

MULTICOT

User's guide



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FOREWORD

**READ CAREFULLY THE SAFETY RULES OF THE APPENDIX B
BEFORE USING THE DEVICE**

WARNING

The information contained in this booklet can be changed without notice.

The constructor grants no warranty whatsoever regarding the unlimited warranties of commercial quality of this product, or its suitability to a particular use.

The constructor is not responsible for mistakes that could be found in this handbook and is not responsible either for direct or indirect damage resulting from the equipment, its performances and the use of this product.

CLEANING

Use a cloth lightly soaked with an ethyl alcohol -based product.

DON'T USE the following products: acetone, benzene, toluene and halogen hydrocarbon.

THE SECTIONS

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1. INTRODUCTION

1.1 PRESENTATION OF THE PRODUCT

The electronic gauging unit MULTICOT enables to check characteristics from inductive probes, digital probes and linear encoders.

It is possible to make measurements by combining 8 probes on 8 different characteristics on 8 fixtures.

The measured values are compared with a reference piece: the master. The master is defined for each characteristic of the part.

MULTICOT : a gauging unit operated by a microprocessor

The electronic gauging unit MULTICOT, operated by a microprocessor, is entirely programmable thanks to its keyboard. This way it can be used in many different configurations.

1.2 TECHNICAL SPECIFICATIONS

- 8 inputs for inductive probes (sensitivity 83 mV/V/mm on 2,74 k Ω)
- Bus RS485 (Orbit) for digital probes and linear encoders, maximum 8
- All configuration parameters are accessible either by keyboard or by communication port (downloading)
- Up to 8 configurable fixtures
- Static or dynamic calculations per characteristic
- Display of the selected characteristic with 7 digits
- 2 warning lights 'characteristic's control' for each characteristic and 2 warning lights 'part control' (group of characteristics or fixture)
- RS232 or RS485 communication port for the connection with a computer or PLC per ASCII 'Metro' or ModBus/JBus protocol
- 16 key numerical tactile keyboard
- Working temperature: +15 °C to +30 °C
- Relative humidity : maximum 80 %
- Characteristics : 247 mm wide, 102 mm high, 140 mm deep
- Weight : 1300 grams

1.3 FRONT PANEL

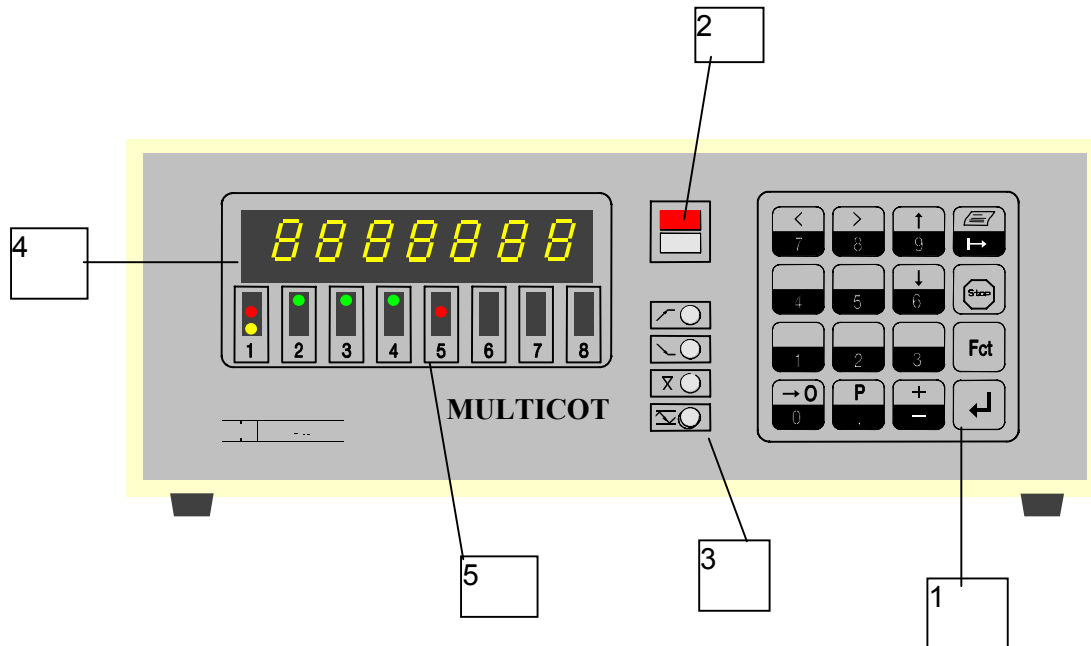






Fig. 1

The following functions are gathered on the front side :

1. the keyboard
2. 2 warning lights for control : 'part good' and 'part rejected'
3. indicators for the measuring mode of the displayed characteristic :

 maxi	 mini	 median	 difference
------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------
4. digital display (7 digits)
5. the warning lights per characteristic : 8 groups of 3 :
 - 2 upper warning lights : green for characteristic 'good' and red for 'out of tolerances'
 - lower warning light (yellow) : number of the displayed characteristic

1.4 THE BACK PANEL

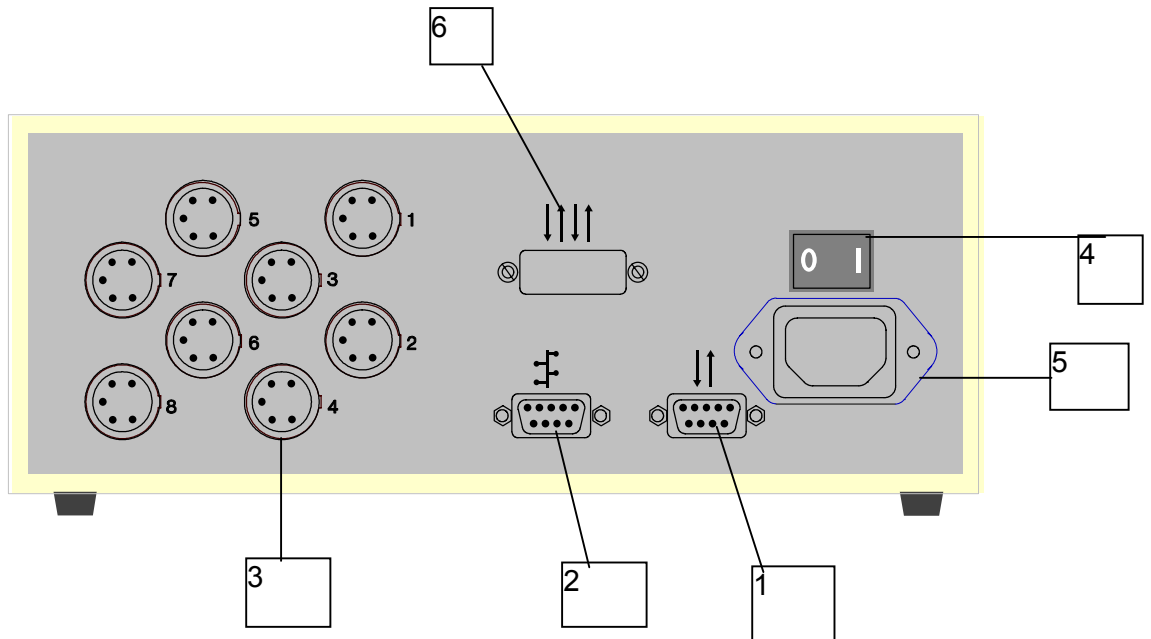


Fig. 2

On the back panel are gathered the following functions:

1. RS232 or RS485 port to connect with a PLC or an external system
2. Orbit Bus for digital probes and linear encoders
3. 8 Din connectors 5 pins for inductive probes
4. Power switch
5. Main connector
6. An optional connector for relay outputs and multi-functional inputs/outputs

1.4.1 THE COMMUNICATION PORT

The MULTICOT is fitted with a serial port, marked \updownarrow . It enables to connect the device to a PLC or an external system. It is used in RS232 or in RS485 according to the acquired configuration.

The transmission format is as follows:

setup speed (see § 3.11), 1 start bit, 8 data bits, no parity, 1 stop bit

CONNECTOR PIN ASSIGNMENT

It is equipped with a Sub D 9 pin- female plug.

Description of signals and pin assignment (RS232 version).

<i>Pin</i>	<i>Signal</i>	<i>Direction</i>	<i>Description</i>
1			Not used
2	RX	Input	Reception of data
3	TX	Output	Transfer of data
4			
5	Ground	-	Ground / signal return
6 to 9			Not used

Description of signals and pin assignment (RS485 version).

<i>Pin</i>	<i>Signal</i>	<i>Direction</i>	<i>Description</i>
1,4,6,7,8,9			Not used
2	A	← →	Emission/reception of data
3	B	← →	Emission/reception of data
5	Ground	-	

1.4.2 ORBIT BUS FOR DIGITAL PROBES AND LINEAR ENCODERS

The MULTICOT is fitted with an Orbit bus terminal (RS485 bus) used to connect digital probes and linear encoders (marked 2 on Fig. 2).




ORBIT CONNECTOR PIN ASSIGNMENT

It is fitted with a Sub D 9 pin female connector.

Description of signals and pin assignment.

<i>Pin</i>	<i>Signal</i>	<i>Direction</i>	<i>Description</i>
1,4,5,9	0V		Power supply of probes
2	A	← →	Emission/reception of data
3	B	← →	Emission/reception of data
6,7,8	+5V	→	Power supply of probes

2. SIMPLIFIED STARTING

All the configurations are accessible and changeable according to the same principle: a combination of keys allows to have access to the function and to display the actual value. By pressing the  key you go back to the measuring mode without changing the value. To change the configuration you need to enter a new value instead of the displayed value, or use the  key if you choose pre-programmed values. By pressing the  key you go back to the measuring mode and store in memory the new configuration.

The 'simplified starting' includes the basic instructions you need to follow to make the MULTICOT work.


2.1 OPERATING MODE

When it is switched on, the MULTICOT is in measuring mode.

The measuring mode carries out the reading of probes, calculates the characteristics from programmed combinations, compares the characteristics with tolerances and displays the results on the display and the warning lights.

Digital display

The digital display corresponds to the value of the selected characteristic in the measuring mode.

You may go from one characteristic to another by pressing its number from 1 to 8 by keyboard (or key  to display next characteristic).

If a characteristic is not in the fixture in progress, it won't be selected.

When you change fixtures, the selected characteristic automatically becomes the first one in the fixture.

Operating mode of the warning lights

3 horizontal rows of 8 lights are under the digital display :

- The 2 rows at the top represent the characteristics' state :
 - ◊ red light ON (at the top) : characteristic faulty (out of tolerances)
 - ◊ green light ON (in the middle) : characteristic good (between the tolerances)
 - ◊ red and green lights OFF : the characteristic isn't in the fixture
- The warning light (yellow) at the bottom row represents the characteristic's number whose value is displayed on the digital display.

These warning lights may flash if there are errors in the calibration control.

- When a probe is in adjustment, the group of 3 vertical warning lights having its number is on.

2 warning lights are on the right of the digital display :

- the green warning light indicates the part is good (relay OK activated)
- the red warning light indicates the part is faulty (relay NOK activated)

2.2 PROBES' COMBINATION

In measuring mode, the MULTICOT carries out the measurement on probes and calculates the characteristics from programmed combinations.



The calculation formula used for the characteristic number 'c' is as follows :





$$K1(c)*C1+K2(c)*C2+K3(c)*C3+K4(c)*C4+K5(c)*C5+K6(c)*C6+K7(c)*C7+K8(c)*C8$$

The coefficients K1(c) to K8(c) are real numbers chosen in the interval -20.0 to +20.0. The values C1 to C8 are the direct measurements of probes.

A probe that is not used must be given the coefficient 0.
The sign of the coefficient enables to choose the probe's direction.

Checking and changing the coefficients

If the characteristic 'c' is selected and displayed, the key-sequence   displays the coefficient K1(c) and enables to modify it.




The same procedures with   to   enable you to view and modify the coefficients K2(c) to K8(c). For the coefficients of the other characteristics, you only need to renew the operation by selecting the other characteristics.

2.3 TOLERANCE LIMITS




The tolerance limits determine how the 2 upper rows of 8 warning lights 'characteristic's states', the 2 warning lights 'part's state' and the 2 relays (in option) work.

The mini and maxi tolerances correspond to the effective mini and maxi values and not to differences.

Modification of the tolerance limits




For the displayed characteristic in progress, the key sequence    displays the minimum tolerance (lower).

If there is no modification to do, you only need to enter.
If there is a modification to do, the new tolerance will then be captured by keyboard.


The same procedure enables to display and modify the maximum tolerance (upper) by pressing the key sequence   .







2.4 DISPLAY AND ADJUSTMENT OF PROBES

This function is used to enable you to check the probes and adjust their mechanical position on the measuring stand. The position of inductive probes must be adjusted nearest to zero (at half the measuring range).

By pressing the key-sequence   , the direct value of probe 1 is displayed without the calculation of the combination with other probes.

In the case when the probe is a digital one or a linear encoder (Orbit type), it must be identified. If it is not, the message 'Id.n' (n=probe number) is displayed. You must then press the tip of the probe (>1%) to enable its identification. As soon as you have done it, the probe's value is displayed.




If you wish to do the identification of a digital probe again or cancel it, you must press the key  during its direct display.



The same procedure enables to display and adjust the probes 2 to 8 with the key-sequences  
 to   .

2.5 DEFINITION OF THE MASTER'S VALUE AND CALIBRATION

The MULTICOT measures by comparison with a reference piece, the *master*. For that, for each characteristic, it is necessary to define a value for the master. Then the MULTICOT measures the master piece and stores the result as a reference.


This operation is called the calibration.

The key-sequence    displays the actual value of the master piece for the displayed characteristic. The new value of the master piece can then be captured by keyboard. You need to repeat the procedure for all the characteristics which belong to the fixture.

The key-sequence   triggers the reading of the master and therefore the calibration of all characteristics of the fixture. The master piece must be present under the probe(s).
The calibration is kept permanently until the next calibration procedure.

The MULTICOT is now ready for operation.

3. ADVANCED FUNCTIONS

Each access to one of the described functions (modification or consultation) will be entered (and ended) by pressing the key .

3.1 SELECTION OF THE MEASURING MODE

The MULTICOT enables to choose between 5 measuring modes for each characteristic:

- *direct measurement*

The displayed characteristic represents the measured value.

- *minimum* 


The displayed characteristic represents the minimum value met since the beginning of the measuring. It is a dynamic measurement.

- *maximum* 

The displayed characteristic represents the maximum value met since the beginning of the measuring. It is a dynamic measurement.





- *median* 

The displayed characteristic represents the median [(maxi+mini)/2] of the values met since the beginning of the measuring. It is a dynamic measurement.

- *difference (maxi-mini)* 




The displayed characteristic represents the difference between the maximum and the minimum met since the beginning of the measuring. It is a dynamic measurement.

Modification of the measuring mode

The key-sequence    displays the message 'Mod.'. The key  enables to change of mode for the selected characteristic. The selected mode is indicated by 4 leds (lower left of the keyboard). The direct mode corresponds to the switching off of these 4 leds.




3.2 SELECTION OF CALIBRATION MODE

Modification of the master's nominal value of a characteristic


The key-sequence    enables to display and change the calibration value of a characteristic.

Using the function in an inopportune way can have serious consequences, because it changes the reference of the measurement.




Selection of the device's calibration mode

The key-sequence    displays the calibration mode :

- 'CtL 0' for the direct calibration
- 'CtL 1' for the calibration with repetition control




You may change modes with the key .


Calibration modes

- **Direct calibration.** The calibration is triggered by pressing the key-sequence  .
Using the function in an inopportune way can have serious consequences, because it changes the reference of the measurement.
- **Calibration and control of repetition.** In this mode, the calibration is carried out once in the same way as for the direct calibration. Then by pressing the  key, you control if the characteristic read on the master piece hasn't changed by a bigger value than the defined tolerance of repetition since the last calibration.

3.3 CALIBRATION TOLERANCE


If the “ Calibration and control of repetition mode ” (CtL 1) has been selected, a tolerance of calibration must be defined for every characteristic. It is the maximum shift of the characteristic read on the master piece that will be allowed in the future different controls of repetition, by comparison with the characteristic read on the master piece during the calibration.

The key-sequence    displays the actual value of the tolerance of calibration for the displayed characteristic. If needed, a new value of the calibration tolerance is then captured by keyboard.

Then every time you press the  key, the MULTICOT carries out a control of repetition. It means that the fixture's characteristics read on the master piece that must be present under the probe(s), are compared with the characteristics read during the calibration. If these characteristics are different from the characteristics of calibration by a bigger quantity than the specified ones the warning lights of the bottom row flash to indicate the characteristics where the master has varied. To get back to normal working, you either need to carry out another control of repetition with a difference lower than the calibration tolerance or make another calibration.

3.4 MEASUREMENT UNIT (MILLIMETRE OR INCH)

The key-sequence    displays the message 'Un.'.





The key  enables to choose the measurement unit between :

- metric units : *millimetre* : display of 'Un. 0'
- imperial units : *inch* : display of 'Un. 1'

Warning : after a change of unit, the values of all the parameters in the old unit (tolerances, masters, etc..) are not converted.

3.5 NUMBER OF DECIMALS




It is possible to choose the position of the decimal point according the envisaged use.


The key-sequence    displays the message 'dEC. n'. The key  enables to choose from 1 to 4 decimals in metric units, or 1 to 5 decimals in imperials units, for all the characteristics.

If 4 decimals are asked in metric units or 5 in imperial units, the MULTICOT uses the measuring range $\pm 200\mu\text{m}$ for the inductive probes (error E3 if over-range) and a resolution of 0.1 μm .

3.6 CONFIGURATION OF PROBE ENTRIES

The MULTICOT allows you to use 8 probes amongst inductive probes, digital probes and linear encoders (on the Orbit RS485 bus). It is possible to modify the partition between the inductive and digital probes.



The key-sequence    displays the partition under 'C 80' : the 1st figure indicates the number of inductive probes and the 2nd number of digital probes.

The key  enables to modify this partition (C71, C62, ..).


Note : the numbering of digital probes begin at 8, and decrease.

3.7 TEMPORARY CHANGE OF MEASURING MODE


This change enables to view all the information about the measured characteristic (direct characteristic, maxi, mini, median, difference). It is only for the numerical display. The tolerances always depend on the default mode.

The  keys enables to go from one mode to the other. By pressing the key  or by not touching the keyboard for 30 seconds, the display goes back to the default mode.

3.8 STARTING OF DYNAMIC MEASUREMENT

Pressing the key  triggers the 0 reset of the maximum and minimum memories used for the measuring of shape faults. The key must be pressed *when the part is already set under the probes* not to record erroneous data.

3.9 MEASUREMENT STOP



Pressing the key  blocks the measurements and therefore the display. A red indicator light indicates the measurements are stopped. They will start again by pressing this key again. It is so possible to block the display on a value, to stop temporarily or permanently a static or dynamic measuring.


3.10 MULTI-POINTS COMMUNICATION


The device can communicate through the communication port (RS232 in standard or RS485 on request) either through a ASCII protocol or through the ModBus/JBus protocol (binary).


For every communication (and particularly in the case of multi-points communication), it is necessary to define a device number for each MULTICOT.


The key-sequence    enables to change :


- device number : display of 'n°' and modification from 00 to 99 with  and .

The modification of the device number is entered with .



- protocol to use : display of 'Pro.' and modification with the key  between 0='protocol ASCII' and 1='protocol ModBus'

The modification of the device number is entered with .

- transmission speed : display of 'b.' and modification with the key  between **b.1**=2400, **b.2**=4800, **b.3**=9600 and **b.4**=19200 baud.





The ending of the configuring of communication is entered with .



3.11 SENDING ONTO THE SERIAL LINK



In the ASCII protocol number 0 with the device number 0, the key-sequence   triggers the sending on serial link of the characteristics' values of the fixture, in the ASCII protocol's format (real number 112 : see § 4.1). The same result can be obtain with " PRINT " input (see § 6.1 and 6.2).


3.12 SELECTION OF FIXTURES


It is possible to define 8 fixtures maximum. They each have a number for the first characteristic in the fixture and a number for the last characteristic. For each fixture, the first and the last characteristic's numbers must be consecutive.

The key-sequence    displays the message 'PSt n' (n = number of fixtures). The key  enables to change the number of fixtures (from 1 to 8).

The key  enables then to display 'PSt1 b', 'b' stands for the number of the beginning characteristic of fixture 1, that we can change from 1 to 8 with the key .

The key  enables then to display 'PSt1 be', 'e' stands for the number of the end- characteristic of fixture 1, that we can change from 1 to 8 with the key .

The key  enables then to display 'PSt2 b', and the operation will be repeated until the last fixture that was asked.




When in operation, one goes from one fixture to the next with the key .

3.13 REFERENCE FOR LINEAR ENCODERS

The MULTICOT can use two types of digital probes on the Orbit instrument bus : digital probes of DP type and linear encoders of LE type.

Because of its working mode, a linear encoder gives the value 0 at power on, whatever its position. However, an internal function of the probe gives the possibility to reference its measuring range.

So the MULTICOT has, if necessary, a special function to reference a linear encoder at its power on. If this function is selected, the MULTICOT will display the error 'E5 n' (n=probe nr) at power on. At this time, the user will have to move in entirely the tip to reference the probe. Then the probe will display 0 with its tip totally out and the maximum of the range with its tip in.




The key-sequence    is used to choose between 'rEF 0' :no reference and 'rEF 1' :reference.

3.14 LOCKING / UNLOCKING OF THE KEYBOARD

The use of advanced functions by keyboard can be protected. This locking can be put on or cancelled by the keyboard and by the communication port.

When locking or unlocking, or when accessing to protected functions while locking, the message 'F.Pr' will be displayed quickly.




Locking :   

Unlocking   

3.15 DISPLAY OF ERRORS





When operating, the display of errors (except E1,E5 and E7) can be cancelled.


In this mode, the 2 red and green lights of a characteristic are lighted if at least one of the probes of the characteristic generates an error (the dynamic measurements of the characteristic are not calculated).

The key-sequence    is used to choose between 'M.Er 0' :*error display* or 'M.Er 1' :*no error display*.

3.16 REGULATION OF THE DISPLAY BRIGHTNESS


It is possible to regulate the display brightness according to eight levels.


The change of display brightness is accessed by the sequence   , and then  to choose the level.

The modification ends by pressing the key .

3.17 GENERAL INITIALISATION

A general initialisation of the MULTICOT can be done with the keyboard at power on, or by the communication port. Use this initialisation *very carefully*, because it cancels all the internal parameters and set the default parameters (see § 3.17).

Power on MULTICOT while pressing the key , the message 'rSt' is then displayed for 3 seconds.

While the display of 'rSt', press the key  to start the general initialisation, confirmed by the displaying of 'Ini' (duration of about 6 seconds).

This general initialisation can also be done (except device number, protocol and communication speed) by the communication port : see § 4.

3.18 VALUES OF THE DEFAULT PARAMETERS

When delivered or after a general initialisation, the MULTICOT has the following parameters :

- unit = mm ; direct calibration ; 8 inductive probes ; 3 decimals ; no reference of linear encoders ; error display
- 1 fixture defined for characteristics 1 to 8 ; characteristic 1 displayed
- characteristic C from 1 to 8 : coefficient probe C =1 and the others=0 (coefficient probe 1 / characteristic 1 = 1, coefficient probe 2 / characteristic 2 = 1, coefficient probe 3 / characteristic 3 = 1, etc..)
- *for every characteristic* :
 - ◊ mode 'direct measurement'
 - ◊ master = 0.0
 - ◊ upper tolerances = 1.0 et lower tolerances = -1.0
 - ◊ tolerances of repetition = 5 µm (0.005 mm)
- device number = 00, protocol 0 and speed 9600 baud

4. COMMUNICATION PROTOCOLS

The communication doesn't work during :

- probe adjustment (see § 2.4)
- the external commands through the opto-coupled inputs (see § 6)
- temporary change of measurement mode (see § 3.7)
- waiting of reference for linear encoders (see § 3.13)

4.1 PROTOCOL 0 : ASCII

Generalities

This specific protocol consist of the exchange of reading or writing messages as follows :

status reading per characteristic	aaa(c)ECvv?
status writing per characteristic	aaa(c)ECvv=n
general status reading	aaa(c)EGvv?
general status writing	aaa(c)EGvv=n
real number reading	aaa(c)Rvvv?
real number writing	aaa(c)Rvvv=±eeee.ddddd

Parameters :

- aaa** = device number (001 to 099, broadcast mode if =0)
- c** = characteristic number from 1 to 8 (or fixture nr :see details)
- vv** or **vvv** = value number ; **n** = command or status
- e/d** = real value in the fixed form ± 00000.00000
- each message is ended with **CR**

Communication : ASCII, setup speed, 8 bits, no parity, 1 stop bit.

In writing, the MULTICOT answers to each message back for handshaking, at the end of requested action (50 to 700 msec according to the actions and the configuration of the fixtures and characteristics).

In reading/writing of real values, the 1st character is replaced with 'e' in the answer if the real number is forbidden.

If the message is not recognised, the error message 'E' is sent back.

The MULTICOT processes the writing commands send in broadcast mode, but doesn't answer them.

List of the general status commands (EG)

00=1	W	starting of dynamic measurement
01=1 to 8	RW	number of the displayed characteristic
02=0 or 1	RW	unit : 0=mm,1=inch
03=0 or 1	RW	'Stop' : 0=disactivated,1=activated
04=0 or 1	R	'part' status : 0=good, 1=faulty
05=0 or 1	RW	calibration mode : 0=calibration, 1=control
06=0 to 7 / 0 to 8	R	error number / probe number (00=no error)
07=1 to 8	RW	number of inductive probes
08=1 to 8	RW	number of the displayed fixture
09=1 to 8	RW	number of fixtures
0A=1	W	calibration
0B=1	W	calibration control

0C=1 to 8	RW	charact. nr beginning fixture	[c = fixture nr]*
0D=1 to 8	RW	charact. nr ending fixture	[c = fixture nr]*
0F=0 or 1	RW	keyboard : 1=locking, 0=unlocking	
0G=0 or 1	RW	reference linear encoders : 0=no, 1=yes	
0H=0 or 1	RW	error display : 0=yes, 1=no	
0x=1	W	general initialisation (about 6 sec.)	

* in the message 'aaa(c)...', c is the fixture number, and not the characteristic (see examples)

List of status commands per characteristic (EC)

01=0 à 4	RW	permanent measurement mode : 0=normal, 1=maxi, 2=mini, 3=median, 4=difference
02=1 à 5	RW	number of decimals <i>for all the characteristics</i>
03=0 ou 1	R	characteristic status : 0=good, 1=faulty

List of the real values per characteristic

080	RW	lower tolerances
088	RW	upper tolerances
096	RW	masters' characteristics
104	RW	tolerances of repetition of the master
112	R	values of the characteristics
120 to 127 [c=1]*	R	direct measurements of probes 1 to 8*
144	RW	coefficients of probe 1
152	RW	coefficients of probe 2
160	RW	coefficients of probe 3
168	RW	coefficients of probe 4
176	RW	coefficients of probe 5
184	RW	coefficients of probe 6
192	RW	coefficients of probe 7
200	RW	coefficients of probe 8

* in the message 'aaa(c)...', c must take the value 1 for the reals 120 to 127 (see examples)

Examples in ASCII protocol

All these examples are given for the device number 01.

Reading of the number of the displayed characteristic	001(1)EG01?
Answer : characteristic 8	001(1)EG01=8
Selection of the characteristic 3	001(1)EG01=3
Answer :	001(1)EG01=3
Reading of the number of decimals of all characteristics	001(1)EC02?
Answer :	001(1)EC02=4
4 decimals for all characteristics	001(1)EC02=4
Answer :	001(1)EC02=4
Reading of coefficient probe 2 of characteristic 5	001(5)R152?
Answer : coefficient =1.5	001(5)R152=+00001.50000

Coefficient of probe 5 of the characteristic 1 = -1 Answer :	001(1)R176=-00001.00000 001(1)R176=-00001.00000
Reading of the upper tolerance of characteristic 2 Answer : tolerance = 2.0	001(2)R088? 001(2)R088=+00002.00000
Reading of the direct value of probe 3 Answer : probe's value	001(1)R123? [(1) imperative] 001(1)R123=+00000.53200
Reading of the number of 1st characteristic in fixture 3 Answer : characteristic 2	001(3)EG0C? 001(3)EG0C=2
General initialisation of device Answer : (handshaking after about 6 seconds)	001(1)EG0x=1 001(1)EG0x=1

Register number 88 'GENERAL STATUS 1' :

bits 0,1,2	nr of the displayed charact. -1	RW	0 to 7	
bit 3	measurement unit	RW	0:mm	1: inch
bit 4	'Stop' status	RW	0:disactiv.	1:activated
bits 5,6,7	number of inductive probes -1	RW	0 to 7	
bit 8	calibration mode	RW	0:direct	1:control
bit 9	(do not use)			
bit 10	start of dynamic measurement	W		1=start
bit 11	calibration control	W		1=control
bit 12	calibration	W		1=calibration
bit 13	general initialisation*	W		1=initialiration
bit 14	reference linear encoders	RW	0 :no	1 :yes
bit 15	error display	RW	0 :yes	0 :no

* if this command is selected, the other bits or the register will be ignored

Register number 89 'GENERAL STATUS 2' :

bits 0,1,2	fixture number -1	RW	0 to 7	
bits 3,4,5	number of fixtures -1	RW	0 to 7	
bit 6	status of relay 'part Ok'	R	0 :off	1:on
bit 7	status of relay 'part non Ok'	R	0 :off	1:on
bit 8	keyboard locking	RW	0 :off	1:on
bits 9,10,11	error number	R	0 to 7	
bits 12,13,14	probe number where error	R	0 to 7	
bit 15	(not used)			

Registers number 90 to 97 'FIXTURE LIMITS NP' : NP = fixture 1 to 8

bits 0,1,2,3	characteristic nr -1 for end of fixture NP	RW	0 to 7
bits 8,9,10,11	characteristic nr -1 for beginning of fixture NP	RW	0 to 7

Numbers of the status registers

	<i>decimal</i>	<i>hexadecimal</i>
Status registers of the characteristics 1 to 8	80 to 87	50 to 57
General status registers	88 and 89	58 and 59
Registers of the fixture's limits 90 to 97	5A to 61	

Numbers of the real values

<i>for the 8 characteristics</i>	<i>decimal</i>	<i>hexa.</i>	<i>read./writ.</i>
Lower tolerances	80 to 87	50 to 57	RW
Upper tolerances	88 to 95	58 to 5F	RW
Characteristics of the masters	96 to 103	60 to 67	RW
Tolerances of repetition of the master	104 to 111	68 to 6F	RW
Values of the characteristics	112 to 119	70 to 78	R
Direct measurements of probes	120 to 127	78 to 7F	R
Coefficients of probe 1	144 to 151	90 to 97	RW
Coefficients of probe 2	152 to 159	98 to 9F	RW
Coefficients of probe 3	160 to 167	A0 to A7	RW
Coefficients of probe 4	168 to 175	A8 to AF	RW
Coefficients of probe 5	176 to 183	B0 to B7	RW
Coefficients of probe 6	184 to 191	B8 to BF	RW
Coefficients of probe 7	192 to 199	C0 to C7	RW
Coefficients of probe 8	200 to 207	C8 to CF	RW

Reading messages

Form of the received questions:

device number	code \$03	number of 1 st register	1 or 2 registers	CRC 16 (lsb)	CRC 16 (msb)
1 byte	1 byte	2 bytes	2 bytes	1 byte	1 byte

Form of answers :

device number	code \$03	read bytes 2 or 4	1 or 2 read registers	CRC 16 (lsb)	CRC 16 (msb)
1 byte	1 byte	1 byte	2 or 4 bytes	1 byte	1 byte

Writing messages

Form of the received questions :

device number	code \$10	number of 1st register	1 or 2 registers	2 or 4 bytes	value to write	CRC 16 (lsb)	CRC 16 (msb)
1 byte	1 byte	2 bytes	2 bytes	1 byte	2/4 bytes	1 byte	1 byte

Form of the answers :

device number	code \$10	number of 1st register	1 or 2 registers	CRC 16 (lsb)	CRC 16 (msb)
1 byte	1 byte	2 bytes	2 bytes	1 byte	1 byte

Error messages

The general format of an error message is as follows :

device number	code function + \$80	error code	CRC 16 (lsb)	CRC 16 (msb)
---------------	----------------------	------------	--------------	--------------

The most significant bit of the received function code is set to 1 to indicate the error.

Error codes used :

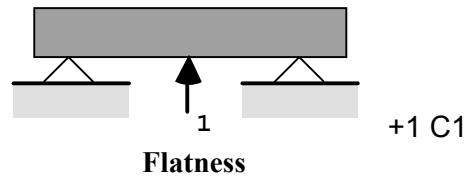
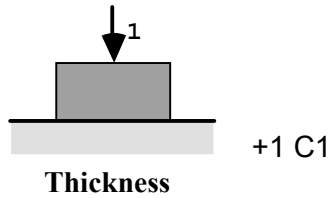
- \$01 : unrecognised function code
- \$02 : unknown register number
- \$17 : wrong request parameters

5. EXAMPLES OF PROBE COMBINATIONS

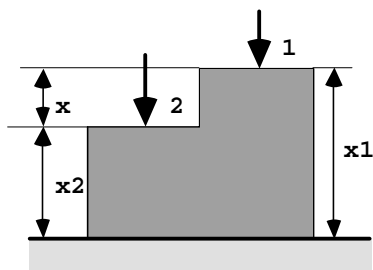
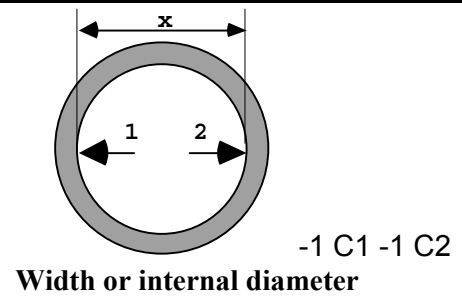
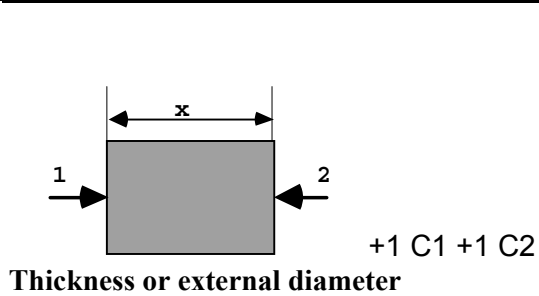
In the following examples, the probe combinations are expressed as follows :

$K C_n$ [K represents the coefficient applied to probe C number n]

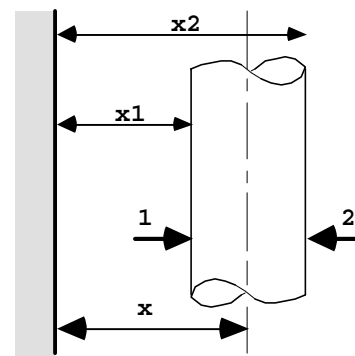
5.1 SIMPLE MEASUREMENTS WITH ONE PROBE



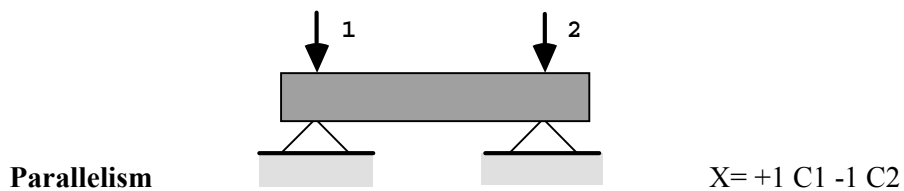
5.2 COMBINED MEASUREMENTS WITH TWO PROBES



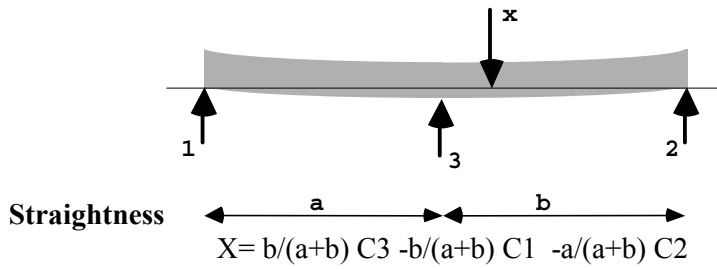
Unhooking
 $X1 = +1 C1$ $X2 = +1 C2$
 $X = +1 C1 -1 C2$



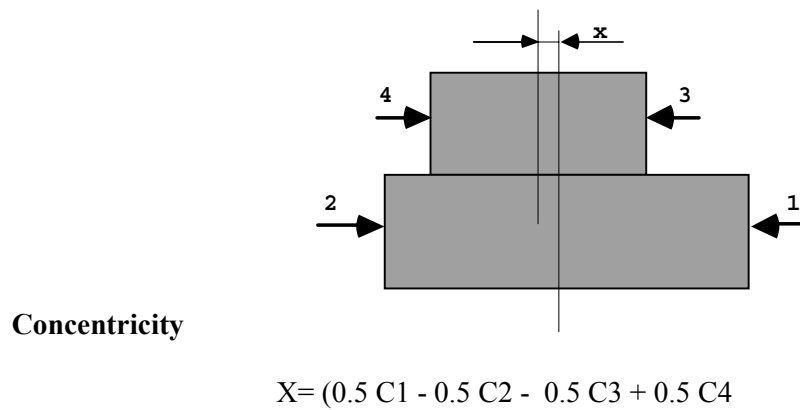
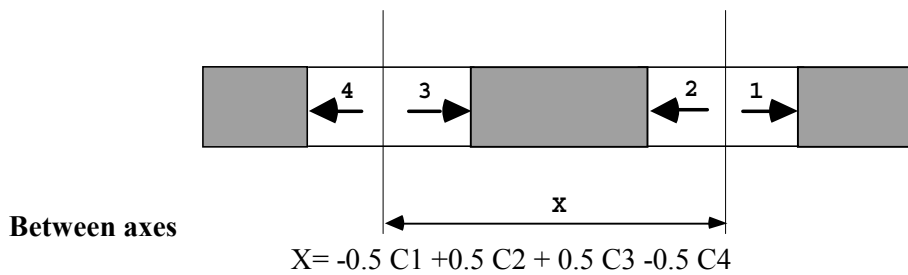
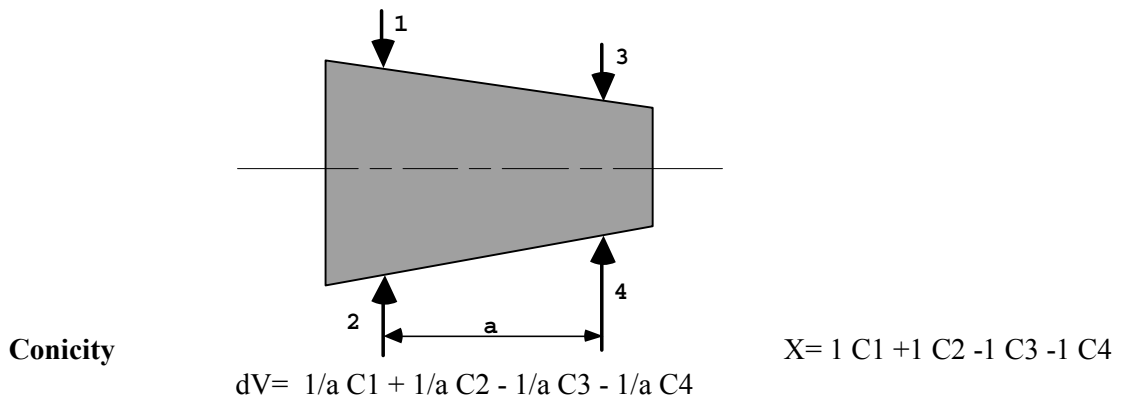
Position
 $X1 = -1 C1$ $X2 = +1 C2$
 $X = -0.5 C1 +0.5 C2$



5.3 MEASUREMENTS WITH THREE PROBES



5.4 MEASUREMENTS WITH FOUR PROBES



6. THE INPUTS / OUTPUTS

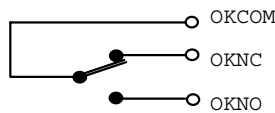
The MULTICOT can be fitted with the 2 following input/output option boards :

- relay board ref. OPT-REL
- multi-functional board ref. OPT-MFCT

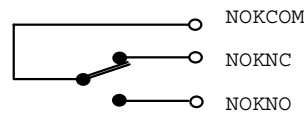
6.1 RELAY BOARD ref. OPT-REL

The relay board has two independent and isolated relays indicating if the part measured by all the characteristics of the fixture is good or not.

<u>Status of relays</u>	<u>'part good'</u>		<u>'part faulty'</u>	
	<i>OKNC</i>	<i>OKNO</i>	<i>NOKNC</i>	<i>NOKNO</i>
All characteristics within tolerances	open	closed	closed	open
At least 1 charact. beyond tolerances	closed	open	open	closed
MULTICOT off	closed	open	closed	open






'GOOD PART' RELAY



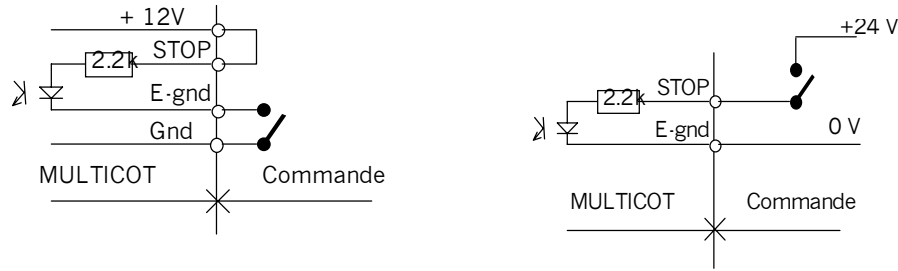
'FAULTY PART' RELAY

Four inputs isolated with optocouplers enable to operate the MULTICOT by remote control. They are active at the logical level 1 (+12 to +24 volts), that must be maintained at 1 for at least 100 milliseconds. Each command is effective when its input comes back to zero, except for the input STOP that stays active as long as the logical level 1 is maintained.

- **STOP** : This input controls the measurements stop as long as it is maintained at the logical level 1.
- **INITDYN** : This input controls the initialisation of memories of all characteristics for the dynamic measurement. It must be activated at the beginning of each dynamic measurement, when the part to be measured is already in place under the probes. This command has the same function as the key  of the keyboard.
- **PRINT** : In protocol 0 with a device number at 00, this input triggers the sending on the serial port of the measurements of the characteristics of the fixture. This command has the same function as the key-sequence   of the keyboard.
- **FIXTURE** : This input controls the reading of the 3 other inputs to codify the number of the fixture to select.

Put the input FIXTURE at 1, then position the inputs INITDYN, PRINT and STOP according to the following table, then put the input FIXTURE at 0, then release the inputs.

	<i>Fixture 1</i>	<i>Fixture 2</i>	<i>Fixture 3</i>	<i>Fixture 4</i>	<i>Fixture 5</i>	<i>Fixture 6</i>	<i>Fixture 7</i>	<i>Fixture 8</i>
INITDYN	0	1	0	1	0	1	0	1
STOP	0	0	1	1	0	0	1	1
PRINT	0	0	0	0	1	1	1	1



Examples of command of the inputs opto

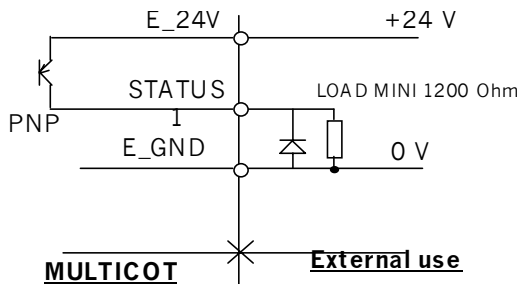
Sub D Connector pin assignment 15 pins female

Borne	Signal	Direction	Description
1	+12 V	Output	Power supply to activate the inputs
2	nc	-	(not connected)
3	OKNC	Output	Contact relay 'part good' 1A 48V
4	OKCOM	Output	Common of contacts 'part good'
5	OKNO	Output	Contact relay 'part good' 1A 48V
6	E_GND		Power return of the inputs
7	STOP	Input	Command for measurement stop
8	PRINT	Input	Command for measurement transfer
9	Gnd	-	Earth / Power return 12V
10	nc	-	(not connected)
11	NOKNC	Output	Contact relay 'part faulty' 1A 48V
12	NOKCOM	Output	Common of contacts 'part faulty'
13	NOKNO	Output	Contact relay 'part faulty' 1A 48V
14	INITDYN	Input	Command for measurement initialisation
15	FIXTURE	Input	Command to select the fixture

6.2 MULTI-FUNCTIONAL BOARD ref. OPT-MFCT

The multi-functional board ref. OPT-MFCT has the functions of the relay board, but also 8 outputs indicating the status of the 8 characteristics. For the description of the common functions, please read the above description of the relay board.

The eight outputs 'characteristic status' are of PNP type with open collector according to the following drawing. They have a commutation power of 20 mA under 48 volts.



Example of use of an output 'characteristic status'

Connector 26 pins female pin assignment:

<i>Pins</i>	<i>Signal</i>	<i>Direction</i>	<i>Description</i>
1	OKNO	-	Relay contact 'good part' 1A 48V
2	(dnc)	-	(don't connect)
3	+12 V	Output	Power supply to activate the inputs
4	Status 5	Output	Output 'Status characteristic 5'
5	Status 7	Output	Output 'Status characteristic 7'
6	Status 4	Output	Output 'Status characteristic 4'
7	Status 2	Output	Output 'Status characteristic 2'
8	E_GND		Power return of the inputs
9	E_24V	Input	External 24 V for outputs 'status characteristics'
10	OKCOM	-	Common of contacts 'good part'
11	(dnc)	-	(don't connect)
12	(dnc)		(don't connect)
13	Gnd	-	Earth / power return 12V
14	Status 6	Output	Output 'Status characteristic 6'
15	Status 8	Output	Output 'Status characteristic 8'
16	Status 3	Output	Output 'Status characteristic 3'
17	Status 1	Output	Output 'Status characteristic 1'
18	E_24V	Input	External power supply for outputs 'status charact.'
19	OKNC	-	Contact relay 'good part' 1A 48V
20	NOKNO	-	Contact relay 'faulty part' 1A 48V
21	NOKCOM	-	Common of contacts 'faulty part'
22	NOKNC	-	Contact relay 'faulty part' 1A 48V
23	INIDYN	Input	Command for measurement initialisation
24	STOP	Input	Command measurement stop
25	FIXTURE	Input	Command fixture's selection
26	PRINT	Input	Command measurement transfer

7. ERROR MESSAGES

Every time the MULTICOT detects an error, it displays an error message as long as the error stays. The only way to go back to a normal situation is to cancel the error. The error messages are displayed as follows : 'En c', where 'n' represents the error number and 'c' the probe number that created the error.

<i>Nr</i>	<i>Cause</i>	<i>Action</i>
E1	unidentified digital probe	identify the digital probe
E2	exceeded digital probe	limit the probe
E3	exceeding in scale $\pm 200\mu\text{m}$	limit the probe to $\pm 200\mu\text{m}$
E4	exceeded AD converter	limit the probe
E5	wait the reference of linear encoder	move in entirely the tip
E6	exceeded dynamic measurement	restart the measurement
E7	error of calibration control	do the calibration again

8. APPENDIXES

APPENDIX A

ONE YEAR WARRANTY FOR THE PARTS OF THE MULTICOT

RESPONSABILITY OF THE OWNER

MULTICOT - PARTS AND LABOUR. During one year from the beginning of the warranty date the constructor commits himself to pay the repair or replacement costs (including the labour costs). The constructor may choose new or renewed replacement parts.

COVER OF THE FIRST FINAL USER. The present warranty is only applied to the first final user of the product and is not transferable to eventual other buyers or users.

LIMITATIONS. The present warranty doesn't cover for accessories or expanding elements that are not included in the packaging when the product goes out of the factory.

The present guarantee doesn't cover the installation or repair costs, the damage resulting from circumstances independent from the constructor's will, such as the damage resulting from a natural catastrophe, a bad use or negligence of the user, damages happening during the transport, or due to an incorrect installation, usage or application ; also, any material damage caused by the use of products, components or accessories and other optional unprovided articles are not covered by the guarantee. The products modified without the preliminary written agreement of the constructor are not covered either, including the electric or mechanical alteration and the removal of serial numbers, commercial makes of the constructor or any other identification.

ACCORDING TO THE PRESENT GUARANTEE, THE ONLY RECOURSE WILL BE THE REPLACEMENT OR THE REPAIRING OF DAMAGED PARTS, AS MENTIONED ABOVE. THE CONSTRUCTOR WON'T BE HELD RESPONSIBLE FOR DIRECT, INDIRECT, SPECIAL DAMAGE OR DAMAGE RESULTING FROM THE USE OF THE PRODUCT, INCLUDING ANY DATA, PROFIT OR COMMERCE LOSS, QUE THESE DAMAGES ARE FORESEABLE OR NOT AND THEY ARE OR NOT BASED ON A VIOLATION OF THE GUARANTEE.

THE PRESENT GUARANTEE REPLACES ANY OTHER EXPRESS OR IMPLICIT GUARANTEE, INCLUDING, BUT NOT LIMITED TO ANY GUARANTEE OF COMMERCIALISATION OR ADEQUATION TO A PARTICULAR USE, AND ALL THESE GUARANTEES ARE EXPRESSLY EXCLUDED AND CANCELLED.

RESPONSABILITY OF THE OWNER

USER'S MANUAL AND OTHER DOCUMENTATION. Please read the manual very carefully as well as any other documentation provided with the system so that you have a good understanding of how it works. This way you will avoid damage that is not under warranty.

TECHNICAL SERVICE. If the device is faulty, bring it back to an approved agent.

APPENDIX B

SAFETY RULES

CAREFUL : In order to avoid the risks of electrocution, please respect all the safety rules. The signs in the documentation and on the device indicate the dangerous points.

CE: This device is according to safety standard EN61010-1 and electromagnetic compatibility EN55022 class B, CEI 801-2 (level II), CEI 801-3 (level III), CEI 801-4 (level III).

Any change carried out by the client and not approved by the constructor can cancel the right to use the equipment.

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SUMMARY OF FUNCTIONS

For all the characteristics

Display of the characteristics 1 to 8	to
Display next characteristic	
Change of fixture (<i>PSt x</i>)	
Fixture's calibration	
Control of fixture's master reading	
Stop / start of measurement	
Start of dynamic measurement	
Transmit on the serial port (if device nr 0 and protocol 0)	
Direct display (adjustement) of the probes 1 to 8	to

For the characteristic displayed

Coefficient of probe 1	value
For the probes 2 to 8	[idem 2 to 8]
Lower tolerance	value
Upper tolerance	value

GENERAL USE

Change of parameter

Numerical value : input the value and valid with

Preset value : use the key to see to the next value (for precedent value : only for the device number). Any other key valid the displayed value.

ADVANCED SETUP

For all the characteristics

Fixtures : selection and limits (<i>PSt 1 df</i>)	
Communication : device number, protocol and speed	
Partition of probes (<i>C80</i>)	
Master reading mode : 'direct' (<i>CtL 0</i>) or 'control' (<i>CtL 1</i>)	
Measurement unit : mm (<i>Un. 0</i>) or inch (<i>Un. 1</i>)	
Reference of linear encoders (<i>rEF. 1</i>)	
Display (<i>M.Er. 0</i>) or mask (<i>M.Er 1</i>) the error numbers	
Number of decimals (<i>dEC.1</i> to 5)	
Regulation of the display brightness	

For the characteristic displayed

Nominal value of the master reading	value
Tolerance of repetition	value
Measurement mode : <i>direct</i> , 	
Temporary change of measurement mode	

Errors

General form : **En c** (c=probe nr)

Digital probe unidentified	E1*
Over/underrange of digital probe	E2
Overrange in scale $\pm 200\mu\text{m}$	E3
AD converter overrange	E4
Waiting for reference of digital probe	E5*
Exceeding of dynamic measurement	E6
Error of control of master reading	E7*

* non maskable