the Type S starts sending data as described in the next section, 1.2.2. This mode is saved into the Type S flash memory, so there is no need to set that mode at each power on.

The head# is always 00 since this is a daisy-chaining mode command, which will be broadcasted to all heads on the chain.

### 1.2.2 Wane mode data format

After each lug a data packet is sent. The data is the same as described in section 1.1, (in particular, see fig. 2.) The fields A, B, and C are 4-byte wide ASCII hexadecimal coded values. Since the board's left edge always starts at zero, that field is not sent.

The sent data is summarized:

| Field | Header | Head # | A | B | C | Footer |
|---|---|---|---|---|---|---|
| Value | 0x0A | 00 – 32 | 0000 – FFFF | 0000 – FFFF | 0000 – FFFF | 0x0D |

### 1.2.3 Daisy Chaining and the Wane Mode

The small data rate of the wane mode makes it possible to be used in daisy chaining mode. See " Type S Specification " manual for details. Daisy chaining essentially consists of serially linking several Type S devices using the RS-485 communication protocol. All Type S devices use a shared RS485 bus. Each sends its data one after the other, using the RS485 hand-shaking protocol.

## 2 Wane Mode Optimization

In this section we explain the wane mode algorithm and how its parameters can be fine-tuned to suit one's needs.

### 2.1.1 Wane Analysis Algorithm

The wane analysis algorithm uses three parameters: the number of core points, in percentage of the total number of points, and $T_1$, and $T_2$, tolerances in mils (thousandth of an inch.) To understand how the algorithm uses these parameters, we must go through all the steps it performs in order to find the wane on a board.

Consider **fig. 3** a) through g). In fig. 3 a), we have a scanned board as represented in fig 1., and it is now in the Type S device's memory. Using the core points parameter that tells the algorithm how many points in percentage in the center of the board to keep, we exclude the board's edges. Then a first line is fitted through the core points. Using this line and the parameter $T_1$ that is a

tolerance in mils, we draw an acceptance region, as shown in pink in fig. 3 b). Then we find the first points, to the left and to the right, starting from the edges, which enter that acceptance region, as in fig 3. c). This new region will be used for the second fit.

The second fit proceeds much like the first; the points it will use for fitting are now delimited by the "first edge" and "second edge" as shown in fig 3. c). The line fitted, shown in blue in fig. 3 d), will be the second and final fit. Again an acceptance region is computed, but this time using parameter $T_2$, also a tolerance in mils. This acceptance region is drawn in pale blue in fig. 3 e). Again, the first points, starting at the extremities, that enter the tolerance region are found. The result is shown in fig. 3 f). At last, these delimit the face, and will become values A and B (from fig. 2) and the algorithm terminates.

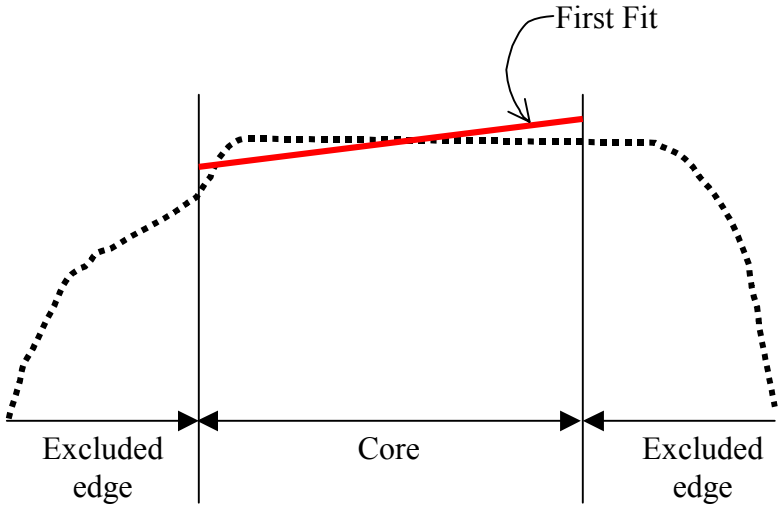



**Fig 3. a)** The Core parameter tells the algorithm how many points (in term of percentage) to keep in the center of the board, this excludes edges from the computation. A first linear fit (in red) is computed using core points.

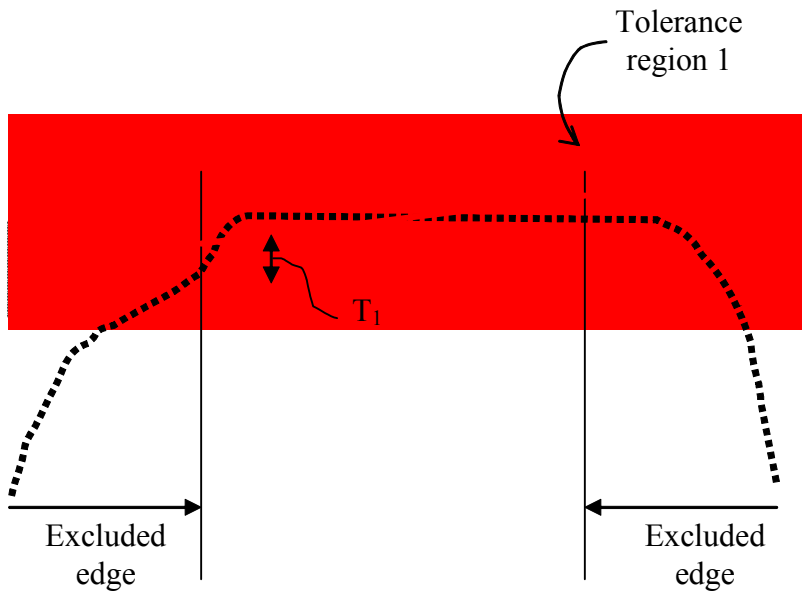



**Fig 3. b)** One a line has been fitted through core points a first tolerance region is computed. The region is shown here in pink. This region is controlled by the $T_1$ parameter.

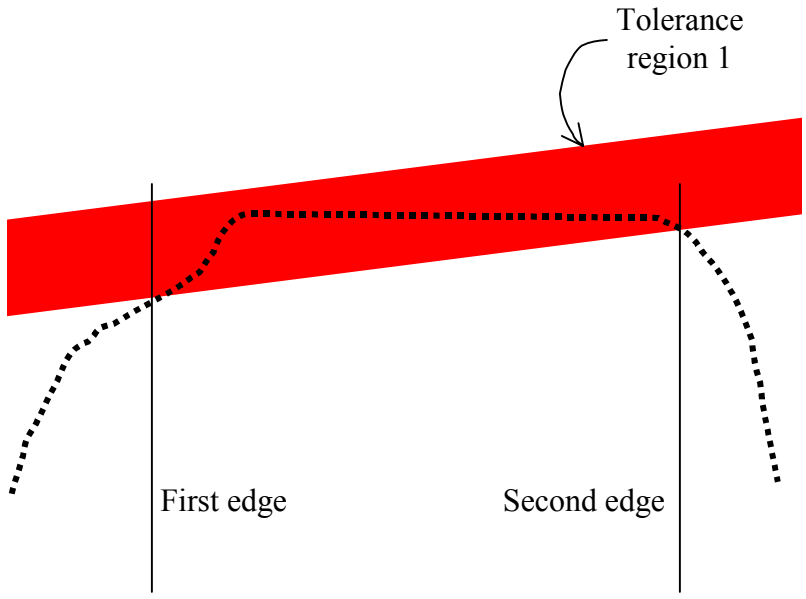



**Fig 3. c)** The algorithm finds the first point on each side that enters the tolerance region (shown in pink). This defines the second fit region.

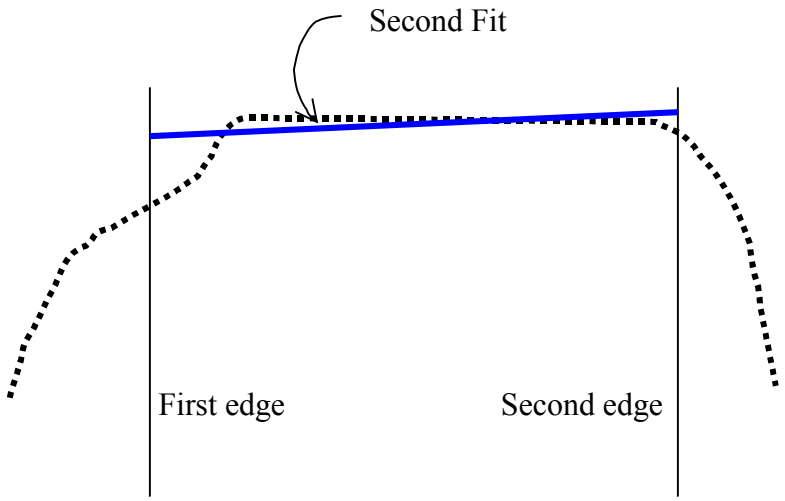



**Fig 3. d)** Using the region defined in the previous step, a second linear fit is performed. This time, the fit is closer to the actual face.

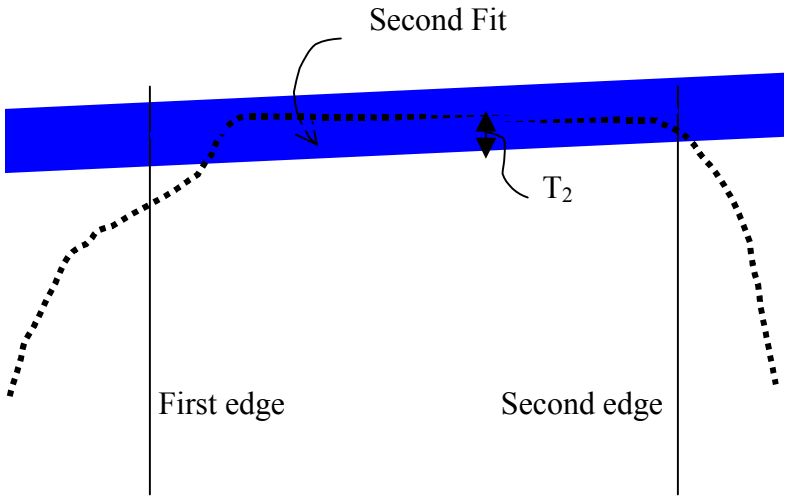



**Fig 3. e)** Again, a region is defined, but this time the width of the region is controlled by parameter $T_2$.

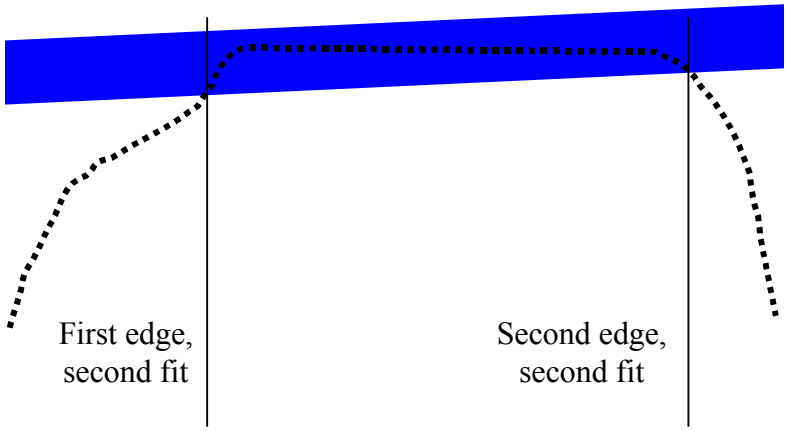



**Fig 3. f)** Again, the first points on each side that enters the tolerance region are found.

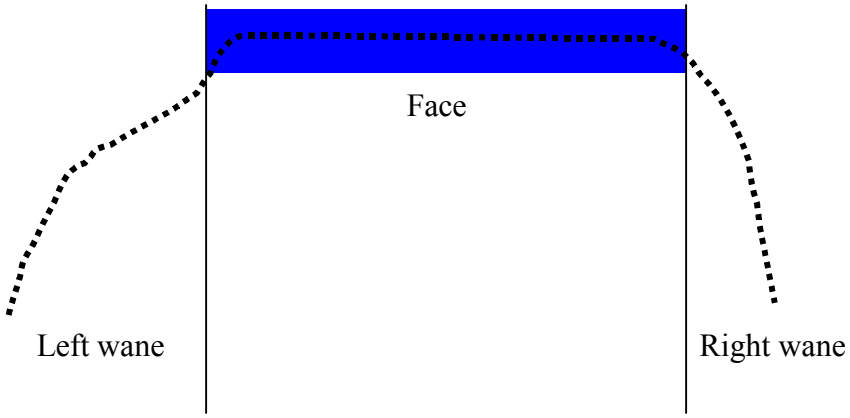
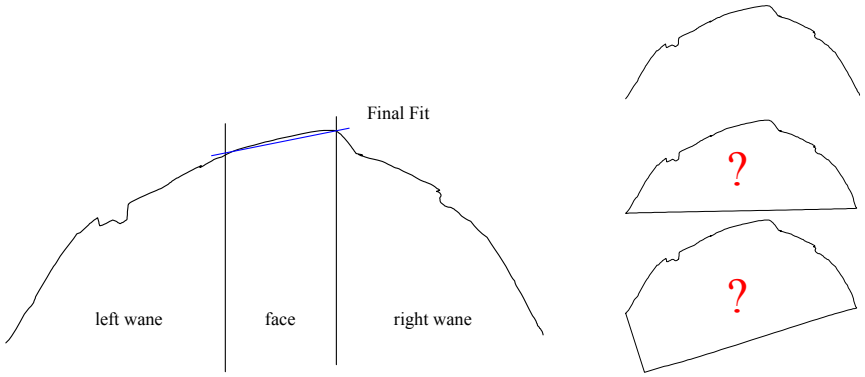



**Fig 3. g)** Finally, the face is found.

The robustness of the wane analysis algorithm depends on the user-defined parameters. The Type S device provide sensible default values for the parameters (namely, 30% for the core points, 50 and 25 mils for $T_1$ and $T_2$, respectively) but you should change those values, using the monitor mode command described in the next section, section 2.2, to optimize your results.

Also note that the wane analysis is not robust on severely twisted boards. Consider fig. 4. If a board were relatively straight, the algorithm works well. If, on the contrary, the board is rather twisted (more than about 30º ), wane could be mistaken for a face or vice-versa.




a) b)

**Fig 4.** A pathological case. a) Here, the flat surface at the center is mistaken for a face. b) Several different shapes can give the same projection. The maximum torsion a board can have must be taken into account when adjusting the wane analysis algorithm parameters.

## 2.2 Wane Analysis Parameter Setup Command

You must first enter monitor mode to use this command. The wane parameter setup command

| Field | Header | Command | Core Points | $T_1$ | $T_2$ | Head # | Footer |
|---|---|---|---|---|---|---|---|
| Value | 0x0A | 0x57 | 00 – 99 | 000–255 | 000–255 | 00 – 32 | 0x0D |

**Note:** If all three parameters were set to 00,000, and 000, the current settings are returned. The data sent back has the same format as the command, as shown above.

**Note:** If head number is 00, this is a broadcast command that will be interpreted by all Type S devices on the daisy chain and the command produces no echo. If head number is not 00, only the specified device receives the command, and the specified head echoes the command as interpreted.