CONTROLS

58-E4800

Ultrasonic Pulse Velocity Tester

MANUALE DI ISTRUZIONI
INSTRUCTION MANUAL

Index

This instruction manual is an integral part of the machine and should be read before using the machine and be safely kept for future reference.

The proper use of this machine must be strictly adhered to, any other use must be considered as incorrect.
The manufacturer cannot be held responsible for damage caused by incorrect use of the machine.
The machine must not be tampered with for any reason. In case of tampering, the manufacturer declines any responsibility of functioning and safety of the machine.

This Manual is published by **CONTROLS**.
CONTROLS reserves the right to update its manuals without notification in order to correct possible typing errors, mistakes, updating of information and/or updating of programs and/or accessories.
Such changes will be inserted in the latest edition of the current manual.

This present in English is the original version of the manual. Printed in Italy

1. INTRODUCTION

NOTE:
The present manual is updated for the product it is sold with in order to grant an adequate reference in operating and maintaining the equipment.
The manual may not reflect changes to the product not impacting service operations.

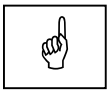
58-E4800 is used to verify the quality of concrete. It allows the measurement of the transit time of an ultrasonic wave through concrete products such as beams, columns, walls, cubes, cylinders and other sample types and to determine the propagation time.

The instrument generates ultrasonic waves which are introduced into the concrete via a transmitter probe head held in contact with the surface of the concrete under examination. These waves are read by a receiver probe, held on the concrete face in the same way, generally on the opposite side of the concrete. The time taken for the wave to travel through the concrete from one probe to the other is displayed by the instrument.

Piezo-electric probe heads of high and low frequency are available. The first are used to increase the resolution so as to identify micro-fissures: the second are used to increase the useful distance between the two heads so as to examine concrete elements of considerable thickness.

An oscilloscope may be connected to the instrument so as to display the wave form and identify voids, cracks and other non homogeneous features in the concrete.

1.1 Icons appearing in the manual



This icon indicates a NOTE; please read thoroughly the items marked by this picture.

This icon indicates a WARNING message; the items marked by this icon refer to the safety aspects of the operator and/or of the service engineer.

1.2 Manual revision history

Revision/Date	Change description
Rev. 1 24 September 2010	Manual release
Rev. 2 27 January 2010	Added chapter: 3.8 Use of the equipment with the flexible case and with the shoulder straps
Rev. 3 20 April 2011	Typing mistake
Rev. 4 21 May 2012	The wrong formula Cap. 3.3.8

1.3 Symbols used

In this manual and on the equipment itself, apart from the symbols indicated on the control panel, the following icons are also used:

Symbol	Description
	Dangerous voltage
CE	Conformity to the CE Directive

1.4 Intended use and improper use

The instrument 58-E4800 should only be used for the quality control of concrete. It allows the measurement of transit time of ultrasonic waves in concrete elements such as beams, columns, walls, cubes, cylinders and other sample types and determine the propagation time.

The instrument is designed to be used by a single operator, who must position the probe heads correctly on the sample under examination and operate the control/reading unit.

The operator is responsible for switching on the instrument, carrying out the operations for which the instrument was designed and manufactured, switching off the instrument at the end of the test or in the case of an emergency.

The operator must be trained on the correct use of the instrument and the relative safety aspects of its use.

The instrument should be used following the procedures described in this manual.

Never use the instrument for reasons other than those for which it was designed and manufactured. Any other use of the instrument is to be considered improper, not foreseen and hence dangerous.
CONTROLS will not be responsible for improper use of the instrument.

1.5 Safety information

WARNING:
Please read this chapter thoroughly.

CONTROLS designs and builds its devices complying with the related safety requirements; furthermore it supplies all information necessary for correct use and the warnings related to use of the equipment.
CONTROLS will not to be held responsible for:

- **use of the equipment different than the intended use,**
- **damages to the unit, to the operator, caused both by installation and maintenance procedures different than those described in this manual supplied with the unit, and by wrong operations,**
- **mechanical and/or electrical modifications performed during and after the installation, different than those described in this manual**

The unit is not designed to be used in an explosive atmosphere.

Any technical intervention must only be performed by qualified technicians authorized by CONTROLS.
Only authorised personnel can remove the covers and/or have access to the components under voltage.

Maintenance and service activities can only be performed by skilled authorized technical personnel that have been properly trained on the residual risks of the equipment.

During normal use, if the operator detects irregularities or damages, he/she should immediately inform the authorized technical personnel.

It is responsibility of the purchaser to make sure that the operators have been properly instructed concerning the safety issues and the residual risks related to the equipment.

The following table lists those parts of the equipment that may present some residual risks for the safety of the personnel if the instructions provided in this manual are not duly followed.

Personnel	Area with residual risks
Operator	**Connector E (Emitter) and relative cable in case the instrument is switched on without previously connecting the emitter probe head, caused by the high tension (at very low Energy). Always connect the probe head before switching on the instrument also ensuring that the cable is not damaged.**
Technical personnel	**Above listed areas**
	Areas around compartments that contain electrical parts

Here follows a list of all WARNINGs present in the manual; please see relevant chapters for full details on each related safety issue.

WARNING:
We recommend that the user carries out the checks listed in the chapter on maintenance before each work period. If any anomalies are noted, immediately inform an authorized technician in merit.

WARNING:
High voltage (at very low Energy) is present in the ***EMITTER*** connector of the instrument, the cable must be connected before switching on the instrument. This voltage could be dangerous for the user. Also ensure that the cables are not damaged.

WARNING:
Failing to perform the recommended maintenance actions or maintenance performed by unauthorized people can void the warranty.
CONTROLS will not be responsible for maintenance and service actions performed by unauthorized people.

WARNING:
Avoid pouring water, even accidentally, or other liquids into the device, as this could cause short circuits. Before cleaning the device, disconnect it from the mains line.

WARNING:
Never try to open the batteries. Do not recharge damaged batteries.

WARNING:
In extreme cases the batteries can lose liquid; if the presence of liquid is noted on the batteries proceed as follows:

- Use a clothe to carefully dry the liquid, avoid contact with the skin.
- In case of contact with the skin or eyes, immediately rinse with water. If reddening, pain or irritation is noted, consult a doctor immediately.

WARNING:
To dispose of disused batteries refer to chapter 1.6.

WARNING:
Only use recharging batteries of the correct type (see chapter 6 for spare parts). Other types of batteries can explode causing damage to the person and material.

WARNING:
Refer to qualified service organization authorized by CONTROLS to carry out the service maintenance actions described in the chapter “Diagnostic and Troubleshooting”. CONTROLS has not to be held responsible for damages to the equipment and/or injuries to personnel in case the above is not strictly followed.

WARNING:
For continued fire protection, replace fuses with same type and rating. Also, in case of failure, components may only be replaced by using original spare parts.

1.6 Environmental risks and disposal

INFORMAZIONI AGLI UTENTI

INFORMATION TO THE OWNER OF THE EQUIPMENT

The above symbol, when attached to the equipment or to the relevant packaging, indicates that the product must be disposed of separately from other rubbish at the end of its useful life.

Therefore, at the end of its useful life, the owner should dispose of the product in a suitable collection point for electrical and electronic products provided by the local authorities.

The correct disposal of this product and the subsequent treatment encourages the manufacture of products using re-cycled materials and limits the environmental impact of the product caused by improper disposal.

Improper disposal of the product is subject to penalties as foreseen by the local regulations.

1.7 CE declaration

This page shows a copy of the CE declaration. The original is supplied with the equipment as a separate document.

EC DECLARATION OF CONFORMITY FOR MACHINERY
DICHIARAZIONE CE DI CONFORMITÀ PER MACCHINE
Directive 98/37/EEC, Annex II, sub A) - *Direttiva 98/37/CE, Allegato II, parte A)*

CE

Manufacturer / *Fabbricante*: **CONTROLS srl**

Address / *Indirizzo*: Via Aosta 6, 20063 Cernusco s/N, (MI) Italy

Herewith declares that the machine
Dichiara che la macchina

Model / *Modello*: **58 – E4800**

Serial number / *Matricola*: **Example**

Description / *Descrizione*: Ultrasonic pulse velocity tester.
Apparecchio a ultrasuoni per calcestruzzo.

- ❑ is in conformity with the provisions of the Machinery Directive (Directive 98/37/CE) and with national implementing legislation.
  Applied standards:
  - UNI EN ISO 12100-1:2005 part 1 and 2

  è conforme alle condizioni della Direttiva Macchine (Direttiva 98/37/CE) e alla legislazione nazionale che la traspone (Decreto del Presidente della Repubblica nr.459 del 24 luglio 1996)
  Norme applicate:
  - *UNI EN ISO 12100:2005 parte 1 e 2*

- ❑ is in conformity with the provisions of the following EC directives:
  - 2004/108/CE
  - 2006/95/CE

  è conforme alle condizioni delle seguenti altre direttive CE:
  - *Direttiva Compatibilità Elettromagnetica 2004/108/CE*
  - *Direttiva Bassa Tensione (Direttiva 2006/95/CE)*

Date of issue / *Data di emissione*

1st - September - 2010

Signature / *Firma*

CONTROLS s.r.l. Via Aosta 6, I-20063 Cernusco s/N (MI) Tel. +39- 02921841 fax +39- 0292103333 e-mail: controls@controls.it www.controls.it

2. DESCRIPTION

Refer to the following figures for main components identification.

Fig. 2-1

Ref	Description
1	Bag with strap
2	N°2 coax. Cable with BNC connectors
3	N°2 54 KHz probes (24KHz and 150KHz probes are available as optional accessories)
4	N°1 RS232 cable for PC connection
5	N°1 Battery charger
6	N°1 Sample bar
7	N°1 ultrasonic pulse velocity tester, including 2 2400 mAh rechargeable batteries
8	N°1 coupling agent (contact paste; (Glycerin 76%, ethylic alcohol 22%, excipients 2%)

2.1 Identification plate

The identification plate is located on the rear side of the equipment, near the power cable
.

Fig. 2-2

2.2 Commands and controls

This chapter describes the commands and controls of the equipment.

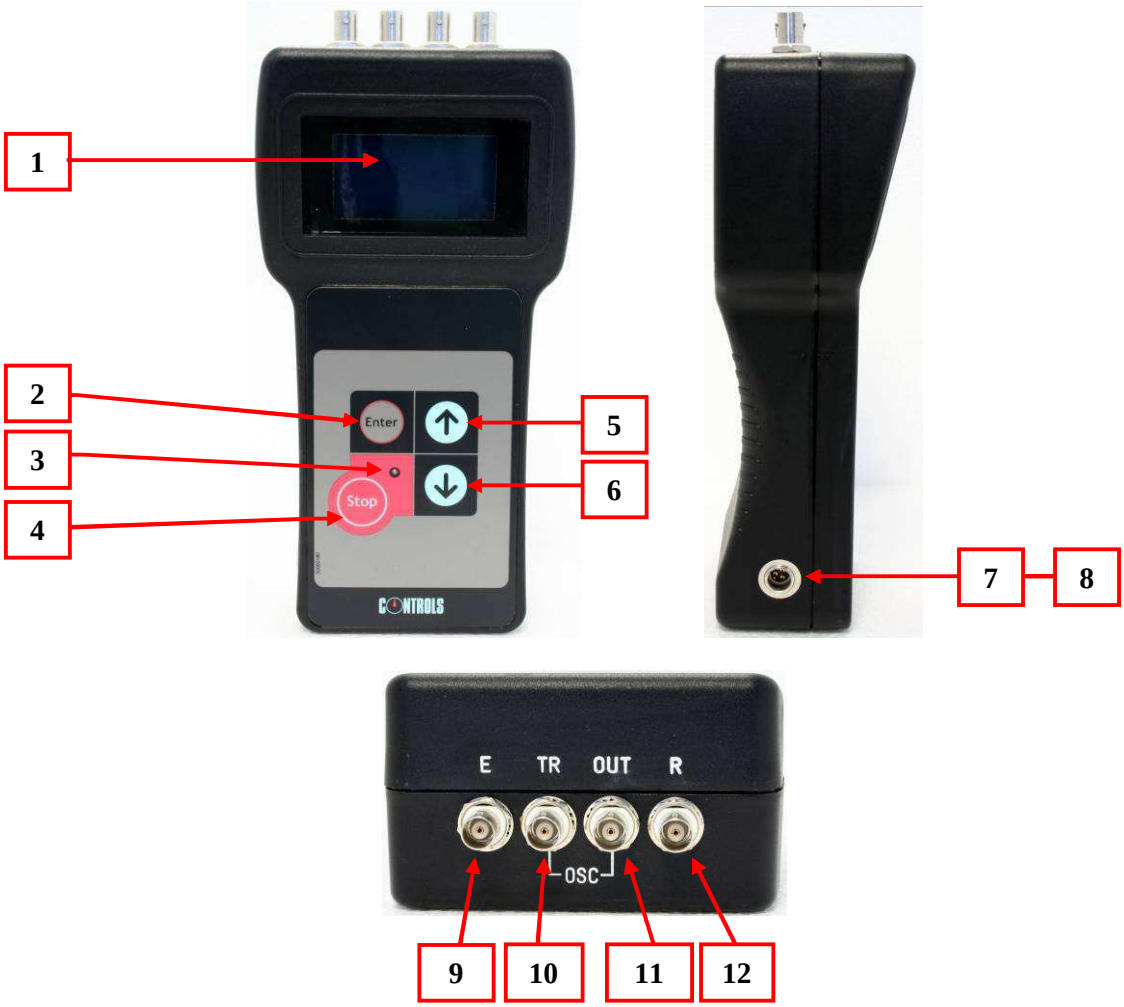


Fig. 2-3

Ref.	Description
1	Display
2	ON/OFF key
3	LED livello carica batteria
4	Multifunction key
5	Multifunction key
6	Multifunction key
7	Battery charger input and serial port output
8	Battery charger input and serial port output
9	EMITTER connector for probe
10	Oscilloscope TRIGGER connector
11	Oscilloscope SIGNAL connector
12	RECEIVER connector for probe

2.3 Technical specifications

Main characteristics	
Product	Strumento ad ultrasuoni
Manufacturer	CONTROLS Cernusco s/N (MI) Italy
Product code	58-E4800
Single-phase line voltage	100 VAC/240 VAC +6%, -10%
Frequency	50/60 Hz
Max. current	90mA
Method of power entry	“Multirange” external battery charger with dedicated output cable
Batteries	Rechargeable, R6 AA size, 1,2V – 2400 mAh
Transit time measurement	From 0.1 to 1999.9 microseconds
Pulse rate	Selectable 1, 2, 5, 10 pulse per second
Resoluction	0.1microseconds
Transmitter output	1200V
Frequency range	From 24toa 150KHz (standard probe 54KHz)
Receiver input impedance	1MOhm
Net weight (approax.)	0,5 Kg
Dimensions [mm]	240x120x75 mm

Environmental conditions	
Operating temperature	+ 10 ÷ + 40°C
Operating humidity	≤ 50%RH @ 40°C

3. USE OF THE EQUIPMENT

This chapter describes the operator's interface and the execution of a test.

WARNING:
We recommend that the user carries out the checks listed in the chapter on maintenance before each work period. If any anomalies are noted, immediately inform an authorized technician in merit.

3.1 Recharging the battery

Connect the battery charger to the mains supply having the characteristics detailed in chapter 2.3.

Now connect the exit cable of the battery charger to the socket on the left hand side of the instrument. To recharge the batteries use only the battery charger supplied with the instrument.

Batteries should only be recharged with the ambient temperature between 10°C and 40°C.

Fig. 3-1

During recharging the display shows:

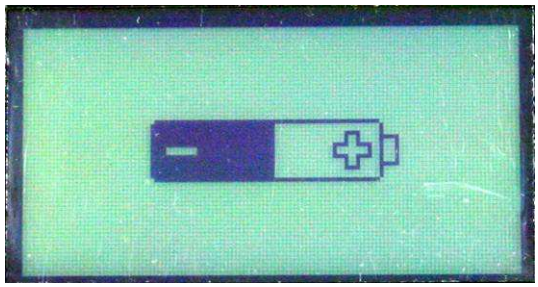


Fig. 3-2

NOTE:
The instrument cannot be used whilst it is being recharged.

The instrument is powered by two rechargeable batteries type "R6 AA size" 1,2V – 2400 mAh min.
With fully charged and efficient batteries the instrument can be used for approximately 14 hours with a pulse rate of 1 Hz.
Working with a higher pulse rate and/or using the back lighting will reduce the operation time.

NOTE:
Remember that batteries have a small current of auto discharge, therefore it is recommended to recharge them periodically (for example once a month) even if the instrument is not being used.

The led on the instrument panel will show the charge status of the batteries as follows:

- led off = batteries charged
- led flashing = limited autonomy
- with battery charger connected, led flashing = charging completed.

To maintain the batteries efficient, we recommend that they are only recharged when fully discharged avoiding intermediate or incomplete charging.

When recharging is complete the display will show:

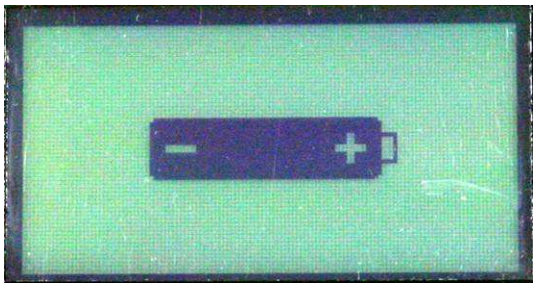


Fig. 3-3

The led on the front panel will flash.

It takes approximately 14 hours to completely recharge of the batteries.

During recharging it is recommended that the battery charger is not disconnected/reconnected.

The batteries can be recharged up to approximately 1000 times if recharged correctly.

3.2 Preparation and use

Connect the two probe heads, which can be used either as emitter or receiver to the connectors marked ***EMITTER*** (***E***) and ***RECEIVER*** (***R***) using the cables supplied with the instrument.

WARNING:
High voltage (at very low Energy) is present in the ***EMITTER*** connector of the instrument, the cable must be connected before switching on the instrument. This voltage could be dangerous for the user. Also ensure that the cables are not damaged.

Switch on the instrument via the ***ENTER*** button; the display will show:

Fig. 3-4

The message will disappear after a few seconds. Now the display will show:

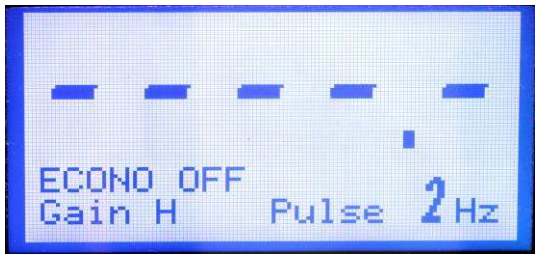


Fig. 3-5

To make readings, a thin layer of contact paste should be spread on both probe heads, and/or on the face of the concrete under examination, and then they are placed on the concrete. A small pressure should be applied to the probe heads, the varying of which will show small variations of the transit time displayed on the instrument (if the applied pressure is high, the transit time decreases slightly). The value shown on the display is the transit time of the ultrasonic waves through the concrete from the transmitter to the receiver expressed in micro-seconds.

Fig. 3-6

If the surface of the sample is not smooth, it is recommended the quantity of contact paste is increased. In any case it is good practice to apply a constant pressure on the probe heads for a few second and then to record the lowest transit time displayed. The instrument can emit 1, 2, 5 or 10 waves per second, which can be set via the pulse rate function.

It is useful to use a high pulse rate if an analogical oscilloscope (optional) is connected to the instrument, or when it is preferred to have quick updating of the transit times displayed on the instrument. However, with a high pulse rate the autonomy of the batteries is reduced due to the higher power consumption.
It is recommended in normal conditions to use a pulse rate of 1 Hz which allows the reduction of signal instability due to electrical noise.

To change the pulse rate, press the arrow down ↓ during the normal operation of the instrument.

Fig. 3-7

NOTE:
The set value is maintained even if the instrument is switched off.

Inversely, by pressing the arrow up key ↑ it is possible to adjust the gain: from High (***H***) to Low (***L***).
Normally use the High (***H***) gain.

Fig. 3-8

The Low (***L***) gain should only be used when examining small samples (e.g. 10 cm) and when an oscilloscope is connected (see chapter 3.4); Indeed, this selection should be made when in normal conditions (with gain high) the wave shape is square rather than a sine wave. In this case, reducing the gain to Low (***L***) a sine wave will be re-obtained.

NOTE:
Setting Low (***L***) in all other cases can result in incorrect readings.

3.3 Interpretation of results

The given information represents just a brief summary of testing procedure and interpretation. For more information please refer to the specialized literature and to national standards (e.g. UNI EN 12504-4, ASTM C597).

The ultrasonic test is a non destructive test based on the reading of ultrasonic pulse velocity across concrete.

3.3.1 Transducers arrangement

Although the direction in which the maximum energy is propagated is at right angles to the face of the transmitting transducer, it is possible to detect pulses which have travelled through the concrete in some other direction. It is therefore possible to make measurements of pulse velocity by placing the two transducers on either opposite face (direct transmission), or on adjacent faces (semi-direct transmission), or the same face (indirect or surface transmission). See next figure.

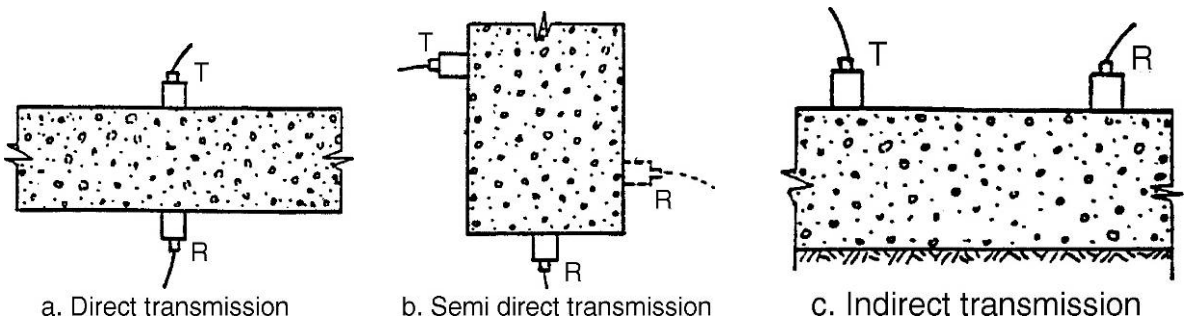


Fig. 3-9

NOTE:
It may be necessary to place the transducers on opposite faces but not directly opposite each other. Such arrangement shall be regarded as a semi-direct transmission. (see previous Figure b)

NOTE:
The indirect transmission arrangement is the least sensitive and should be used, when only one face of the concrete is accessible, or when the quality of the surface concrete relative to the overall quality is of interest.

NOTE:
The semi-direct transmission arrangement has a sensitivity intermediate between the other two arrangements and should only be used when the direct arrangement cannot be used.

3.3.2 Path length and pulse velocity measurement

For direct transmission, the path length is the distance between the transducers and when possible, the accuracy of measurement of the path length should be ± 1% and the accuracy shall be recorded.

For semi-direct transmission, it is generally found to be sufficiently accurate to take the path length as the distance measured from centre to centre of the transducer faces.
The accuracy of estimating of path length is dependent upon the size of the transducer compared with the centre to centre distance and it shall be estimated.

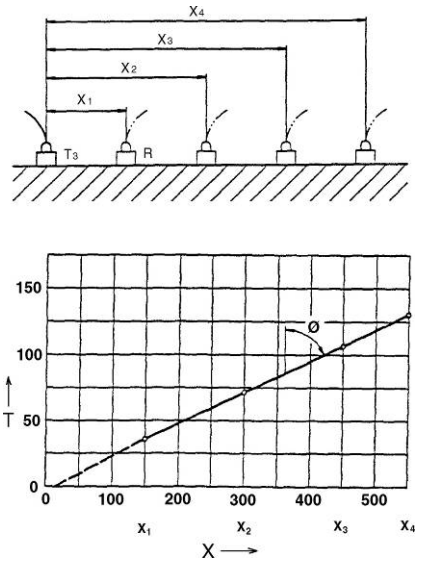
For direct and semi-direct transmissions the pulse velocity shall be calculated from the formula:

$$V = \frac{L}{T}$$

where:
V = pulse velocity, in km/s
L = path length, in mm
T = time taken by the pulse to transverse the length, in ms.
The resultant determination of the pulse velocity shall be expressed to the nearest 0,01 km/s or to three significant figures.

With indirect transmission there is some uncertainty regarding the exact length of the transmission path, because of the significant size of the areas of contact between the transducers and the concrete. It is therefore preferable to make a series of measurements with the transducers at different distances apart to eliminate this uncertainty.

To do this, the transmitting transducer shall be placed in contact with the concrete surface at a fixed point “P” and the receiving transducer shall be placed at fixed increments “X” along a chosen line on the surface. The transmission times recorded should be plotted as points on a graph showing their relation to the distance separating the transducers.



Pulse velocity determination by indirect (surface) transmission

Fig. 3-10

The slope of the best straight line drawn through the points (tan) shall be measured and recorded as the mean pulse velocity along the chosen line on the concrete surface. Where the points measured and recorded in this way indicate a discontinuity, it is likely that a surface crack or surface layer of inferior quality is present and a velocity measured in such an instance in unreliable.

3.3.3 Evaluation of homogeneity and uniformity of concrete

Drawing a grid on the concrete member and measuring the transit time in the grid points it is possible to evaluate the concrete homogeneity. It is important to make use of diagrams to clearly represent the test results and to demonstrate the mean quality of the concrete.

3.3.4 Presence of cracks, voids, deteriorated regions

When an ultrasonic pulse travelling through concrete meets a concrete-air interface there is a negligible transmission of energy across this interface (due to diffraction and reflection) so that the transit time is necessarily longer than in similar concrete with no defects. It is possible to make use of this effect locating defects, voids, deteriorated regions and cracks.

If the length of the defect is very small it is impossible to make significant evaluation (e.g. it is impossible to reveal voids with length smaller than the head diameter).

3.3.5 Correlation of pulse velocity and strength

It should be realised that the important physical properties of materials which influence pulse velocity are the elastic modulus and the density. In concrete these properties are related to the type of aggregate, its proportion [in the mix] and its physical properties and the physical properties of the cement paste, which relate. mainly, to the original water/cement ratio [of the mix] and the maturity of the concrete.
On the other hand, the strength of concrete is more related to W/C ratio than to aggregate type and proportions of aggregate and paste Thus correlations between the pulse velocity and strength of concrete are physically indirect and have to be established for the specific concrete mix. For an unknown concrete; the estimation of strength, on the basis of pulse velocity alone, is not reliable.

3.3.6 Estimation of time for formwork striking and prestressing

If some small doors are preset in the concrete moulds, it is possible to control the process of hardening in the concrete structure.

3.3.7 Estimation of dynamic elastic modulus

From measurement of ultrasonic waves velocity it is possible to calculate the elastic dynamic modulus ED as follows:

$$E_D = V^2 Q \frac{(1+n)(1-2n)}{1-n}$$

Where:
V = velocity in km/s
Q = concrete density in kg/m3
n = Poisson's ratio (for high strength concrete
n = 0,15; for low strength concrete n = 0,30)
ED = Dynamic elastic modulus MN/m2

From the diagram in next figure it is possible to evaluate the elastic module. For elastic module estimation it is enough to know the ultrasonic pulse velocity in km/s and enter in the diagram moving vertically from the velocity axis.
The related Static and Dynamic elastic module can be read on the vertical axis at the cross with "Static" and "Dynamic"curves.

Static and Dynamic elastic module estimation from ultrasonic pulse

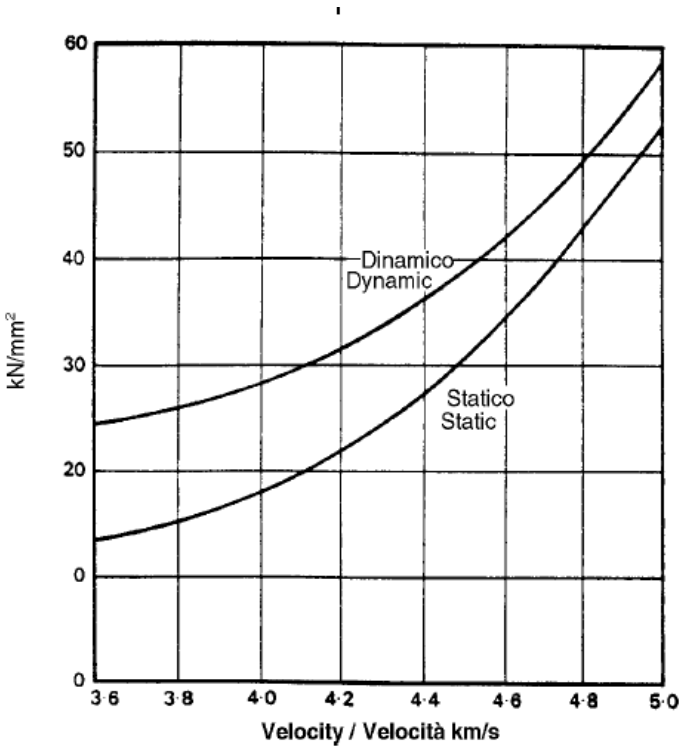


Fig. 3-11

3.3.8 Depth of cracks

When a crack has been located, perform two readings as indicated in next figure (part 1 and part 2). One reading is taken with the heads placed in symmetrical position with respect to the crack (2), the other with the same distance between the probes but without defects between them (1).
The following formula can be used to calculate the depth "h"of the fault, provided the crack is not fitted with water:

$$h = x * \sqrt{\frac{tc^2}{ts^2} - 1}$$

“There are a number of suggested methods and formulae for determining crack depth using the Ultrasonic tester, the above is one of the simplest but we would suggest reference is made to all available resources to assess the best one for your application.”

where:
x = half distance between the probes
h = crack depth (some measure unit of x)
tc = transit time across the crack (unit msec)
ts = transit time along the surface of the same type of concrete without defects (in msec)

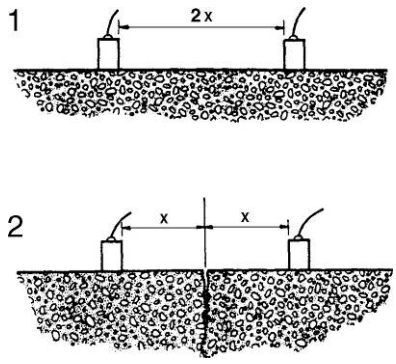


Fig. 3-12

3.3.9 Recommendation for the proper use of the ultrasonic tester

If the meter is not programmed to be used for a long time it is essential to remove the batteries, otherwise the meter could be damaged and the batteries could loose the residual charge so it will be impossible to switch on the meter and to display the message “Battery low”.
Both the probes have to be connected perfectly to obtain reliable readings.
If the reading is not stable (changes bigger than ±1 ms), try to improve the reading by applying more contact paste between probes and specimen.
In general, placing the probes in air at a distance of 23-25 cm one from the other, the display should show the message “Tp = OVERFLOW”. The same message is given when, testing concrete, the distance between the two probes is too big or when the concrete quality is very poor or the porosity is very high.
Where the concrete presents irregular surfaces they should be ground to make them as smooth as possible and a suitable amount of concrete paste should be used to ensure the best contact possible.

3.4 Connection to an oscilloscope

Whilst not essential, the oscilloscope allows the display of the wave form read by the receiver probe head, allowing the evaluation of the entity of the signal. This can be necessary in the presence of high noise generated by external sources, or to evaluate the correctness of the values shown on the display.

The connection must be made with shielded cables equipped with BNC connector (the same as are used for the probe heads). Connect "TR" to CH2 of the oscilloscope and "OUT" to CH1 of the oscilloscope. Set the TRIGGER on the oscilloscope to channel 2 and activate it if you want to display flight time.

NOTE:
Refer to the instruction manual of the oscilloscope for its correct use.
Generally on channel 1 the form f the wave can be seen, whilst channel 2 shows the delay.

It is recommended that an oscilloscope is used in all those cases where the selection of low gain (L) proves necessary. The selection of this gain must be made when the wave shape tends to be square rather than a sine wave and this evaluation can only be made with the help of an oscilloscope. Refer to chapter 3.2 for more details on the selection of gain.

NOTE:
Setting Low (***L***) in all other cases can result in incorrect readings.

3.5 Connection to a PC

The instrument is fitted with a serial RS232 port which transmits with the following parameters: 9600 baud rate, 8 data bit, 1 stop bit, no parity. To connect a PC use the cable supplied with the instrument. If the PC does not have a serial port, a RS232/USB convertor may be used. These are readily available in PC stores or may be ordered from CONTROLS (code number 58-Q0800/3).

The transmission of data occurs as per the set intervals. By pressing the arrow up key ↑ for 5 seconds the interval in seconds is shown which can be varied using the arrows in an interval between 1 and 120 seconds. By setting the interval to zero, the communication to the RS232 port is excluded. To save the new setting keep the arrow up key ↑ pressed for 5 seconds. The instrument returns to the main screen. To exit without saving the new setting press ***STOP***.

Fig. 3-13

3.6 Setting “Economy mode”

By keeping the arrow down key ↓ pressed for 5 seconds, it is possible to set the auto switch off mode (called ***ECONOMY MODE***) to ON or OFF.

This function allows longer autonomy of the batteries.

The auto switch off will occur after 5 minutes from the last activation of any key of the instrument.

Press the ***STOP*** key to exit.

3.7 Switching off the instrument

From any menu/window, press the ***ENTER*** key for 3 seconds.

Fig. 3-14

If the instrument is to be left off for a long time it recommended to remove the batteries (refer to chapter 4.1.2), otherwise damage could be caused to the instrument and the residual charge may be lost preventing the display of the Battery Low message on the display.

3.8 Use of the equipment with the flexible case and with the shoulder straps

In some conditions, for instance in situ, can be useful insert the equipment into the flexible case and carry using the shoulder straps.
The case allows also to fix a small flexible visor to protect the display against the rays of light.

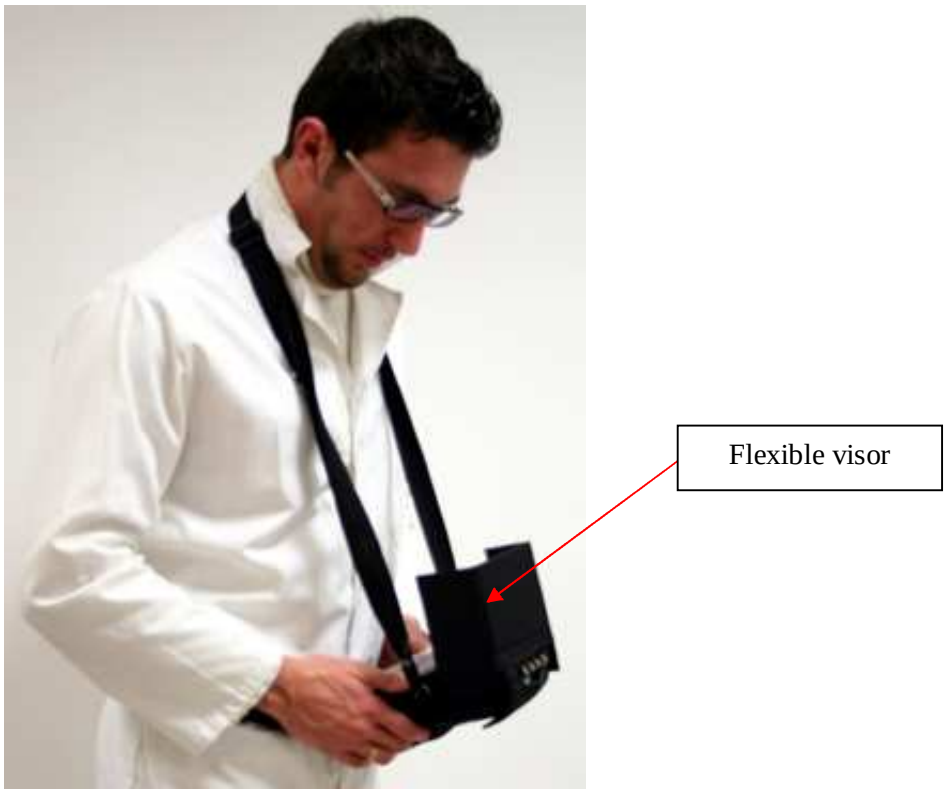


Fig. 3-15

The case also includes a support used when placing the instrument on a table.

Fig. 3-16

4. MAINTENANCE

As with all electrical equipment, this unit must be used correctly and maintenance and inspections must be performed at regular intervals. Such precautions will guarantee the safe and efficient functioning of the equipment.

Periodic maintenance consists of inspections made directly by the test operator and/or by the authorized service personnel.

Maintenance to the equipment is responsibility of the purchaser and must be performed as stated by this chapter.

Failing to perform the recommended maintenance actions or maintenance performed by unauthorized people can void the warranty.

WARNING:
Failing to perform the recommended maintenance actions or maintenance performed by unauthorized people can void the warranty.
CONTROLS will not be responsible for maintenance and service actions performed by unauthorized people.

WARNING:
Avoid pouring water, even accidentally, or other liquids into the device, as this could cause short circuits. Before cleaning the device, disconnect it from the mains line.

4.1 Preventive maintenance

The preventive maintenance actions are listed in the following table:

Action	Who	When
Check to ensure that there is no external damage to the equipment, which could jeopardise the safety of use	Operator	Before every working session
Carefully check of the probe head connection cables	Operator	Before every working session
Calibration checking (chapter 4.1.1)	Operator	1 year and/or whenever the accuracy of results is in doubt
General inspection	Operator	Weekly
Replacement of batteries (chapter 4.1.2)	Qualified tecnica personnel	When necessary

4.1.1 Checking the calibration

The instrument is supplied complete with a calibration bar on which its transit time in micro-seconds is printed. This bar is used as a reference when checking the calibration of the values displayed by the instrument.

Before calibration, check that the gain is set on High (***H***). Refer to chapter 3.2 for more details on this function.

Place the calibration bar between the two probe heads on which contact paste has been applied and apply a small constant pressure. Check that the display shows the same value as that printed on the calibration bar (+/- 0,1 micro-seconds). If it does not, the instrument can be re-calibrated, press the ***STOP*** key for 5 seconds.

Now by using the arrow keys: ↑ and ↓ it is possible to adjust the zero of the instrument until the display shows the same value as that printed on the calibration bar.

Press the ***STOP*** key to save the calibration.

Fig. 4-1

To return to the main menu press ***STOP***.
The calibration will remain in the memory even when the instrument is switched off.

4.1.2 Replacing the batteries

Before removing the rear cover of the instrument ensure that the mains cable is disconnected. Also wait until the battery is fully discharged.

1. Use a screw driver to remove the screws of the back panel of the instrument;

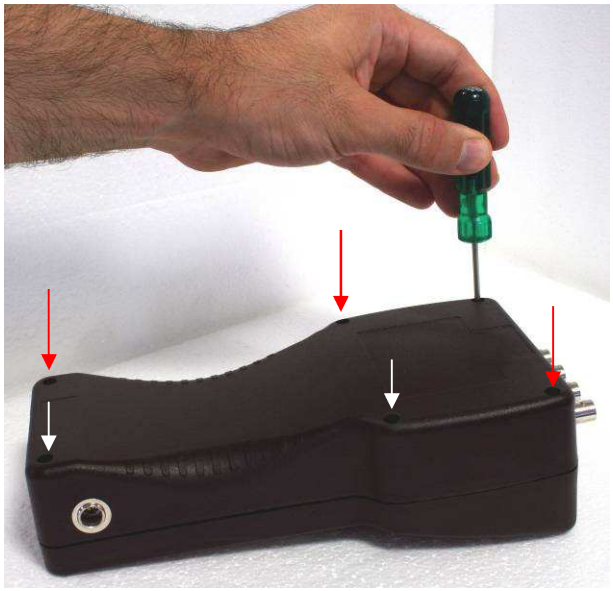


Fig. 4-2

2. When the instrument is open, take care not to damage the electrical components inside the instrument;

Fig. 4-3

3. Having located the batteries, cut the strap that holds them in position, then remove the batteries and insert the new ones checking to connect to the correct poles +/-;

WARNING:
Never try to open the batteries. Do not recharge damaged batteries.

WARNING:
In extreme cases the batteries can lose liquid; if the presence of liquid is noted on the batteries proceed as follows:

- Use a clothe to carefully dry the liquid, avoid contact with the skin.
- In case of contact with the skin or eyes, immediately rinse with water. If reddening, pain or irritation is noted, consult a doctor immediately.

Fig. 4-4

4. Once the new batteries have been inserted, block them in the same position with a new strap.

WARNING:
To dispose of disused batteries refer to chapter 1.6.

WARNING:
Only use recharging batteries of the correct type (see chapter 6 for spare parts). Other types of batteries can explode causing damage to the person and material.

5. DIAGNOSTICS & TROUBLESHOOTING

The present chapter provides information on the diagnostic programs present in the system and on the troubleshooting of the most common problems.

WARNING:
Refer to qualified service organization authorized by CONTROLS to carry out the service maintenance actions described in the chapter “Diagnostic and Troubleshooting”. CONTROLS has not to be held responsible for damages to the equipment and/or injuries to personnel in case the above is not strictly followed.

5.1 Troubleshooting

The following table provides a list of possible causes and checks in case a faulty condition is encountered:

Type of fault	Actions
The instrument does not switch on (display off)	• Check the battery charge (inside the instrument) • Check the power feed line and connectors • Check the connection of the flat key board cable • Check the connection of the flat display cable
Transit time not read	• Check the correct connection of the probe heads • Check the quality of the BNC cables • Distance between probe heads too high

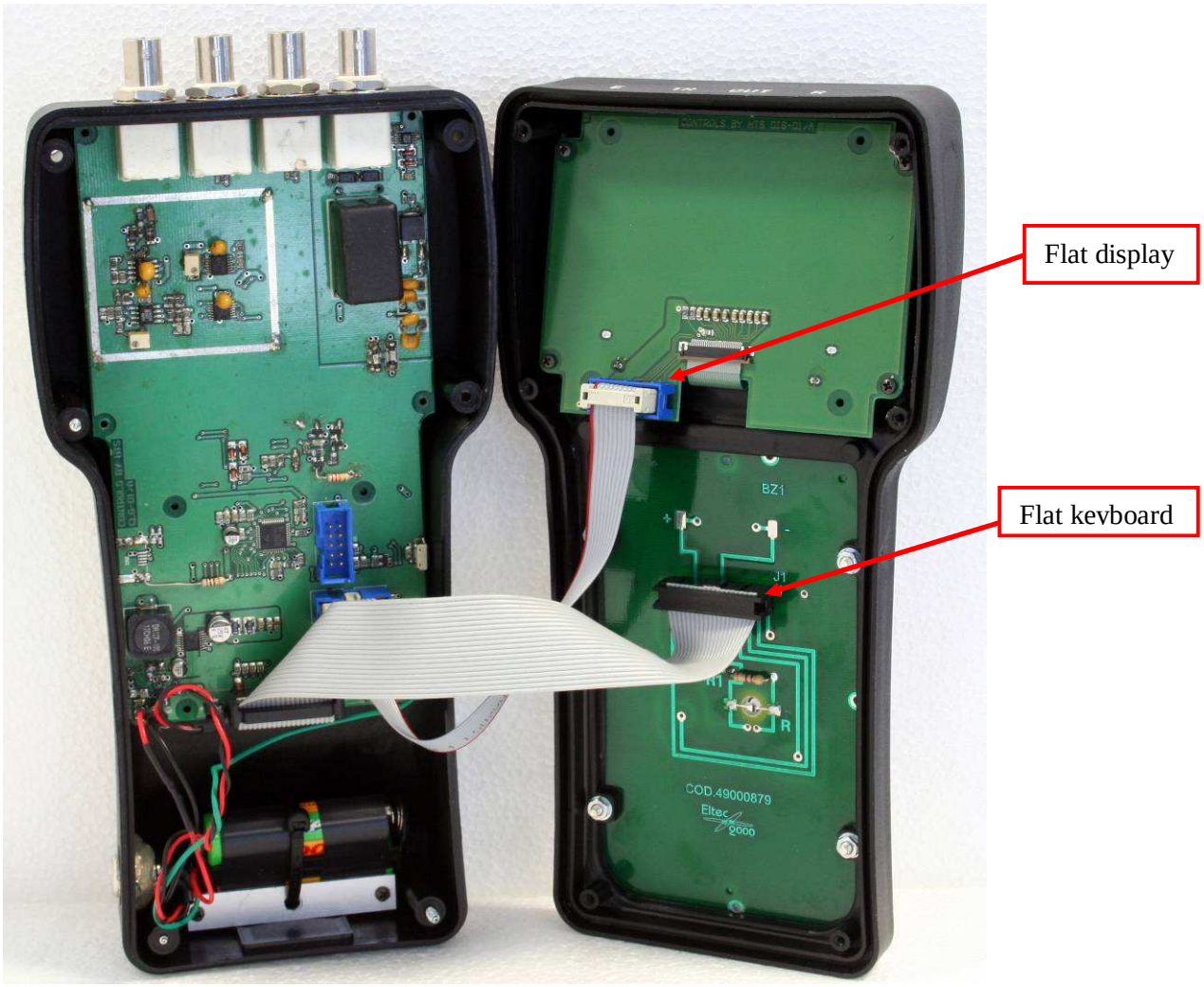


Fig. 5-1

6. SPARE PARTS

This chapter contains the list of spare parts. For each item, the following information is provided:

- CONTROLS order code
- Item description
- Quantity in the unit

Orders for spare parts have to be addressed to CONTROLS representatives.
When ordering spare parts, please provide code number, serial number, year of manufacture and any other useful information of the unit involved.

WARNING:
For continued fire protection, replace fuses with same type and rating. Also, in case of failure, components may only be replaced by using original spare parts.

Ref.	Codice ricambio/ Spare part code	Descrizione	Description	Q.tà in una apparecchiatura/ Q.ty in one unit
1	58-E4800/R01	Batteria ricaricabile	Rechargeable battery	2
2	58-E4800/R02	Tastiera	Keyboard	1
3	58-E4800/R03	Display	Display	1
4	58-E4800/R04	Scheda principale	Main board	1
5	58-E4800/R05	Carica-batterie	Battery charger	1
6	58-E0046/1	Sonda 54 Khz	Head 54 Khz	2
7	58-E0048/5	Cavo coax. 3mt.	Coax cable 3mt.	2
8	58-E0046/3	Gelatina	Contact paste	1
9	58-E0046/30	Sonda 24 Khz	Head 24 Khz	2 optional
10	58-E0046/33	Sonda 154 Khz	Head 154 Khz	2 optional

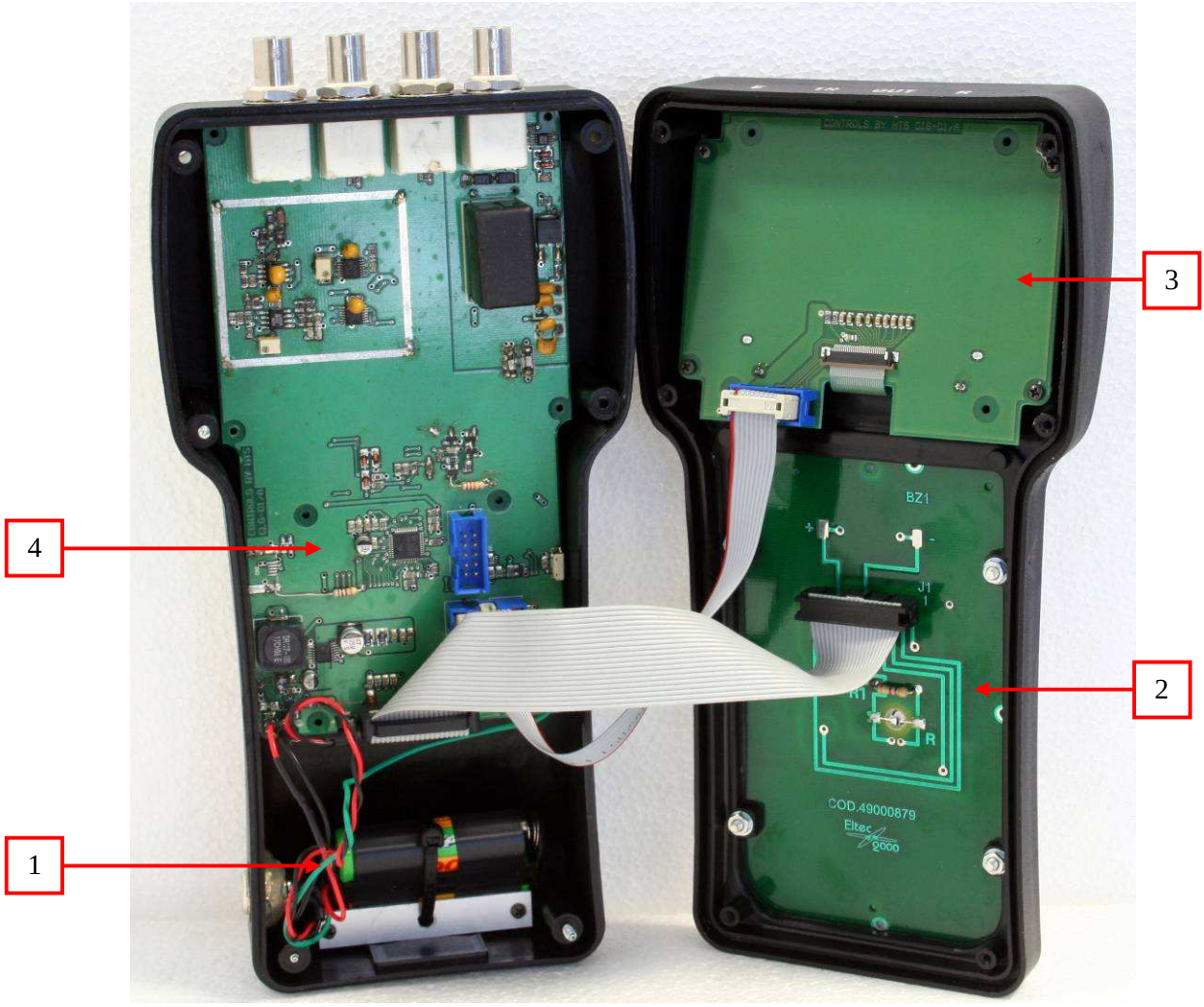


Fig. 6-1

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