User Manual
Digital Readout

VISION 900

GIVI MISURE

www.givimisure.it

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STANDARD FUNCTIONS

ADDITIONAL INFORMATION

PRELIMINARY REMARKS

GIVI MISURE would like to thank you for purchasing the programmable digital readout

VISION 900
MICROCOMPUTER

and confirms the excellent choice made.
Thanks to a powerful microcontroller, the instrument is completely programmable by keyboard. This means that VISION 900 can be optimized with a number of specific functions for any type of machine tool.

Disposal of waste electrical and electronic equipment (WEEE)
European Council Directive 2002/96/EC

The use of the WEEE symbol indicates that this product may not be treated as household waste. If this product is disposed correctly, you will help to protect the environment. For more detailed information about the recycling of this product, please contact your local authority, your household waste disposal service provider or the retailer where you purchased the product.

INSTALLATION

WARNING !

It is forbidden to switch on the instrument unless the machine on which it is installed conforms to 2006/42/EC Directive.
All of the equipments connected to the instrument must have insulation characteristics in compliance with the regulations in force.
The instrument can be installed only by specialized personnel, following the instructions provided by the Manufacturer.
It is strictly forbidden to intervene on the instrument while it is powered from the mains power supply or by other devices.

GROUNDING The instrument is connected to the ground through the power supply connector. To avoid discharges, we recommend the use of a socket with a grounding connection. In case of inadequate grounding connections, all the accessible parts, including those apparently protected, may generate electrical discharges.

PROTECTION According to power supply:

- **230 Vac 50/60 Hz or 110 Vac 60 Hz**; by fuse located on the rear panel (use only delayed fuses ø 5x20 mm 500 mA 250 V). Unplug or completely disconnect the power supply before changing the fuses.
- **24 Vac 50/60 Hz**; by an automatic brake circuit (self-restoring) that protects the instrument in case of overcurrent, short circuit, etc.

PREVENTION To avoid fires or explosions, this instrument should not be used in the presence of inflammable gases, solvents, explosives, etc.

REAR PANEL It can be removed only by specialized personnel, after disconnecting the power supply (it is not sufficient to turn off the switch).

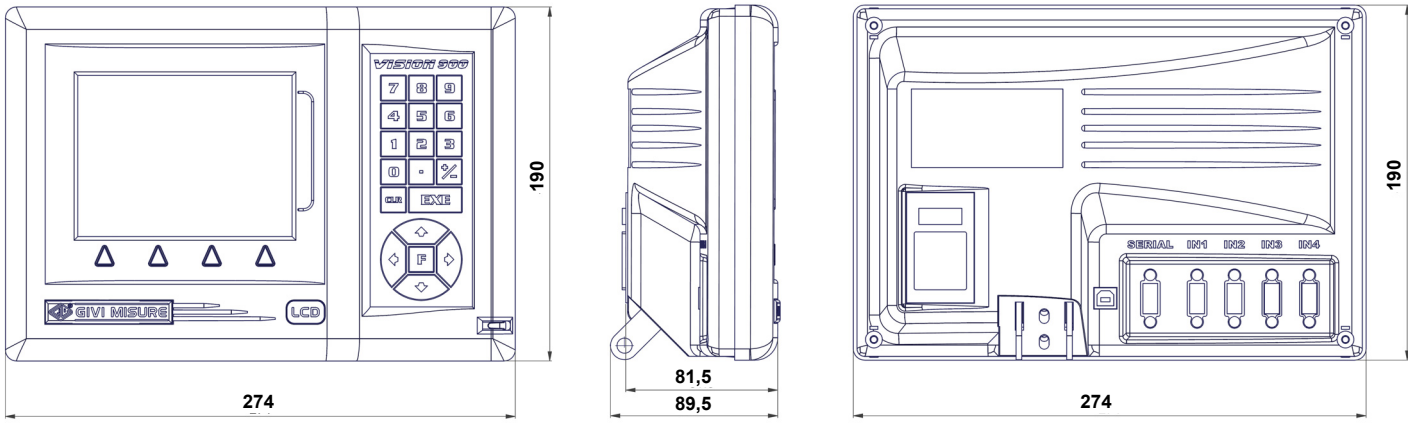
INSTALLATION The measuring systems (optical scale, rotary encoder, etc.) must be installed following the instructions provided by the Manufacturer. Connect the axes connectors to the corresponding inputs (X, Y, Z and W) on the instrument. Connect the power supply cable and turn on the instrument, using the switch placed on the rear panel.

CLEANING The front panel can be cleaned only after disconnecting power supply, using a moist cloth. The instrument is not protected against liquid penetration. DO NOT USE SOLVENTS.

MAINTENANCE Not required.

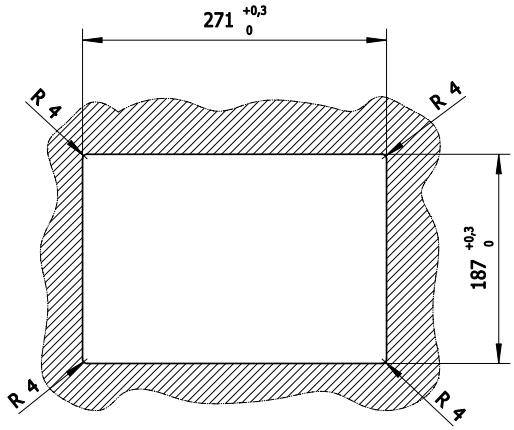
In case of accidental or momentary mains voltage drops, the instrument does NOT provide wrong and potentially dangerous information. When switched on again, the instrument signals the occurred anomaly and requires the zero reference search (REF).

DIMENSIONAL SPECIFICATIONS (STANDARD)

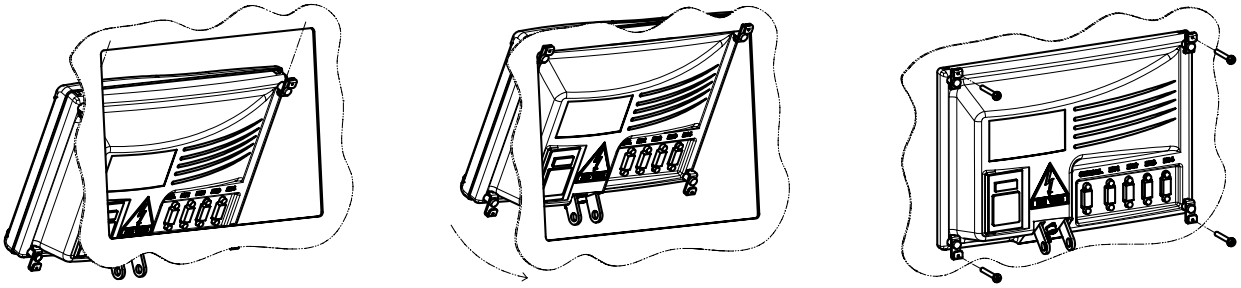


DIMENSIONAL SPECIFICATIONS (PANEL MOUNTABLE)

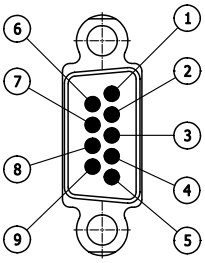
HOW TO PREPARE THE PANEL

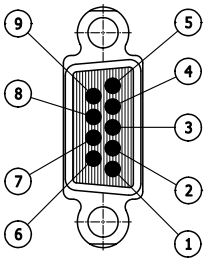


HOW TO MOUNT THE INSTRUMENT



CONNECTIONS





SERIAL – I/O	IN1 / IN2 / IN3 / IN4

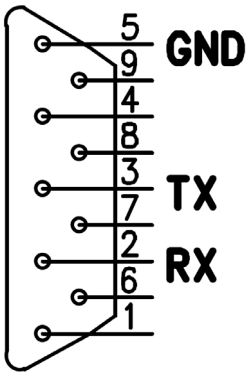
SERIAL	PIN LAYOUT	1	2	3	4	5	6	7	8	9
	SIGNALS	GND (CAN Bus)	RX (RS-232)	TX (RS-232)	GND (TP)	GND (RS-232)	IN (TP)	5V*	CAN_H	CAN_L

IN1-IN4	PIN LAYOUT	1	2	3	4	5	6	7	8	9
	SIGNALS	B	/	Z	A	/	/	V+	GND	SHD

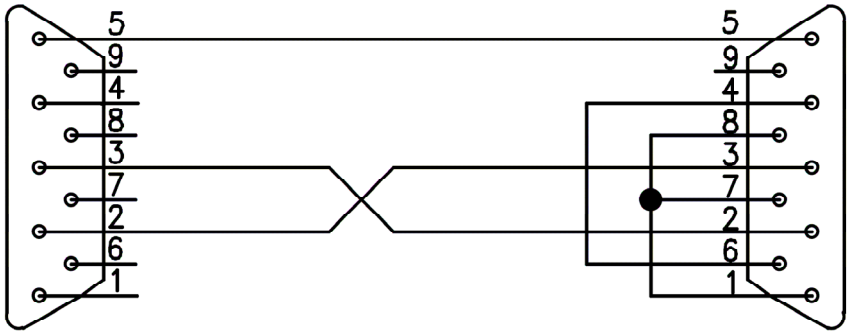
* Output current: 100 mA_{MAX}

SERIAL – I/O CONNECTIONS

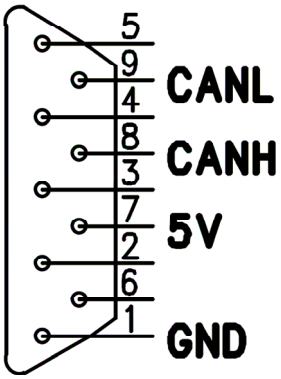
RS-232



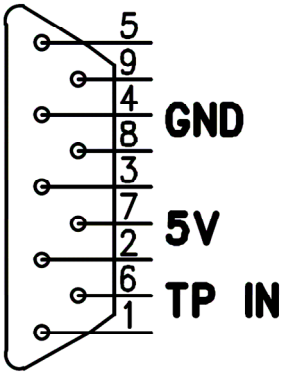
CONNECTION CABLE RS-232
(SERIAL PRINTER/PC)

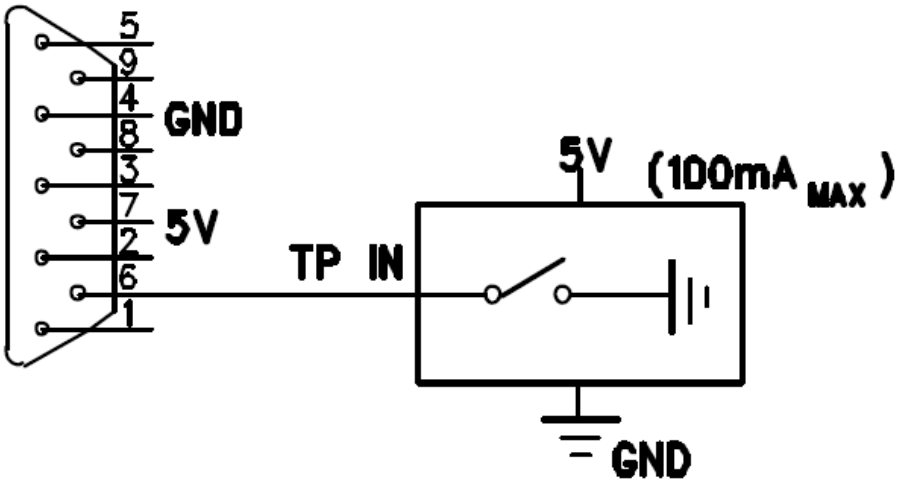


CAN Bus



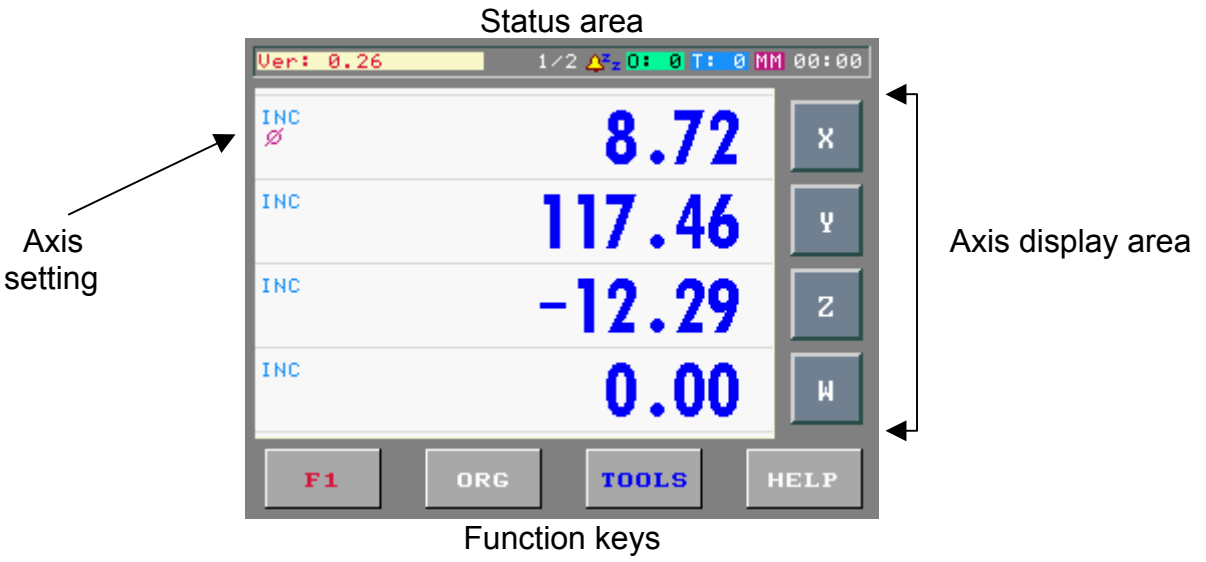
TOUCH PROBE

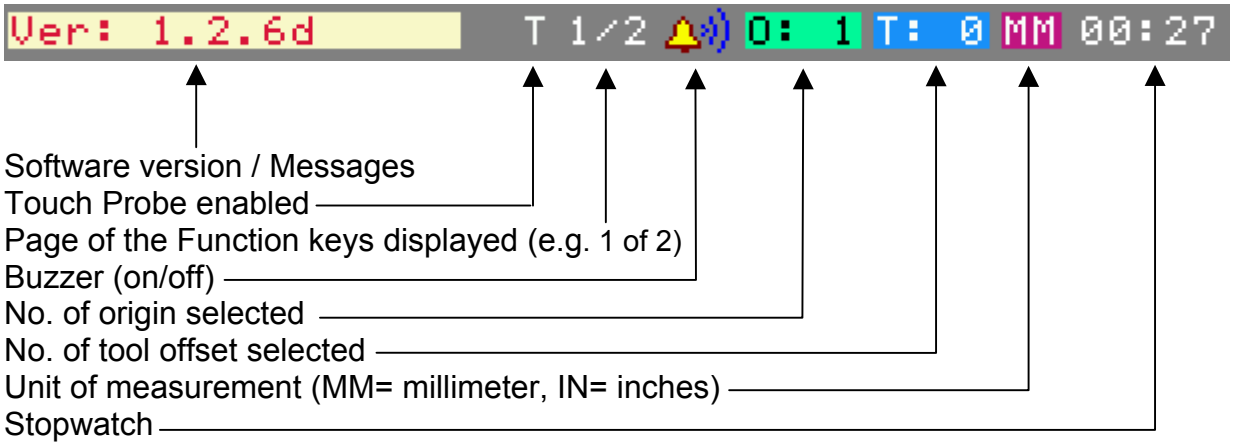




KEY - MESSAGES AND SIGNALING

The following keys and symbols are used in this manual, with the following meaning:





X Y Z W	X, Y, Z, W AXIS KEYS
F1 ... F8	PROGRAMMED KEYS USED FOR THE QUICK RECALL OF FUNCTIONS
ORG	KEY USED TO STORE / RECALL ORIGINS
TOOLS	KEY USED TO STORE / RECALL TOOL OFFSETS
HELP	KEY USED TO RECALL THE ONLINE HELP
ZERO	KEY USED TO RESET THE AXIS POSITIONS

KEYS DEDICATED TO SPECIFIC FUNCTIONS

KEYS DEDICATED TO SPECIFIC FUNCTIONS

KEY USED TO RECALL THE CALCULATOR

KEYS USED TO STORE / RECALL AND DISPLAY THE MEMORIZED PROGRAMS

KEY USED TO CLEAR THE OPERATION IN PROGRESS

NUMERICAL KEYS FOR DIGIT ENTRY

KEY USED TO SELECT THE OPTIONS DISPLAYED
ALSO USED TO SELECT THE ALGEBRAIC SIGN

KEY USED TO CONFIRM DATA OR SELECTIONS

KEYS USED TO INCREASE / DECREASE THE DISPLAY BRIGHTNESS

KEYS USED TO SELECT THE FUNCTION KEY PAGES AND THE ONLINE HELP PAGES

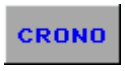
CODED FUNCTIONS KEY (TO BE USED TOGETHER WITH A NUMBER)

CALCULATOR OPERATION KEYS

CALCULATOR FUNCTION KEYS

CALCULATOR MEMORY KEYS

KEY USED TO SWITCH FROM GRAPHIC TO TEXT DISPLAY



KEY USED TO RECALL THE STOPWATCH

KEY USED TO START / STOP THE STOPWATCH

KEY USED TO RESET THE STOPWATCH

KEY USED TO TURN ON / OFF THE AXIS DISPLAY

KEY USED TO SET THE DECIMAL POINT (D.P.) OR THE AXIS DISPLAY LABEL (LABEL)

INFO	KEY USED TO RECALL THE INSTRUMENT CONFIGURATION INFO
LIST	KEY USED TO RECALL THE LIST OF TOOL OFFSETS
DEL	DELETE KEY

The instrument provides a series of acoustic and visual signals to support the user during configuration and use. When pressing a key, a short buzz can be heard, while messages appear on the displays, according to the operation/function (see this manual). A different color of the axes keys signals their activation or their predisposition to execute a function.
If the key is active, the function is in progress; if it is standardly colored, the function has been completed.

Wrong operations are signaled with a long buzz together with the following message: Error

that temporarily appears on the display to inform the operator that the entered key is not compatible with the current operation.
In case of “overflow” error, i.e. the number of digits entered is greater than the instrument counting capacity, the error is shown on the display as:

To exit this situation, see the “Position Reset/Preset” paragraph.

In certain situations, the error message will be accompanied by a number, indicating the cause of the error. For example: Error 20

The list of possible errors is provided in the table below:

Error Number	Description
10	Execute the zero reference (REF) search
11	Axis not in “Linear” reading mode
12	Axis not in “Angular” reading mode
13	Axis not in “Diametral” reading mode
20	Function unavailable
21	Function key not programmed
22	Program unavailable
23	Out of memory
24	CSS enabled (+24V external)
28	Axis coupling enabled
81	Instrument not set for axis coupling
90	Internal malfunctioning (request technical assistance)
E0	Configuration error (request technical assistance)

DATA AND PROGRAMS RETENTION

When the mains power supply is disconnected, the instrument can retain in its memory all the data and programs set.
When powered off, the instrument can also store the last axis counting position.

To delete all the operation settings (counters resetting, axes origins, tool offsets, etc.) see function F 0.

☞ The instrument, both in ABS and INC mode, cannot consider shifts of the carriages made whenever the mains power supply is disconnected (due to inertia, manual maneuvers, or thermal expansion). Whenever any of the above occurs, the positions shown in the displays are unreliable; they do not represent the new positions of the carriages but the ones they had prior to power disconnection.

☞ To avoid errors, we recommend to link the counting mode ABS/INC to the encoder zero reference (REF). In addition, it will be necessary to link to the REF all the functions that require this link, as specified in their description.

STANDARD FUNCTIONS

INVERSION OF COUNTING DIRECTION

Turn on the instrument and wait for the end of the self-testing cycle. The displays remain lit up and show the zero reference (REF) search. Press CLR to enable the axes counting. Manually move the carriages and evaluate which axes need to be inverted (the direction in which they advance depends on the scales installation). For scales with **coded-distance reference indexes** it is important to properly set the positive counting direction, as per mounting instructions.

EXAMPLE:
AXIS X = *TO BE INVERTED*
AXIS Y = *CORRECT*
AXIS Z = *TO BE INVERTED*
AXIS W = *CORRECT*

Press **F** **98722** **EXE**

Axis X	dir-
Axis Y	dir-
Axis Z	dir-
Axis W	dir-

☞ The dash position (-) to the right or left of “dir” does not reflect the movement direction. The shift from dir- to -dir simply indicates to the operator that the inversion of direction has been executed.

Press **+/-** because the X axis has to be inverted

Axis X	-dir
Axis Y	dir-
Axis Z	dir-
Axis W	dir-

Press **EXE** the selection is confirmed and the X axis is inverted

Axis X	-dir
Axis Y	dir-
Axis Z	dir-
Axis W	dir-

Once the operation has been completed, the instrument goes on considering the next axis. Since it has not to be inverted,

Press **EXE** to go to the Z axis setting

Axis X	-dir
Axis Y	dir-
Axis Z	dir-
Axis W	dir-

Press **+/-** because the Z axis has to be inverted

Axis X	-dir
Axis Y	dir-
Axis Z	-dir
Axis W	dir-

Press **EXE** the selection is confirmed and the Z axis is inverted

Axis X	-dir
Axis Y	dir-
Axis Z	-dir
Axis W	dir-

Press **EXE** to confirm the setting of the W axis

123.45

After the last confirmation with the EXE key, the instrument exits programming (all the displays show the positions). In case of wrong settings, press the CLR key and repeat the operation from the beginning.

SCALE ZERO REFERENCE (REF)

The scale zero reference (REF) can be considered as a precision micro-contact, generally located in the middle of the measuring length. Its position, with reference to the geometrical trim of the machine, is unchangeable over time. This could be modified only if the scale is disassembled (e.g. due to service, maintenance or substitution). In this case, the operator will have to set the references again. Using scales with coded-distance references (NCS), the zero reference search is completed after a short movement (around 20 mm) in any point of the scale.

☞ For a correct recognition of the zero reference position, on scales with **coded-distance references**, it is important to properly set the positive counting direction, as per mounting instructions.

The zero reference can be searched ***automatically*** whenever the instrument is turned on, or ***manually:***

A) **Automatically.** Whenever a momentary or prolonged interruption of power supply (voluntary or not), the instruments proposes to the operator the zero reference (REF) search to avoid the displaying of incorrect positions (LAST POSITION). This is the case, for instance, of a sudden power failure while the carriage is moving (since it would continue to move due to inertia), or of the movement due to thermal expansion (for example caused by a temperature drop during the night), or of involuntary or accidental shiftings (while cleaning the machine). The operator is therefore warned against a potential risk. He can decide to perform the zero reference (REF) search, by passing the carriages on the corresponding points, or he can cancel the operation, pressing the CLR key. In this case, it is advisable to check the accuracy of the positions reached.

B) **Manually.** Whenever the operator deems it necessary, he can verify the positions reached by the carriages, performing the zero reference (REF) search **manually** on the concerned axis (or on all the axes).

Example:

Press [X] and/or [Y] and/or [Z] and/or [W] and [REF]

The instrument will require the zero reference (REF) search on the selected axes.

☞ When an axis concludes the zero reference (REF) search, it is automatically excluded from this function, to avoid interferences with other operating functions. In any case, the instrument will not accept any setting until all the axes have terminated the zero reference (REF) search, displaying an error message at the pressure of any key (except CLR). The operator can then decide to:

A) Complete the zero reference search for all the activated axes;
B) To perform it on some axes and cancel it for all the others;
C) To cancel it for all the axes because unnecessary.

SELF-TESTING

A general test of the instrument is performed automatically whenever it is turned on, checking the validity of the stored data. If no problem is detected, the following wording will appear on the display:

SET-UP DIGITAL READOUT

Test E2prom : no Error

ABSOLUTE / INCREMENTAL COUNTING

A signal on the display area of each axis indicates:

ABS = AXIS IN ABSOLUTE COUNTING
INC = AXIS IN INCREMENTAL COUNTING

To switch one or more axes from one counting mode to the other,

Press [X] and/or [Y] and/or [Z] and/or [W] the keys of the activated axes light up.

Press [ABS INC]

On the axis display, a signal indicates that the axis is in ABS (or in INC).

The counting system is managed by the instrument, which has a dual internal counter (ABS/INC) for each axis. The information relating to the axis movement updates simultaneously both counters. The information entered by the operator, instead, only affects the counter of the selected counting system. For instance, it is possible to reset the ABS counter in a given point (ORIGIN) and operate in INCREMENTAL counting (that is handier and more versatile to use). The operator can then carry out all the resetting, pre-selections, functions, etc. required by the machining process, since he can return to the ABS counting at any time to find out the **absolute** positions of the carriages and, therefore, the ORIGINS he had set.

POSITION RESET / PRESET

Regardless of the selected counting mode, ABS or INC, to reset a value, proceed as described below.

Press [X] and/or [Y] and/or [Z] and/or [W] the keys of the activated axes light up.

Press [ZERO] and the value will be reset **0.00 X**

To enter a value (preset), e.g. 113.03 on the Y axis,

Press [Y] **113.03** **113.03 Y**

Press [EXE] to confirm the entered value **113.03 Y**

To enter the same value on more than one axis, e.g. 100.05 on the X and Z axes,

Press [X] [Z] **100.05** **100.05 X**

Press [EXE] and the value will be preset **100.05 X**

ON EACH DISPLAY, DATA CAN BE ENTERED:

A) without the non-significant decimal zeros: **1250** → 1 2 5 0 . 0 0

B) with the proper number of decimal digits: **1133.04** → 1 1 3 3 . 0 4

The entered data are rounded:

- down: from **13.051** to **13.054** → 1 3 . 0 5

- up: from **13.055** to **13.059** → 1 3 . 0 6

C) With a number of digits not exceeding the instrument counting capacity:

+/-**1599999.9**	as for resolution 100 µm
+/-**159999.99**	as for resolution 10 µm
+/-**15999.999**	as for resolution 1 µm

Attempts to enter a higher number of digits will lead to an "overflow" error.

For instance, to enter the value 1234567.89 on the Y axis,

Press [Y] **1234567.89** → 1 1 3 . 0 3 Y

Pressing [EXE] the value is not accepted **("overflow" error)** → -------.-- Y

To exit this situation,

Press [Y] **XXXXX.XX** (correct data) [EXE] → XXXXX. XX Y

or reset the axis:

Press [Y] [ZERO] → 0. 0 0 Y

D) With the negative algebraic sign entered during or on completion of the data entry (the positive sign is implied and never shown on the axis display).

MM/INCH CONVERSION

At any pressure of the 

key, the unit of measurement switches from **MM** to **INCH** and vice versa. This occurs instantly on all the axes. The selected unit of measurement is signaled by MM or IN lit on the status bar, as well as by the decimal point position on the axes. If the conversion is not compatible with the operational conditions of the instrument, it will not be performed.

MIDPOINT CALCULATION

With this function it is possible to easily identify the midpoint between two points A and B of a workpiece (distance between holes centers, geometrical figures, workpiece sides, etc.). To execute the function, for instance on the Y axis:

Go to the first position A, moving the carriage along the Y axis. Let us suppose that in that position the axis display will show the value 30.00 (which is not necessary to reset).

Press 

The Y axis and the ½ keys are activated on the display.

Move to the second position B. Let us suppose that in that position the Y axis display will show the value 52.22.

Press 

or 

A dimension will appear on the Y axis display. This will correspond to the exact halfway (rounded, if necessary) between the two positions A and B. It will be sufficient to move the carriage to the 0.00 position and it will be placed in the required midpoint.

☞ This function can be carried out only if the axis is set for **INCREMENTAL** counting. Vice versa, the instrument does not complete the calculation, as this would interfere with the **ABSOLUTE** counting settings.

MEMORY CLEARING F 0

The F 0 function can be used to delete the data entered by the operator, either entirely or selectively. These data are stored in different areas.

Press **F** **0** **EXE**

ENTER CODE	1 MEMORY

and, if required 

The display will show an indication of the type of data stored in each area, together with the number of the area. Pressing on the keyboard the numbers indicated below, the corresponding actions will occur:

1: All the stored data will be deleted.
2: Data relating to linear corrections and scale factors will be reset to the value 1 (i.e. no correction).
3: Absolute and incremental positions and references will be deleted.
4: The offsets will be deleted.
5: The origins will be deleted.
6: The material weight will be deleted.
7: The constant pitch will be deleted.
8: The rotation speed will be deleted.
9: The inclined constant pitch will be deleted.

Use the  key to delete eventual other data (e.g. round flange, special round flange, etc.).
At any pressure of the above mentioned numbers, the corresponding data will be cancelled. To delete functions with no code, select them and press EXE.

SETTING PRINTING LINE SPACINGS F 9

When printing labels (see paragraph RS-232 SERIAL OUTPUT), it is possible to set some spacings (max. 19) among the printings, for the correct positioning of the labels.

Select F 9 to set the number of spacings.

Press **F** **9** **EXE**

prt. line	0

Press  to increase the number (0-19)

prt. line	1

Press **EXE** to confirm the setting

57.0865	X

Printing example (4 spacings):

1st spacing →
2nd spacing →
3rd spacing →
4th spacing →

```
= DIGITAL  READOUT =
AXIS  X :        57 . 0865
AXIS  Y :        10 . 8480
AXIS  Z :        - 7 . 0985
UNIT    :        INCH
```

```
= DIGITAL  READOUT =
AXIS  X :        57 . 0865
AXIS  Y :        10 . 8480
AXIS  Z :        - 7 . 0985
UNIT    :        INCH
```

CONSTANT PITCH F 26

The function is used to process pieces having a constant machining pitch.
Let us suppose that 6 holes having a pitch of 13.75 mm have to be drilled.

Press **F** **26** **EXE**

INITIAL POINT	0.00 X
	0.00 Y
	0.00 Z
	0.00 W

The instrument signals to move the carriages until the origins of the first hole.

Press **EXE** and enter the value of the pitch

Axis X	0.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

Press **13.75** **EXE**

Axis X	13.75
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

The instrument goes on to consider the other axes. Enter the values or press EXE until the instrument quits the setting.

In the axis display area, the function status is displayed:
F26 - PITCH X: 0 →

To store the program set, assigning it a number (e.g. program 0),

Press [STORE] **0** [EXE]

STO. PRG. PITCH	0

☞ It is possible to store up to 10 programs (from 0 to 9).

To recall a previously set program,

Press [F] **26** [EXE] [REC]

RCL. PRG. PITCH	0

Enter the number of the program to be recalled.

To verify the program data,

Press [COR]

Axis X	13.75 mm
Axis Y	DISABLED
Axis Z	DISABLED
Axis W	DISABLED

Press [EXE] to start machining

0.00 X

Execute the first hole (the X axis display has to show the zero position; vice versa move the carriages to zero).

Press [X] and the X display shows the value **-13.75 X**

Go to zero with the carriage and make the second hole. Proceed as described until the workpiece has been completed.
Use the **CLR** key, if it is not necessary to repeat the operation for other pieces, otherwise use the **0** key. The display will show the value of the last position reached, that is:

13.75 x no. 5 pitches = 68.75

Return to zero with the carriage, press X and start over.

During machining, it is possible to invert the pitch direction for each axis.

Press [+/-] e.g. inversion of X axis direction

13.75 X

F26 - PITCH X: -1 ←

It is necessary to consider that:

A) The counting direction must be the same as the movement direction (if necessary, invert it with the **+/-** key while entering the pitch, therefore:
13.75 +/- EXE).

B) If a position is not reached accurately, the instrument avoids the formation of a cumulative error. The digital readout will in fact signal the correct values for the subsequent position to be reached.

AXIS COUPLING F 28

This function can be used to perform an algebraic sum of the movements of two carriages moving in parallel directions (e.g. the main carriage and the tool carriage of a lathe, the upright and the quill of a miller, etc.). If this function is activated (e.g. Z+W signaled in the axis display area), the operator can see the real position of the tool. If, for example, one carriage moves forwards and the other moves backwards by the same value, the counting does not change (the distance between the tool and the workpiece has not changed).
The instrument is configured by the Manufacturer as required by the application. It will be possible to reconfigure it, if different applications are required, asking for the access codes and procedures.

At the end of the installation, verify the following:

MACHINE	INSTRUMENT	AXES INPUT (see the rear panel)				AXES BEING ADDED ON DISPLAYS:
		X (In 1)	Y (In 2)	Z (In 3)	W (In 4)	
GENERIC	VI922IN	LONG.	TRANS.	--	--	**--**
GENERIC	VI933IN	LONG.	TRANS.	VERT.	--	**--**
LATHE	VI933TO	TRANS.	**Carriage**	**Tool Carriage**	--	**Y**
MILLING	VI933FR	LONG.	TRANS.	VERT.	--	**--**
MILLING	VI944FR	LONG.	TRANS.	VERT.	4thAXIS	**--**
MILLING	VI944FV	LONG.	TRANS.	**VERT.**	**Quill**	**Z**
MILLING	VI944FT	LONG.	**TRANS.**	VERT.	**Saddle**	**Y**
BORING	VI944AL	**LONG.**	TRANS.	VERT.	**Quill**	**X**
GENERIC	VI944IN	LONG.	TRANS.	VERT.	4thAXIS	**--**

☞ **1.** The axes being added together are shown in **bold**. The other configurations do not operate with the sum because this is not required by the application.

2. The axes to be added need to have the same counting direction, scale factors and incremental/decremental percentages. The linear correction factor, instead, can be different for each axis.

To enable/disable the axis coupling function,

Press **F** **28** **EXE**

AXIS COUPLING	YES

A graph with the indication of the axes under consideration will be displayed.

Press  to select

AXIS COUPLING	NO

Press **EXE** and the sum will be excluded

123.45	X

The instrument proceeds considering other sums that could be displayed. Proceed as described above, confirming the selection with the EXE key. At the end of the possible sums, the instrument quits the function.

The selected condition will be permanently stored until a new setting is entered.

LINEAR CORRECTION F 30

Machining errors can derive from geometrical defects of the machine due to wear, lack of linearity of the guides, coupling clearances between carriage and guide, badly distributed weights, etc. If these errors are linear, i.e. proportional to the movement executed, they can be compensated with the linear correction function.
The correction factor **CF** is calculated by the operator with the following formula:

$$CF = \frac{\textbf{MEASURED DIMENSION (measured with accuracy)}}{\textbf{DIMENSION AS PER DRAWING}}$$

Let us suppose that a machining has been performed, moving the X axis by 400.00 mm (value shown on the X axis displayed), but an error has been detected (positive or negative). For instance, the measured piece is either longer or shorter than intended. That means:

A) 400.20 mm **the workpiece is longer with an error of 200 µm**
B) 399.88 mm **the workpiece is shorter with an error of 120 µm**

in case **A** **CF =** 400.20 : 400.00 = 1.0005
in case **B** **CF =** 399.88 : 400.00 = 0.9997

To compensate for these errors,

Press **F** **30** **EXE**

Axis X	1.000000
Axis Y	1.000000
Axis Z	1.000000
Axis W	1.000000

To enter the correction factor on the X axis,

Press **1.0005** **EXE**

Axis X	1.000500
Axis Y	1.000000
Axis Z	1.000000
Axis W	1.000000

or press **0.9997** **EXE**

Axis X	0.999700
Axis Y	1.000000
Axis Z	1.000000
Axis W	1.000000

All the movements performed on the X axis will be compensated with the CF entered. Consider the remaining axes; confirm them with the EXE key or repeat the operation described above to enter a CF factor. At the end, all the displays will be enabled for counting.

☞ Instead of manually entering the CF value, the instrument can calculate it **automatically**, using the function **F 31** with a single segment.

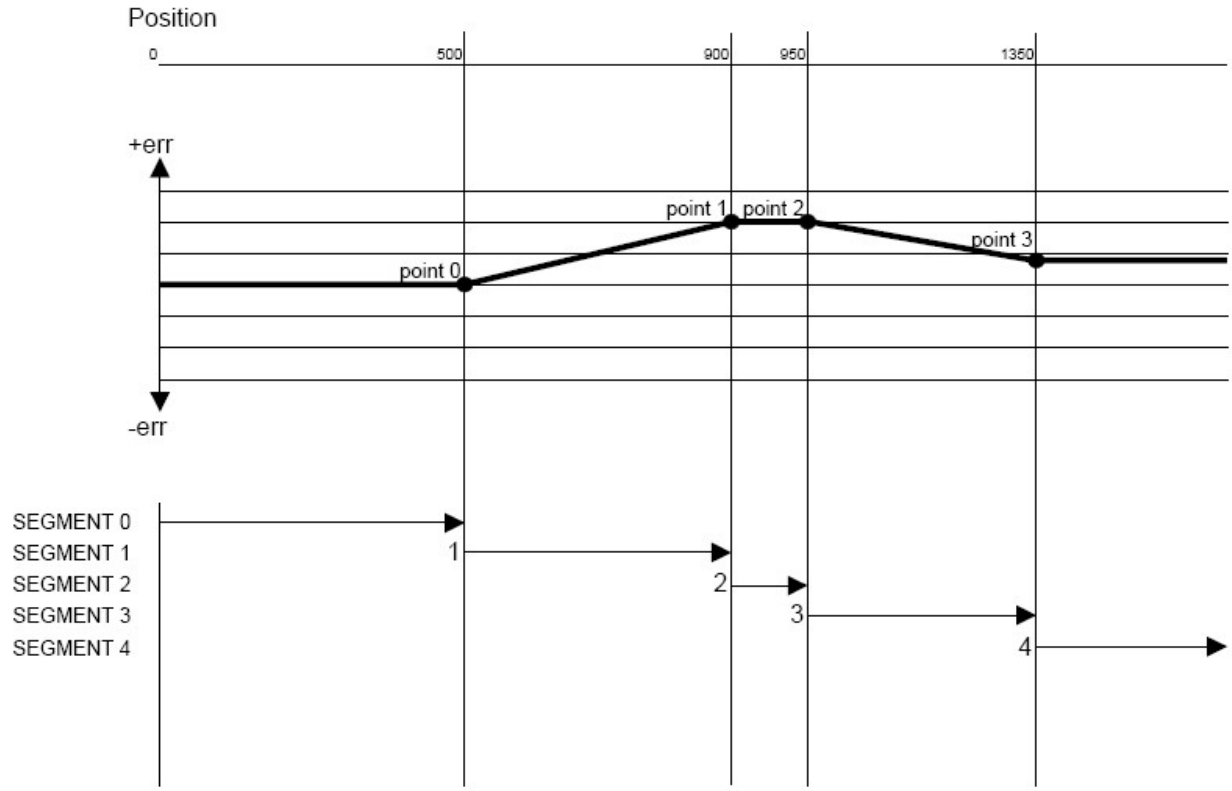
The linear correction function has the following characteristics:

1. it is permanently stored (it becomes a mechanical component of the activated axis);
2. it can always be modified, axis by axis, entering other **CF** values;
3. it can be disabled entering **CF = 1** or deleting the linear correction and the scale factor with the function **F 0**;
4. it can affect one or more axes with the same **CF**, or it can have different **CF** values for each axis;
5. it has priority over preset, reset, origins, scale factors, etc. functions.

☞ The correction must be entered before the other functions (which otherwise would be modified).

NON-LINEAR CORRECTION F 31

If the machining errors are linear, but proportional only for some segments to the movement executed, it is possible to use the non-linear correction function. The different correction factors **CF** applied are automatically calculated based on the positions that delimit the segments (**up to 10 segments**), defined by the operator. Let us suppose we have checked the positions on the X axis (shown by the X axis display) and we have found a positive error if machining occurs between the positions 500 mm and 900 mm. Similarly, we found a negative error while machining between 950 mm and 1350 mm.
Therefore, our machine has a geometrical defect on two segments (from 500 mm to 900 mm and from 950 mm to 1350 mm), as shown by the example in the figure:



segment **1) 400.20 mm** **with an error of 200 µm**
segment **3) 399.88 mm** **with an error of 120 µm**

in segment **1** **CF =** 400.20 : 400.00 = 1.0005
in segment **3** **CF =** 399.88 : 400.00 = 0.9997
in segment **0, 2, 4** **CF =** 1.0000

To activate the correction on one or more axes,

Press **F** **31** **EXE**

Axis X	NO
Axis Y	NO
Axis Z	NO
Axis W	NO

Press ± to select

Axis X	YES
Axis Y	NO
Axis Z	NO
Axis W	NO

Press **EXE** the display proceeds to examine the next axis, e.g.:

Axis X	YES
Axis Y	NO
Axis Z	NO
Axis W	NO

Complete the selection on all the axes (X, Y, Z and W).

To enter the positions necessary to identify the various segments on the axis,

Press COR during the axis selection, e.g. X axis

123.45 X

Go on the starting point of the segments “Point 0” (e.g. 500 mm) and press the **EXE** key

500.00 X

The display will reset. Go on the final point of the segment Point 1.

In our case, make a movement of 400 mm

400.00 X

Enter the value of the real measured movement.

For instance, enter the real value of the piece: 400.20 mm

400.20 X

Press EXE the display resets. Go on the final point of the next segment

50.00 X

Enter the measured movement value or press EXE to confirm the value displayed.

In our example, the real movement corresponds to the position displayed

50.00 X

Press EXE the display resets. Go on the final point of the next segment

400.00 X

Enter the measured movement value.

In our example, enter the real value of the piece: 399.88 mm

399.88 X

Press EXE the display resets. Go on the final point of the next segment

0.00 X

or press CLR to quit programming

Axis X	YES
Axis Y	NO
Axis Z	NO
Axis W	NO

Complete the selection on all the axes (X, Y, Z and W).

1. The correction is permanently stored (it becomes a mechanical component of the activated axis) and it is linked to the REF.
2. To operate correctly, it is necessary to perform always the zero reference (REF) search on the axes where the correction is enabled.
3. To display the CF used, based on the physical position of the scale, it is possible to use the function F 30 without digiting a new value.
4. If enabled, the non-linear correction takes priority over the linear correction function (F 30).
5. As the linear correction, the non-linear correction takes priority over the functions of preset, reset, origins, scale factor, etc.
6. The positions needed to identify the segments have to be programmed before the other functions (that would be otherwise modified).
7. To disable the non-linear correction on one or more axes, select NO in the function's main page. Alternatively, it is possible to set the CF value at 1 for all the segments.
8. The positions need to be programmed with the axis in incremental counting mode.
9. The function F 31 and the segments programming can be recalled only if the axis coupling is disabled (see function F 28). Once programming has been concluded, the sum can be reactivated.
10. Once the COR key has been pressed to enter programming, the previous segments are deleted.

SCALE FACTOR F 32

This function can be used to realize workpieces with scale factors **SF** defined by the operator. It is possible to execute:

- **reduction scales**	**1 : 2.5**	**(SF = 2.5)**		**1 : 4**	**(SF = 4)**	**etc.**
- **enlargement scales**	**2 : 1**	**(SF = 0.5)**		**4 : 1**	**(SF = 0.25)**	**etc.**
- **% of increase (*)**	**+ 10%**	**(SF = 0.9)**		**+ 15%**	**(SF = 0.85)**	**etc.**
- **% of decrease (*)**	**- 10%**	**(SF = 1.1)**		**- 15%**	**(SF = 1.15)**	**etc.**

(*) *Used to determine shortening or lengthening percentages.*

The function works in both ABS or INC counting modes. It is disabled (the instrument goes back to the scale factor 1 : 1) when the instrument is switched off. However, the scale factor remains stored and it can be quickly retrieved.
If an OFFSET is required, it must be set after entering the scale factor, to prevent interpretation errors (the OFFSET already entered will be moved by the same scale factor).

To activate the function,

Press **F** **32** **EXE**

Press  to select

SCALE FACTOR	YES

Press **EXE** the display shows the current **SF**, e.g.:

SCALE FACTOR	1.000000

To introduce the reduction scale 1 : 2.5

Press **2.5** **EXE**

1 2 3 . 4 5

The function is confirmed and activated for all the axes.
It is not possible to activate it separately for each single axis.

RADIUS/DIAMETER CONVERSION F 34

The function can be used to select the required reading mode, for each single axis.

Press **F** **34** **EXE**

Axis X	Rad.
Axis Y	Rad.
Axis Z	Rad.
Axis W	Rad.

To change the reading mode,

Press  to select

Axis X	Dia.
Axis Y	Rad.
Axis Z	Rad.
Axis W	Rad.

Press **EXE** the display proceeds to examine the next axis

Axis X	Dia.
Axis Y	Rad.
Axis Z	Rad.
Axis W	Rad.

Proceeds accordingly to confirm or modify the other axes settings. After the last confirmation with the EXE key, the displays will be enabled for counting. The symbol ⌀ is displayed on the axes set in diametral reading.
While choosing the reading mode, consider that:

A) RADIAL READING: the display shows the same value of the carriage movement. This is the most common reading mode.

B) DIAMETRAL READING: the display shows a value that is the **double** of the carriage movement. This reading mode is typically used for the transversal axes of lathes. In fact, if the tool advances by 1 mm, the workpiece diameter decreases by 2 mm.

1. The unit of measurement can be switched from MM to INCHES and vice versa in both reading modes.
2. The permanently lighted symbol ⌀ indicates that the axis is in diametral reading.
3. Any previous OFFSET setting is disabled since it is altered by the reading mode selected. On the contrary, the reference positions are retained.
4. In the instruments operating with axis coupling, the axes being added need to have the same reading mode.

VARIABLE RESOLUTION F 36

The instrument shows on the displays the resolutions initially programmed by the Manufacturer (these correspond to the resolutions of the measuring systems). If the machining can be facilitated by a lower resolution (e.g. roughing machining), the operator can decrease it.

Press **F** **36** **EXE**

Axis X	0.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

Press **+/-**

Axis X	0.0
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

At any pressure, the decimal point shifts to the lower resolution. Confirm it with the EXE key. Then, the instrument considers the other axes. Proceed as described to change or confirm the values. When switched on again, the instrument returns to the original resolution.

The function F 36 does not modify the number of decimals displayed; the decimals considered unnecessary will be kept at 0. To decrease/increase the number of decimals displayed, see the function **F 98760**.

SEXAGESIMAL DEGREES READING F 37

The angular reading, expressed in sexagesimal degrees, can be selected with the function F 37.

Press **F** **37** **EXE**

DMS	NO

Press +/- to select

DMS	YES

Press EXE to confirm the selection

0. 0 0. 0 0

On the axis displays set in angular reading, degrees will be expressed as: **DDD.MM.SS.** The resolution depends on the number of encoder pulses (PPR).

1. The selection is stored permanently.
2. To preset a new value, enter the degrees, press the decimal point and introduce minutes and seconds. The value will be automatically adapted to the resolution in use.

ANGULAR READING F 38

On request, the instrument can be configured by the Manufacturer with one or more axes in angular reading. The axes concerned are linked to rotary encoders and the symbol ANG is shown on the display. The resolution depends on the number of encoder pulses (PPR). The instrument calculates exactly the following formula:

$\frac{360°}{PPR \times 4}$ and selects, among the available resolutions, the one closest to the calculated value.

POSSIBLE RESOLUTIONS: **1° - 0.5° - 0.2° - 0.1° - 0.05° - 0.02° - 0.01° - 0.005° - 0.002° - 0.001°**

The highest possible resolution is 3.6 seconds of an arc (0.001°), that can be obtained with an encoder having 90000 PPR.

If the instrument has been configured by the Manufacturer in angular reading, the operator can select the reading mode:

A) ANGLE from 0° to 360°.
B) ANGLE from 0° to 180° in positive field and from -180° to 0° in negative field.

To switch from one reading mode to the other,

Press F 38 EXE

ANGULAR READING	0 - 360°

Press +/- to select

ANGULAR READING	+ / - 180°

Press EXE to confirm the selection

0. 0 0

1. The selection is stored permanently.
2. All the functions linked to the linear reading cannot be executed, e.g.:
   MM/INCH - CONSTANT PITCH - AXIS COUPLING - LINEAR CORRECTION - NON-LINEAR CORRECTION - SCALE FACTOR - RADIUS/DIAMETER CONVERSION.
3. The instrument will never incur into an “overflow” error because counting is reset after each rotation (or half-rotation) of the encoder.

TAPER CALCULATION F 44

With this function it is possible to calculate tapers, when both diameters and their distance are known.

Let us suppose that a workpiece with the following dimensions has to be machined:

ø1 = 60 mm **ø2 = 80 mm** **L = 190 mm**

Press	F	44	EXE	MIN. DIAMETER	
Enter **ø1**	60		EXE	MIN. DIAMETER MAX. DIAMETER	60
Enter **ø2**	80		EXE	MIN. DIAMETER MAX. DIAMETER LENGTH	60 80
Enter **L**	190		EXE	MIN. DIAMETER MAX. DIAMETER LENGTH >> ANGLE <<	60 80 190 3.013°

Skewing the tool carriage by **3.013 °** the workpiece with the desired dimensions can be realized.

Press CLR to quit the function

123.45

AUTOMATIC TAPER CALCULATION F 46

The function is used to calculate the taper of a workpiece already produced. Lightly touching the minimum and the maximum diameter of the piece, the instrument displays the inclination angle of the taper.

Press **F** **46** **EXE**

MIN. DIAMETER	0.00 X

Move the carriages and lightly touch the workpiece's minimum diameter with the tool.
E.g. 60 mm

Press **EXE**

MIN. DIAMETER	60.00 X
MAX. DIAMETER	60.00 X
LENGTH	0.00 Y

Move the carriages and lightly touch the workpiece's maximum diameter with the tool.
E.g. 80 mm, L= 190 mm

Press **EXE**

MIN. DIAMETER	60.00 X
MAX. DIAMETER	80.00 X
LENGTH	190.00 Y
>> ANGLE <<	3.013°

The display shows the inclination angle of the taper.

Press **CLR** to quit the function

123.45

THREADS CALCULATION F 48

This function can be used to calculate the necessary parameters for threads machining, both in metric system (ISO) and inches (WHITWORTH).

Let us suppose a thread has to be machined.

Press **F** **48** **EXE**

SELECT THREAD	- ISO STANDARD

with the key **+/-** select ISO or WHITWORTH

SELECT THREAD	- ISO STANDARD

Press **EXE**

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	

Enter the desired diameter, e.g. 6 mm.

Press **6** **EXE**

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	6
PITCH (mm)	

Enter the thread pitch, e.g. 1 mm.

Press **1** **EXE**

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	6
PITCH (mm)	1
SCREW TOOL RAD.	0.144338 mm

Continuing with **EXE**

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	6
PITCH (mm)	1
HOLE TOOL RAD.	0.072169 mm

the instrument provides all the values necessary for the thread machining

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	6
PITCH (mm)	1
HOLE INT. DIAM.	4.91747 mm

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	6
PITCH (mm)	1
HOLE. EXT. DIAM.	6.072169 mm

SELECT THREAD	- ISO STANDARD
DIAMETER (mm)	6
PITCH (mm)	1
WEB DIAMETER	4.77313 mm

Press **CLR** to quit the function

123.45

MATERIAL WEIGHT CALCULATION F 50

With this function it is possible to calculate the weight of a workpiece.

Press **F** **50** **EXE**

SELECT MATERIAL	- ALUMINIUM

Press **+/-** to select the material and press **EXE**

SELECT MATERIAL	- STEEL

Enter the data required by the instrument. At the end of the operation, the display will show the weight of the material in kg.

SELECTABLE MATERIALS AND GEOMETRICAL SHAPES:

MATERIAL: *Aluminium, steel, brass, bronze.*
GEOMETRICAL SHAPE: *Round, square, hexagon, flat, round pipe, square pipe, rectangular pipe.*

☞ It is possible to set the density of any material, including alloys.

Press **F** **50** **EXE**

SELECT MATERIAL	- ALUMINIUM

Press **COR**

NEW DENSITY

Enter the density (e.g. 3.2).

Press **3.2** **EXE**

DENSITY VALUE	3.2
GEOM. SHAPE	- ROUND

Proceed as described above until the piece weight has been determined.

Press **CLR** to quit the function

1 2 3 . 4 5

☞ To store the density, press **STORE**, enter the program number (from 0 to 9) and confirm it with **EXE**.

To recall a program, e.g. no. **4**, enter:

F 50 EXE REC 4 EXE.

To verify the data of the program, use the **COR** key.

PERIPHERAL SPEED CALCULATION F 52

With this function it is possible to calculate the peripheral speed, given the piece diameter and its rotation speed expressed in **revolutions/minute** (RPM).

Press **F** **52** **EXE**

ENTER RPM VALUE

Enter the rotation speed of the workpiece. E.g. 50 RPM.

Press **50** **EXE**

ENTER RPM VALUE	50
ENTER DIAMETER	

Enter the workpiece diameter. E.g. 200 mm.

Press **200** **EXE**

ENTER RPM VALUE	50
ENTER DIAMETER	200
SPEED (m/min)	31.416

31.416 m/min. is the peripheral speed of a workpiece with a diameter of 200 mm that rotates at a speed of 50 RPM.

Press **CLR** to quit the function

1 2 3 . 4 5

ANGULAR SPEED CALCULATION F 54

This function is used to calculate the angular speed, given the workpiece diameter and the peripheral speed, expressed in m/min.

Press **F** **54** **EXE**

ENTER SPEED VAL.

The instrument requires the cutting speed, recommended by the tool manufacturer, in m/min. E.g. 70 m/min.

Press **70** **EXE**

ENTER SPEED VAL.	70
ENTER DIAMETER	

Enter the workpiece diameter. E.g. 100 mm.

Press **100** **EXE**

ENTER SPEED VAL.	50
ENTER DIAMETER	100
SPEED (RPM)	222.817

222.817 is the result of the theoretical calculation made by the instrument. This result will be displayed considering the type of spindle rotation speed that has been set.

TYPE OF SPINDLE ROTATION SPEED	SPEED VALUE DISPLAYED
INDEFINITE	The instrument displays the rotation speed closest to the calculated one.
CONTINUOUS	The instrument displays the rotation speed closest to the calculated one, with the exception of the rotation speeds below or above the allowed ones (the instrument displays the limit values).
DISCRETE	The instrument displays the rotation speed closest to the calculated one, selecting among the rotation speeds previously set.

For details on setting the instrument in INDEFINITE, CONTINUOUS or DISCRETE modes, see function **F 98718.**

Press CLR to quit the function

123.45

ENABLING THE AUTOMATIC TRANSMISSION OF POSITIONS F 55

Function F 55 is used to enable the automatic transmission of displayed positions on serial output.

Press F 55 EXE

Send NO

Press +/- to select

Send YES

Press EXE to confirm the selection

57.0865 X

Data on ABS or INC positions (e.g. X= 57.0865, Y= 10.8480, Z= -7.0985) are sent every 0.5 sec. in ASCII mode and have the following format:
11 data characters + 2 control characters.

“ 57.0865” + CR + LF
“ 10.8480” + CR + LF
“ -7.0985” + CR + LF

where: **CR = CARRIAGE RETURN (0Dh)**
LF = LINE FEED (0Ah)

ROUND FLANGE F 64

With this function it is possible to make a series of holes along a circumference.

Let us suppose that we need to make 4 holes on a flange with 100 mm diameter.

Press **F** **64** **EXE**

CENTER POINT	0.00 X
	0.00 Y

The instrument indicates to move the carriages and reach the circumference center.

Press **EXE**

ENTER DIAMETER

Enter the piece diameter. E.g. 100 mm.

Press **100** **EXE**

ENTER DIAMETER	100
STARTING ANGLE	

Enter the starting angle (degrees and hundredths of a degree). E.g. 0°.

Press **0** **EXE**

ENTER DIAMETER	100
STARTING ANGLE	0
NUMBER OF POINTS	

Enter the number of holes. E.g. 4.

Press **4** **EXE**

-50.00	**X**
0.00	**Y**

The program has been completed.

In the axis display area, the function status is displayed:
F64 - POINT 1

To store the program set, assigning it a number (e.g. program 0),

Press STORE **0** EXE

STO. ROUND FL.	0

☞ It is possible to store up to 10 programs (from 0 to 9).

THE DISPLAYS INDICATE X -50.00 Y 0.00.

Reach zero with the carriages, and drill the first hole. Proceed as described until the workpiece has been completed. Press **CLR** if it is not necessary to repeat the operation for other pieces, otherwise press **EXE**.

To recall a previously set program,

Press F **64** EXE REC

RCL. ROUND FL.	0

Enter the number of the program to be recalled.

To verify the program data,

Press COR

DIAMETER	100 mm
STARTING ANGLE	0 °
NUMBER OF POINTS	4

Press EXE to start machining

-50.00	X
0.00	Y

Press CLR to quit the function

123.45

SPECIAL ROUND FLANGE F 66

This function can be used to drill a series of holes along an arc of circumference.
Let us suppose that 3 holes have to be drilled.

Press F **66** EXE

CENTER POINT	0.00 X
	0.00 Y

The instrument indicates to move the carriages and reach the circumference center.

Press **EXE**

ENTER DIAMETER

Enter the piece diameter. E.g. 100 mm.

Press **100** **EXE**

ENTER DIAMETER 100
STARTING ANGLE

Enter the starting angle (degrees and hundredths of a degree). E.g. 0°.

Press **0** **EXE**

ENTER DIAMETER 100
STARTING ANGLE 0
FINAL ANGLE

Enter the final angle (degrees and hundredths of a degree). E.g. 180°.

Press **180** **EXE**

ENTER DIAMETER 100
STARTING ANGLE 0
FINAL ANGLE 180
NUMBER OF POINTS

Enter the number of holes. E.g. 3.

Press **3** **EXE**

-50.00 X
0.00 Y

The program has been completed.
In the axis display area, the function status is displayed:
F66 - POINT 1

To store the program set, assigning it a number (e.g. program 0),

Press **STORE** **0** **EXE**

STO. SP.RND.FL. 0

☞ It is possible to store up to 10 programs (from 0 to 9).

THE DISPLAYS INDICATE X -50.00 Y 0.00.

Reach zero with the carriages, and drill the first hole. Proceed as described until the workpiece has been completed. Press **CLR** if it is not necessary to repeat the operation for other pieces, otherwise press **EXE**.

To recall a previously set program,

Press **F** **66** **EXE** REC

RCL. SP.RND.FL.	0

Enter the number of the program to be recalled.
To verify the program data,

Press COR

ENTER DIAMETER	100 mm
STARTING ANGLE	0 °
FINAL ANGLE	180 °
NUMBER OF POINTS	3

Press **EXE** to start machining

-50.00	X
0.00	Y

Press CLR to quit the function

123.45

INCLINED CONSTANT PITCH F 68

This function can be used to drill a series of holes with a constant pitch along an inclined axis with respect to the X axis (**the inclination is possible only as compared to the X and Y axes**). Let us suppose that a series of holes has to be drilled, at a constant pitch of 100 mm on the X axis.

Press **F** **68** **EXE**

INITIAL POINT	0.00 X
	0.00 Y
	0.00 Z
	0.00 W

The instrument indicates to move the carriages until the origins of the first hole.

Press **EXE** and enter the pitch value

Axis X	0.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

Press **100** **EXE**

Axis X	100.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

The instrument proceeds to consider the other axes.
Press EXE to set the pitches of the Y, Z, W axes at 0.

Axis X	100.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00
ENTER ANGLE	0.00

Enter the inclination angle (degrees and hundredths of a degree). E.g. 45°.

Press **45** **EXE**

0.00 X

The program has been completed.
In the axis display area, the function status is displayed:
F68 - PITCH X: 0 →

To store the program set, assigning it a number (e.g. program 0),

Press STORE **0** **EXE**

STO. PRG.INC.P.	0

☞ It is possible to store up to 10 programs (from 0 to 9).

To recall a previously set program,

Press **F** **68** **EXE** REC

RCL. PRG.INC.P.	0

Enter the number of the program to be recalled.
To verify the program data,

Press COR

Axis X	100.00 mm
Axis Y	DISABLED
Axis Z	DISABLED
Axis W	DISABLED
X Y ANGLE	45.00 °

Press **EXE** to start machining

0.00 X

Press X to start drilling the first hole

-70.71 X

-70.71 Y

Reach zero with the carriages, and drill the first hole. Proceed as described until the workpiece has been completed. Press **CLR** if it is not necessary to repeat the operation for other pieces, otherwise press **0**. The display will show the value of the movements to be performed to reach the starting point.

During machining, it is possible to invert the direction of the pitches for each single axis.

Press  e.g. inversion of direction

70.71	X
70.71	Y

F68 - PITCH X: -1 ←

It is necessary to consider that:

A) The counting direction has to be the same as the movement direction (if necessary, use the **+/-** key to invert it while entering the pitch, that is: **100.00 +/- EXE**).

B) If a position is not reached accurately, the instrument avoids the formation of a cumulative error. The digital readout will in fact signal the correct values for the subsequent position to be reached.

C) It is not possible to perform any other function during this operation.

ZERO APPROACHING ALERT F 69

To simplify those machinings where the position to be reached is 0 mm (or inches), it is possible to set a machining window, so that the instrument signals the zero approaching. Let us suppose the following alert window has to be set:

X axis = 1.5 mm
Y = Z = W axis = 0 mm (no window)

Press **F** **69** **EXE**

Axis X	0.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

Press **1.5** **EXE**

Axis X	1.50
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

The instrument proceeds to consider the other axes. Press **EXE** to set the windows for the Y, Z, W axes at 0.

Axis X	1.50
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

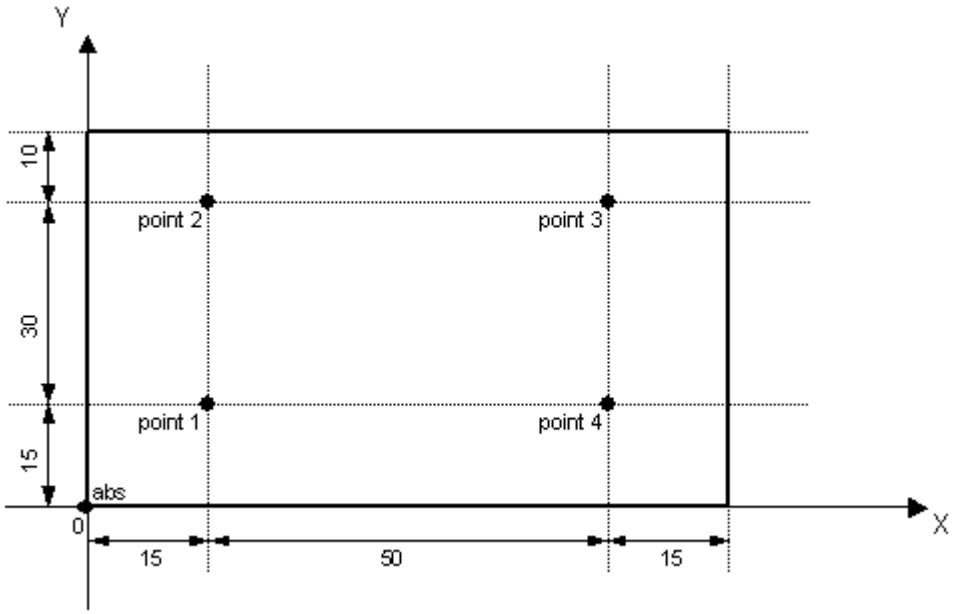
After the last confirmation with the EXE key, the displays will be enabled for counting.
All the movements performed on the X axis will be signaled if the position reaches the programmed machining window (e.g. ± 1.5 mm).

1. The function is active only for axes in linear reading mode.
2. The window set on one axis is stored permanently.
3. To disable signaling on one or more axes, set the window = 0.
4. Alert consists of the symbol ◂ displayed next to the axis position, and of a single beep alert produced at any passage inside the window.
5. When 0 is reached, the visual alert stops.

PROGRAMMING THE MEMORY BLOCKS F 70

This function allows to store up to 1000 memory blocks, containing the positions of the axes (X, Y, Z, W), in **incremental** counting mode.
When repetitive operations are to be carried out, it is possible to program a sequence of blocks that could be recalled when needed.

Let us suppose that 4 holes have to be drilled, as in the picture:

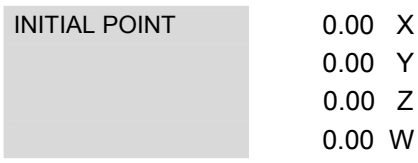


Press **F** **70** **EXE**

INITIAL POINT	0.00 X
	0.00 Y
	0.00 Z
	0.00 W

The instrument indicates to move the carriages to reach the initial machining point (abs).
While using the function **F 70**, the axes involved in the machining will be bound and it will not be possible to perform operations such as set, preset, etc. In this phase, it is possible to exclude the axes that are not to be considered.

E.g. press [Z] and [W] to exclude Z and W (axis keys not active)



Move on the X and Y axes to reach the initial point (abs).

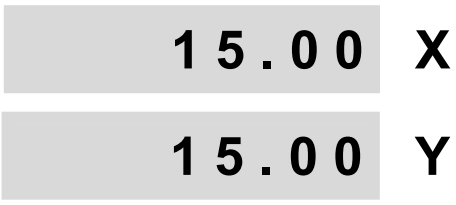
Press **EXE** and enter the memory number (e.g. 10)

Press STORE to enter the memory blocks storage

X and Y axes are set in **incremental** counting and at the value of X = 0.00 and Y = 0.00.
In the axis display area, the function status is displayed:
F70 - MEMORY 10

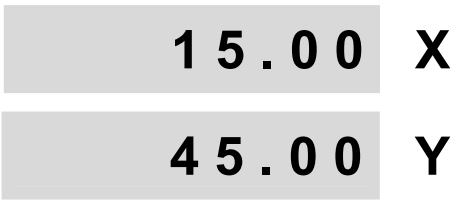
Reach the position X = 15.00 and Y = 15.00 (point 1 of the machining).

Press **EXE** to store the X and Y positions in memory no. 10



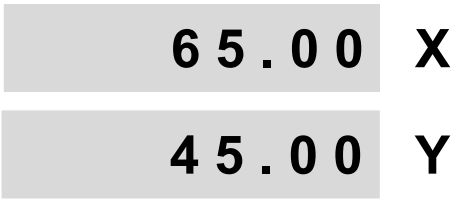
Reach the position X = 15.00 and Y = 45.00 (point 2 of the machining).

Press **EXE** to store the X and Y positions in memory no. 11



Reach the position X = 65.00 and Y = 45.00 (point 3 of the machining).

Press **EXE** to store the X and Y positions in memory no. 12



Reach the position X = 65.00 and Y = 15.00 (point 4 of the machining).

Press **EXE** to store the X and Y positions in memory no. 13

65.00 X
15.00 Y

Press **CLR** to quit the function

123.45

A machining program has been created and stored in the memory blocks from no. 10 to no. 13.
When it is necessary to repeat a previously stored machining, position the workpiece and recall the initial memory block (e.g. memory no. 10):

Press **F** **70** **EXE**

INITIAL POINT
0.00 X
0.00 Y
0.00 Z
0.00 W

Move the carriages to reach the initial machining point (abs).

E.g. press **Z** and **W** to exclude Z and W (axis keys not active)

INITIAL POINT
0.00 X
0.00 Y
0.00 Z
0.00 W

Position accurately the X and Y axes in the initial point (abs).

Press **EXE** enter the memory number to be executed (e.g. 10)

SdM 10

Press **REC** to enter the memory blocks execution

0.00 X
0.00 Y

X and Y axes are set in **incremental** counting and the distance to the first point will be displayed (memory no. 10).

-15.00 X
-15.00 Y

Reach the position X = 0.00 and Y = 0.00 (point 1 of the machining) and drill the first hole.

Press  to recall the X and Y positions in memory no. 11

0.00 X

-30.00 Y

Reach the position X = 0.00 and Y = 0.00 (point 2 of the machining) and drill the second hole.

Press  to recall the X and Y positions in memory no. 12

-50.00 X

0.00 Y

Reach the position X = 0.00 and Y = 0.00 (point 3 of the machining) and drill the third hole.

Press  to recall the X and Y positions in memory no. 13

0.00 X

30.00 Y

Reach the position X = 0.00 and Y = 0.00 (point 4 of the machining) and drill the fourth hole.

To return to a previous hole (e.g. from point 4 to point 3):

Press  to recall the X and Y positions in memory no. 12

0.00 X

-30.00 Y

At the end, to repeat the machining, position a new workpiece:

Press  the displays show the distance to reach point 1

50.00 X

0.00 Y

Reach the position X = 0.00 and Y = 0.00 (point 1 of the machining) and drill the first hole.
Drill the next holes for all the workpieces.
After completing all the workpieces,

Press CLR to quit the function

123.45

1. It is possible to store 1000 memory blocks (from 0 to 999).
2. To modify one or more memory blocks, enter new positions during programming.
3. It is not possible to add one or more blocks within an already stored machining program. If necessary, store newly the program, starting from a free memory block.
4. It is not possible to delete the blocks of an entire program. If necessary, use the blocks to store a new program.

CIRCUMFERENCE CENTER F 72

With this function, it is possible to find the CENTER of a circle, by touching with the tool 3 points of its circumference.

Press F 72 EXE

0.00 X

0.00 Y

In the axis display area, the function status is displayed:
F72 - POINT 1

Move the carriages and lightly touch any point of the circle.

Press EXE

123.45 X

123.45 Y

F72 - POINT 2

Move the carriages (45° minimum) and lightly touch the second point.

Press EXE

123.45 X

123.45 Y

F72 - POINT 3

Move the carriages (45° minimum) and lightly touch the third point.

Press **EXE** the display will show the necessary movement to reach the circumference center (position 0.00)

F72 - X CENTER VALUE 0.00 mm

Press EXE to display the values of X, Y and Radius.

Move the carriages to reach the indicated X and Y positions.

Press **CLR** to quit the function

123.45

MIRROR IMAGE F 74

This function can be used to reverse the sign of the coordinates of the following programs: Constant Pitch, Inclined Constant Pitch, Memory Blocks.
This function can be carried out only if these programs have been previously stored.

Press **F** **74** **EXE**

Axis X	Nor.
Axis Y	Nor.
Axis Z	Nor.
Axis W	Nor.

Press **+/-**

Axis X	Spec.
Axis Y	Nor.
Axis Z	Nor.
Axis W	Nor.

Press **EXE** the display proceeds to examine the next axis

Axis X	Spec.
Axis Y	Nor.
Axis Z	Nor.
Axis W	Nor.

The selection is confirmed and the instrument automatically proceeds to consider the following axis. Proceed accordingly to confirm or modify the other axes setting. After the last confirmation with the EXE key, the displays will be enabled for counting.

☞ When turning on the instrument, in the axis display area, it is possible to see the NOR. or SPEC. status for around 1 second, depending on whether the axes are set in “Normal” or “Specular” mode.

SCALE FACTOR DISPLAYING F 78

With this function, it is possible to display the scale factor set. Let us suppose that a scale factor has been set with function **F 32**.

Press **F** **78** **EXE**

SCALE FACT. DISP.	NO

Press ± to select

SCALE FACT. DISP.	YES

Press **EXE** to confirm the selection

1 2 3 .4 5

In the axis display area, the scale factor is displayed. E.g. reduction scale 1 : 2.5

SF= 2.500000

1. The function remains active when the instrument is switched off.
2. If function F 78 is selected, the display shows the scale factor even when other functions are activated (e.g. axis speed displaying).

AXIS SPEED DISPLAYING F 80

With this function it is possible to display the translation speed of the axes.

Press **F** **80** **EXE**

ENABLE SPEED	NO

Press ± to select

ENABLE SPEED	YES

Press **EXE** to confirm the selection

1 2 3 .4 5

In the axis display area, the translation speed is displayed, expressed in m/min.

X 0.000 Y 0.000 Z 0.000 W 0.000

1. The function remains active when the instrument is switched off.
2. Function F 78 has priority over function F 80. If the function F 78 is selected, the display will show the scale factor even if the axis speed displaying is enabled.

BUZZER ON/OFF F 82

The instrument emits an acoustic alert in some situations (e.g. pressing a key, signaling an error, etc.).
It is possible to disable the acoustic alerts with the function **F 82**.

Press **F** **82** **EXE**

BUZZER	ON

Press +/- to select

BUZZER	OFF

Press **EXE** to confirm the selection

1 2 3 .4 5

In the status area, a signaling icon indicates the buzzer status.

= buzzer ON

= buzzer OFF

DEVICE DIAGNOSTIC F 89

With this function it is possible to verify the correct functioning of: scales, keyboard, display, touch panel.

Press **F** **89** **EXE**

Axis X	0.00
Axis Y	0.00
Axis Z	0.00
Axis W	0.00

1) Scales test

This test permits the control of the correct reading of the selected scales, highlighted in reverse.

☞ The control can be performed only for scales with coded-distance reference indexes, at a maximum translation speed of 6 m/min.
Avoid performing any machining during the scales test, since exceeding the maximum translation speed may result in errors in the displayed positions.

When moving, if a reading error is detected on one or more scales (e.g. due to dirt), the following message is displayed in the status area (e.g. error on the Z axis):

Fault Z

The message is displayed at any passage on the error area.

2) Keyboard test

Press **EXE** the code of the pressed key will be displayed CODE 000

Press all the keys and verify that to each key corresponds its code, as indicated in the table below:

Key	Code	Key	Code	Key	Code	Key	Code	Key	Code
0	108	4	201	8	102	↑	001	F	401
1	301	5	202	9	104	↓	002	CLR	
2	302	6	204	.	208	→	008	EXE	
3	304	7	101	+/-	308	←	004		

Example:

Press +/- CODE 308

Press **F** CODE 401

3) Display test

Press **EXE**

If the display works correctly, the following screens in the basic colors will be displayed clearly: Vertical stripes, Horizontal stripes, Red, Green, Blue, Cyan, Magenta, Yellow, Black and White.

4) Touch Panel test

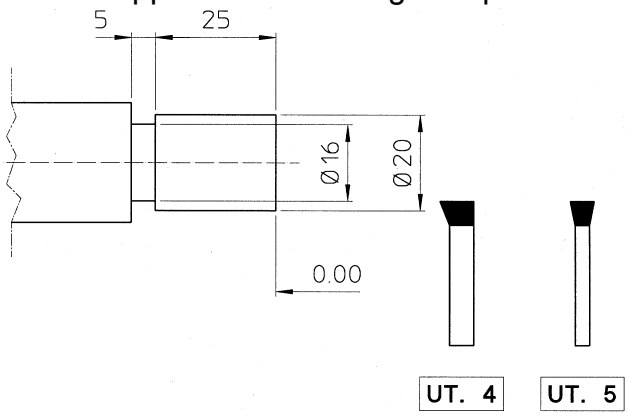
Press **EXE**

An 8x8 grid will be displayed. Touch the squares with the touch-pen; the touch panel works correctly if the corresponding square lights up.

Press **CLR** to quit the function 123.45

100 TOOL OFFSETS

With this function it is possible to store up to 100 tools (0-99). The cutting position of each tool is linked to the scales **REF** and it is always traceable after a power disconnection.
Let us suppose the following workpiece has to be machined:



☞ For simplicity, only the Y axis and two tools are considered.

Perform the zero REF search, as described in the corresponding paragraph. With the tool **no. 4** lightly touch the workpiece, moving the carriage along the Y axis and reset it (or preset it).

Press TOOLS **4** STORE TOOL OFFSET 4

and the position of the tool **no. 4** is acquired.
Change the tool and lightly touch the workpiece again. Reset (or preset) the Y axis.

Press TOOLS **5** STORE TOOL OFFSET 5

and the position of the tool **no. 5** is acquired. Proceed as described for any other tool.

Execute the machining, recalling the tools, i.e.:

Press TOOLS **4** REC TOOL OFFSET 4

Move the carriage until the **0.00** position (or until the preset value) and proceed with the machining.

☞ The OFFSETS can be recalled only if previously set. They are disabled to prevent errors when the operator changes the scale factor, the linear correction or a basic configuration of the instrument.

In the status area, a signaling indicating the tool set is displayed.

T: 4 e.g. tool no. 4

While storing/recalling the tool offsets, it is possible to recall a list of the tools already stored.

Example:

Press TOOLS LIST

TOOL OFFSET 4

a summary page is displayed, containing the offset positions of the tools, in groups of 5.
It is possible to store and recall the offsets directly from the list, using the STORE and REC keys respectively.

Use  to select the tools (0-99) pages.

Use  to select a tool in a given page.

To delete a tool from the list, select it with the arrow keys and press DEL.
A confirmation will be required; select YES with the +/- key and confirm with EXE.

100 ORIGINS OF THE AXES

With this function (in **ABSOLUTE** counting) it is possible to store up to 100 starting positions for machining (origin 0-99). These machining origins are linked to the scales **REF** and they are always traceable after a power disconnection.
Let us suppose that some origins have to be set and stored.

Switch the counting mode to ABSOLUTE (see absolute/incremental counting).

Perform the zero REF search, position the carriages on the first machining origin and enter the desired number of the origin (e.g. 1):

Press ORG **1** STORE

ORIGINS 1

and the origin no. 1 is stored.
To recall previously stored origins,

Press ORG **1** REC

ORIGINS 1

Position the carriages on **0.00** and proceed with the machining. In case of power failures, perform the REF search and proceed as described above.

☞ The ORIGINS can be recalled only if previously set. They are disabled to prevent errors when the operator changes the scale factor, the linear correction or a basic configuration of the instrument.

In the status area, a signal indicating the origin set is displayed.

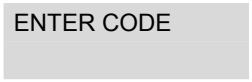
e.g. origin no. 1

SPECIAL FUNCTIONS RECALL F 1 - F 8

The instrument allows the operator to quickly recall up to 8 frequently used functions.
Let us suppose that the function CONSTANT PITCH has to be frequently used. Usually, it is activated as described in the paragraph dedicated to function **F 26**. It may be convenient to dedicate a key (e.g. **F1**) to recall this function.

Press 

26 



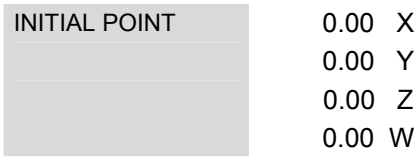
☞ To display the keys from F5 to F8 use the key  . To return to F1 - F4 displaying, press  .

In the status area, a signal indicating the key page is displayed:

e.g. page 1 of 2

From now on, to enable the function CONSTANT PITCH,

Press 



Function keys from F1 to F8 are displayed by pressing the F key.

☞ The selection is stored permanently. To modify it, it is necessary to assign a new function to the key.

SETTING THE TYPE OF SPINDLE ROTATION SPEED F 98718

With this function, it is possible to define the type of rotation, selectable on the lathe.
By default, the instrument is programmed as indefinite. If left in this configuration, its RPM settings will be the results of the theoretical calculation. The operator should select on the machine the number of revolutions among those allowed by the machine manual gear.

To change the setting, follow the programming below.

Press **F** **98718** **EXE**

SET SPEED	INDEFINITE

Press +/- to select

SET SPEED	DISCRETE

Press **EXE**

SET SPEED	DISCRETE >> 01 <<

Set the minimum available speed (e.g. 25 RPM).

Press **25** **EXE** data is acquired and stored

SET SPEED	DISCRETE >> 02 <<

The instrument is ready to accept the other RPM. Enter them in ascending order and confirm with the **EXE** key to store them permanently.
To terminate the process, enter a RPM value of 0 and confirm. A maximum of 20 RPM can be entered.

☞ While entering the RPM, it is possible to delete all the values by pressing **COR** and confirming with the **EXE** key.

If the machine is equipped with a stepless RPM changer, the instrument can be set in continuous mode.

Press **F** **98718** **EXE**

SET SPEED	DISCRETE

Press +/- to select

SET SPEED	CONTINUOUS

Press **EXE**

SET SPEED	CONTINUOUS MIN.

Set the minimum speed (e.g. 6 RPM).

Press **6** **EXE** data is acquired and stored

SET SPEED	CONTINUOUS MIN.
	6

Set the maximum speed (e.g. 2700 RPM).

Press **2700** **EXE** data is acquired and stored

SET SPEED	CONTINUOUS MAX.
	2700

The instrument quits programming and returns to the axis positions displaying.

TOUCH PROBE F 98757

A Touch Probe input with several functionalities is available on the digital readout.
When closing TP to GND, one of the following operations will be executed, depending on the programmed mode (Mode x):

OFF = Touch Probe input disabled.
Mode 1 = Sending of displayed positions to RS-232 serial port.
Mode 2 = Reset of programmed axes.
Mode 3 = Execution of the next machining step.

Example: Mode 1.

Press **F** **98757** **EXE**

TOUCH PROBE	OFF

Press +/- to select

TOUCH PROBE	Mode 1

Press **EXE** to confirm the selection

1 2 3 .4 5

In the status area, the “T” letter indicates the active state of the Touch Probe input.
At the closure of the TP input, the positions displayed are sent to the serial port.

☞ For the transmission parameters, please refer to paragraph “RS-232 serial output”.

Example: Mode 2 with X, Y and W axes programmed.

Press **F** **98757** **EXE**

TOUCH PROBE	OFF

Press  to select

TOUCH PROBE	Mode 2

Press EXE

TOUCH PROBE	Mode 2
Axis	

Press X and Y and W

TOUCH PROBE	Mode 2
Axis	XY W

Press EXE to confirm the selection

1 2 3 .4 5

In the status area, the “T” letter indicates the active state of the Touch Probe input.
At the closure of the TP input, the X, Y and W axes are reset.

Example: Mode 3.

Press F 98757 EXE

TOUCH PROBE	OFF

Press  to select

TOUCH PROBE	Mode 3

Press EXE to confirm the selection

1 2 3 .4 5

In the status area, the “T” letter indicates the active state of the Touch Probe input.
At the closure of the TP input, the request for the next machining step is confirmed. This mode can be used, for instance, in functions F72, F64, F66.

AXIS DISPLAY CONFIGURATION F 98760

The function is used to set the axis display configuration.
With the function, it is possible to:

- Assign an identification label (label) displayed on the axes keys. Possible labels are: A-Z, Xo, Yo, Zo, Wo.
- Enable / Disable the axis displaying.
- Select the font size.
- Set the number of decimals displayed (from 0 to 6).

Example: setting Zo label on axis 2.

Press **F** **98760** **EXE**

Axis 1	X
Axis 2	Y
Axis 3	Z
Axis 4	W

Press **EXE** to confirm axis 1 and select axis 2

Axis 1	X
Axis 2	Y
Axis 3	Z
Axis 4	W

Press ◄ or ► to select the new label to be assigned to the axis

Axis 1	X
Axis 2	Zo
Axis 3	Z
Axis 4	W

Press **EXE** to confirm axis 2 and select axis 3

Axis 1	X
Axis 2	Zo
Axis 3	Z
Axis 4	W

☞ In this phase, it is possible to enable/disable the displaying of an axis, by using the ON/OFF key.

Example: disabling the W axis displaying.

Press **ON OFF** during the selection of the W axis

Axis 1	X
Axis 2	Zo
Axis 3	Z
Axis 4	OFF

Press **EXE** to confirm the selection

123.45

After having selected the labels, it is possible to choose a different font size for the positions displayed, according to the number of axes. Possible sizes are: SMALL / MEDIUM / LARGE (2 axes), SMALL / MEDIUM (3 axes) and SMALL (4 axes).

Example: 2-axis digital readout, MEDIUM font size.

Press **+/-** to select the desired font size

Axis 1	X
Axis 2	Y
Font size	MEDIUM

Press **EXE** to confirm the selection

123.45

or press CLR to quit the function

The configuration of the number of decimals displayed allows the alignment of the decimal point of all the axes, for an easier reading.

☞ The **physical resolution** of the axes will not be modified. For instance, if an optical scale with resolution 0.5 µm is connected, all the calculations will be executed with this resolution. However, it will be possible to select an axis displaying with only 3 decimals (1 µm).

Example: setting the axes with 3 decimals.

Press F 98760 EXE

Axis 1	X
Axis 2	Y
Axis 3	Z
Axis 4	W

Press DP LABEL to proceed with the Decimal Point configuration

Axis 1	0.0000
Axis 2	0.000
Axis 3	0.000
Axis 4	0.000

Press +/- to select the desired number of decimals

Axis 1	0.000
Axis 2	0.000
Axis 3	0.000
Axis 4	0.000

Press EXE the display proceeds to examine the next axis, e.g.

Axis 1	0.000
Axis 2	0.000
Axis 3	0.000
Axis 4	0.000

Proceed accordingly to confirm or modify the other axes settings. After the last confirmation with the EXE key, the displays will be enabled for counting.

INSTRUMENT CONFIGURATION INFO

From the second menu of the digital readout function keys,

Press INFO to access the info page

A summary page will be displayed, containing the various settings of the axes.
For example:

- Axis identification label
- Linear / Angular setting
- Physical resolution
- Number of decimals displayed
- Incremental / Absolute counting
- Possible axis couplings entered
- Linear correction
- Radial / Diametral counting

Press CLR to quit info

123.45

LANGUAGE SELECTION F 98762

This function can be used to select the language of the messages displayed by the instrument.
For instance:

Press F 98762 EXE

SELECT LANGUAGE	ENGLISH

Press +/- to select

SELEZIONE LINGUA	ITALIANO

Press EXE the selection is acquired and stored

The instrument quits the function and returns to the positions displaying.

CALCULATOR

The digital readout is equipped with a calculator, as shown in the figure below:

The calculating system is used as a traditional calculator (possible operations are: addition, subtraction, multiplication, division, percentage, square root, sine, cosine and tangent). In addition, the calculator is provided with three memory function keys MS, MR and M+ to temporarily store the result during calculations.

Press CALC to access the calculator

Execute the desired calculations. E.g. tan(60) + 120.5.

Press **60** TAN the tangent result will be displayed — 1.732051

Press + **120.5** = — 122.232051

Store the result and recall it in a new calculation. E.g. 350 + MR.

Press MS to store the result in the calculator memory — 122.232051

To execute the new calculation using the memory,

Press C **350** + MR = — 472.232051

To delete the operation result,

Press C — 0

Press CLR to quit the calculator — **123.45**

STOPWATCH

The instrument is equipped with a machining counting system (hours : minutes : seconds), represented by a stopwatch, as shown in the figure below:

The maximum possible counting is 24 hours.

Press CRONO to access the stopwatch

Press START STOP to start or stop the counting

Press RESET to reset the counting

☞ It is possible to use the RESET key only if counting is not running.

Press CLR to quit the stopwatch

123.45

☞ The stopwatch counting (hours : minutes) is always displayed in the status area.

RS-232 SERIAL OUTPUT

The asynchronous serial interface is normally used to transfer data to a printer or to other devices having a SLAVE function.
The transmission parameters are fixed and they are the following ones:

- SPEED OF TRANSMISSION 9600 BAUD
- DATA LENGTH 8 BIT
- ONE STOP BIT
- NO PARITY BIT

The SLAVE needs to have the same parameters.

To activate the function,

Press 

the keys of the activated axes light up.

Press 

and transmission occurs

Data have the following format:

= DIGITAL READOUT =
AXIS X : 57 . 0865
AXIS Y : 10 . 8480
AXIS Z : - 7 . 0985
UNIT : INCH

Instead of printing the label, it is possible to request the readout to send the positions displayed. The request has to be made in ASCII mode on the serial line as follows:

"Q" + CR + LF

Answers (e.g. X= 57.0865, Y= 10.8480, Z= -7.0985) have the following format (11 data characters + 2 control characters):

" 57.0865" + CR + LF
" 10.8480" + CR + LF
" -7.0985" + CR + LF

where **CR = CARRIAGE RETURN (0Dh)**
LF = LINE FEED (0Ah)

ADDITIONAL INFORMATION

TECHNICAL CHARACTERISTICS

Model	***VISION 922IN*** GENERIC 2 DISPLAYED AXES (*) ***VISION 933IN*** GENERIC 3 DISPLAYED AXES (*) ***VISION 933TO*** LATHE 3 DISPLAYED AXES (*) ***VISION 933FR*** MILLING 3 DISPLAYED AXES (*) ***VISION 944FV*** VERTICAL MILLING 4 DISPLAYED AXES (*) ***VISION 944FT*** TRANSV. MILLING 4 DISPLAYED AXES (*) ***VISION 944AL*** BORING 4 DISPLAYED AXES (*) ***VISION 944IN*** GENERIC 4 DISPLAYED AXES (*) (*) Four input axes are always available.
Display	5.7" TFT LCD COLOR
Encoder input signals	5 Vdc two square waves with phase displacement of 90° ± 5° + synchronized index TTL
Maximum input frequency	300 kHz_{MAX}
Power supply	230 Vac ± 10% - 50/60 Hz 110 Vac ± 10% - 60 Hz 24 Vac ± 10% - 50/60 Hz
Current consumption	60 mA (230 Vac) 120 mA (110 Vac) 500 mA (24 Vac)
Connectors	D-SUB 9p F (axes), D-SUB 9p M (RS-232, CAN Bus, Touch Probe), USB-B (USB)
Memory	permanent for configuration and special functions
Linear resolution	1000 - 500 - 200 - 100 - 50 - 20 - 10 - 5 - 2 - 1 - 0.5 - 0.2 - 0.1 µm
	0.05 - 0.02 - 0.01 - 0.005 - 0.002 - 0.001 - 0.0005 - 0.0002 - 0.0001 - 0.00005 - 0.00002 - 0.00001 - 0.000005 inch
Angular resolution	1 - 0.5 - 0.2 - 0.1 - 0.05 - 0.02 - 0.01 - 0.005 - 0.002 - 0.001 °
Protection class (EN 60529)	IP 40 IP 54 with plastic cover provided
Operating temperature	0 °C ÷ 50 °C
Storage temperature	-20 °C ÷ 70 °C
Weight	1120 g
Options	CAN Bus, Touch Probe

Without prior notice, the products may be subject to modifications that the Manufacturer reserves to introduce as deemed necessary for their improvement.

WARRANTY TERMS

The digital readout VISION 900 is guaranteed against manufacturing faults for a period of twenty-four months from the date of purchase. Any repair must take place at the Manufacturer's premises and the Customer shall arrange the delivery of the product, at its own risk and expense.

The Manufacturer is released from any claim against damages due to the nonobservance of the mounting instructions which causes the annulment of the warranty terms.

The warranty does not provide for repairing and/or replacement of those parts that have been damaged by negligence or misuse, improper installation or maintenance, maintenance performed by unauthorized personnel, transport or any other circumstance that excludes a manufacturing fault of the product.

Similarly, the warranty does not apply if serial numbers or any data identifying the product are cancelled or altered in any way, and if product modifications are introduced without the written authorization of the Manufacturer.

The Manufacturer declines any responsibility for damages to people or properties deriving from the use of the product, including any loss of profit or any other direct, indirect or incidental loss.

Any dispute not settled informally shall be referred to the COURT OF MONZA (MB) – ITALY.

NOTES

NOTES

DIGITAL READOUT VISION 900

I NOSTRI PRODOTTI SONO VENDUTI ED ASSISTITI IN TUTTE LE NAZIONI INDUSTRIALIZZATE
OUR PRODUCTS ARE SOLD AND HAVE AFTER-SALE SERVICE IN ANY INDUSTRIALIZED COUNTRY

RIGHE OTTICHE
OPTICAL SCALES

SISTEMI MAGNETICI
MAGNETIC SYSTEMS

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ROTARY ENCODERS

VISUALIZZATORI
DIGITAL READOUTS

POSIZIONATORI
POSITION CONTROLLERS

GIVI MISURE

COMPANY WITH QUALITY MANAGEMENT SYSTEM CERTIFIED BY DNV
= ISO 9001:2008 =

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