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I N T R O M E T

ITM - 52

Eddy current instrument to measure
plated copper coating thickness
in printed circuit board (PCB) through holes

O P E R A T I N G M A N U A L

Revision 1.1

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PRINCIPLE OF OPERATION

The INTROMET ITM-52 instrument is designed for non-destructive non-contact measurement of the copper plating thickness in PCB holes. It can be applied in PCB production to maintain high PCB quality.

The instrument utilizes patented eddy current probes (US 5.600.240; EP 0 657 735 B1). It measures copper plating thickness before or after etching of the circuit pattern as well as under tin-lead solder layers.

INTROMET instrument consists of an electronic unit (Fig.1,2) and changeable probe unit with cable and connector (Fig. 3).

The eddy current measuring sensor fixed in the replaceable plug-in type cartridge (Fig. 3) consists of a metallic tube with super miniature windings printed inside. The probe cartridge can be easily changed if needed.

User inserts the tube tip with the windings (the probe tip) into a PCB hole under test. Electronic oscillator supplies the probe exciting winding and induces a high-frequency magnetic field around the probe tip. The magnetic field induces eddy currents in the copper plating of the hole under test.

Intensity of eddy currents in the plating depends on the copper thickness. Voltage, induced in the probe measure winding, depends on both the excitor winding magnetic field and the eddy currents magnetic field. By these means, the voltage supplied to the electronic unit pre-amplifier, represents the copper plating thickness in the hole. Instrument works under microprocessor control.

Attention!

Ensure the probe tip move freely through the hole and protrude from the hole by 1...1.5 mm (0.04"...0.06") on the opposite side of the PCB.

This is provided by inserting the probe in a hole *up to the stop*.

The calibration unit is applied for the instrument calibration. Calibration procedure provides high precision and excellent repeatability of measurements. Calibration settings are stored in the instrument memory. User can apply his own standards and store the calibration settings in the instrument's memory.

The parameters of the PCB under test, measure mode and print-out settings can be entered through the panel keypad.

Measure data can be stored in instrument's memory and be processed afterwards. Statistics of readings taken can be displayed, printed out and/or downloaded to an external computer.

Caution !

Before operating your new instrument, please, carefully read this Operating Manual

Warning to protect the probes

The tips of the probes are sensitive to mechanical stress.

Please, use the protective cap when the probe is out of use

Please make sure to insert the probe tip into the hole under test straight and perpendicular to the plane of the PCB

Never force the probe tip into a hole which may be too small or having an obstruction

Be extremaly careful using the probe for (0.45 ÷ 0.6) mm hole testing

The probe tips have a special acid-protective coating. By these means, the probes can be used to test holes in PCB without removing traces of plating solution from the PCB through holes.

Please remove all traces of plating solution from the probe surface after use

Caution !

To prevent erroneous measurements don't use the instrument (especially, the probe tip) close to power electromagnetic disturbance sources (power electromagnets, motors, high voltage power lines, transmitters, digital telephones and so on), see also p.7 "START UP"

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1. APPLICATION

The INTROMET ITM-52 instrument is applied to measure copper thickness in plated through holes (PTH) of printed circuit boards. The instrument realizes the non-destructive eddy current test method.

1.1. Applicable PCB

Board Design:

- ◆ Single or double cladded, multilayer
- ◆ Non-etched, etched
- ◆ Without or with tin or tin-lead coating

PCB Thickness:

- ◆ From 1.0 mm to 2.4 mm (from 0.04" to 0.96")

Hole Diameter:

- ◆ From 0.8 mm to 2.0 mm (from 0.032" to 0.080") - the base range
- ◆ From 0.6 mm to 0.8 mm (from 0.024" to 0.032") - the additional range
- ◆ From 0.45 mm to 0.6 mm (from 0.018" to 0.024") - the Extra Small range

1.2. Measuring Range and Resolution

Measuring Range:

- ◆ From 2 μ to 100 μ (from 0.1 mil to 4.0 mil) for hole diameters 0.6...2.0 mm
- ◆ From 2 μ to 60 μ (from 0.1 mil to 2.4 mil) for hole diameters 0.45...0.6 mm

Measuring Accuracy/Precision based on the supplied calibration standard, according to IEC 326-5 :

- ◆ 1.0 μ

1.3. Measuring Range and Resolution of measurement flat copper layer on a surface of PCB

- ◆ From 15 μ to 100 μ (from 0.6 mil to 4.0 mil)

Measuring Accuracy/Precision

- ◆ 2 μ + 0.05T, T is thickness of copper layer

2. FEATURES

- ◆ Inspection opportunity of the holes just after copper plating as well as on any stage of PCB production before or after etching
- ◆ Only one-side access to the holes is required
- ◆ No limitations on PCB size
- ◆ No need for electric contact with plating
- ◆ Plating defect detection capability
- ◆ Miniature and superminiature acid-protected probes patented
- ◆ Ultra wide range of holes diameters, down to 0.4 mm
- ◆ Two calibration techniques:
 1. Calibration with the two points:
 - Zero point - "air" value (the probe is held outside the hole);
 - "Cu - infinity" point - the probe is inserted into the proper hole of the calibrate unit.
 2. Three or more points calibration, utilizing other calibration standards with known copper thickness in the PTH (Master calibration)
- ◆ Visual and sound alarm threshold of measurement corresponding to the lower and upper tolerance limits of the measured plating thickness
- ◆ Measurements display either in metric (μ) or Imperial (mil) systems
- ◆ Automatic zero setting
- ◆ Elimination of the effect of the hole diameter in a wide diameter range
- ◆ Data memory with a capacity up to 15 000 measurements divided into 8 application files for different blocks (sequences) of measurements. Each file stores its own PCB and calibration settings
- ◆ Measure data statistics
- ◆ Date and time record
- ◆ IR interface for external computer / printer connection
- ◆ Measurement of flat layer thickness

3. CONTENTS OF SHIPMENT AND OPTIONS

*Please check the shipping box for possible damage.
If the instrument is damaged, please keep the packaging as proof
for claims against the freight forwarder*

3.1. Contents of shipment

The shipment contains the carrying case with the following contents:

- ◆ INTROMET ITM-52 with batteries installed in protective plastic cover and pouch
- ◆ Probe unit "EP-30" with installed cartridge, cable and protective cap
- ◆ Additional "EP-25" cartridge in protective housing
- ◆ Optional Extra Small probe "EP-20" with cable and protective cap
- ◆ Calibration unit with two holes marked "EP-30", "EP-25"
- ◆ Calibration standard for Extra Small probe with hole marked "EP-20" and hole of 0,6mm diameter
- ◆ Two ferrite beads to be placed on the probe cable while working in hard disturbance environment
- ◆ Hand-held Probe Guide HPH to insert the probe tip in PCB holes perpendicular to PCB plate
- ◆ Reference standard RS-51 of 1.6mm PCB thickness with 5 plated holes of 1.0mm diameter
- ◆ IR interface adapter to an external computer/printer
- ◆ Communication software for an external computer on a diskette
- ◆ Plug-in type AC adapter: 120 V/60 Hz or 220V/50 Hz
- ◆ Operating Manual

3.2. Options

- Spare probe cartridges "EP-30" and "EP-25";
- Probes "EP-30", "EP-25", "EP-20";
- PR-100 probe for measurements on flat surface;
- Set of PCB samples with different thickness of copper layer

4. POWER SUPPLY

INTROMET ITM-52 is supplied from two NiCad rechargeable batteries.

Unit working time before the battery recharge is approx. 8 hours.

"BAT LOW" display and 3 long-time sound alarms indicate that batteries are to be recharged. The instrument is turned off automatically. The batteries should be recharged as soon as possible.

An AC adapter is applied to recharge the batteries:

AC input: 220V/50Hz or 110V/60Hz (depends on the country)

DC output: 9V, 300mA

Common pole: "plus"

Turn off the unit. Connect AC adapter to the proper connector of the INTROMET unit. Connect AC adapter to mains supply. LED indicator lights up on the upper plate indicating the charge process.

In 4 hours or so, after the full charge completed, recharge is stopped automatically and LED indicator "Charge" lights down.

CAUTION

Apply only NiCad rechargeable batteries for power supply

5. OPERATION CONTROLS AND DISPLAYS

INTROMET ITM-52 has a plastic housing with the graphic LCD display and membrane keypad (Fig. 1) on the front panel.

On the rear panel of the housing, there is a cover of the battery compartment which is removed to change batteries (Fig. 2).

On the upper plate of the housing probe connector, serial port connector, DC input connector and LED display "Charge" are placed.

Probe unit with cartridge installed is presented on Fig. 3.

The plastic protective cover is to provide instrument protection against corrosive vapor and liquids while the instrument is in use close to electroplating baths.

The leather pouch is to provide instrument protection against mechanical damage while carrying and operating. It has a self adhesive fastener to fix on operator's hand for convenient measuring.

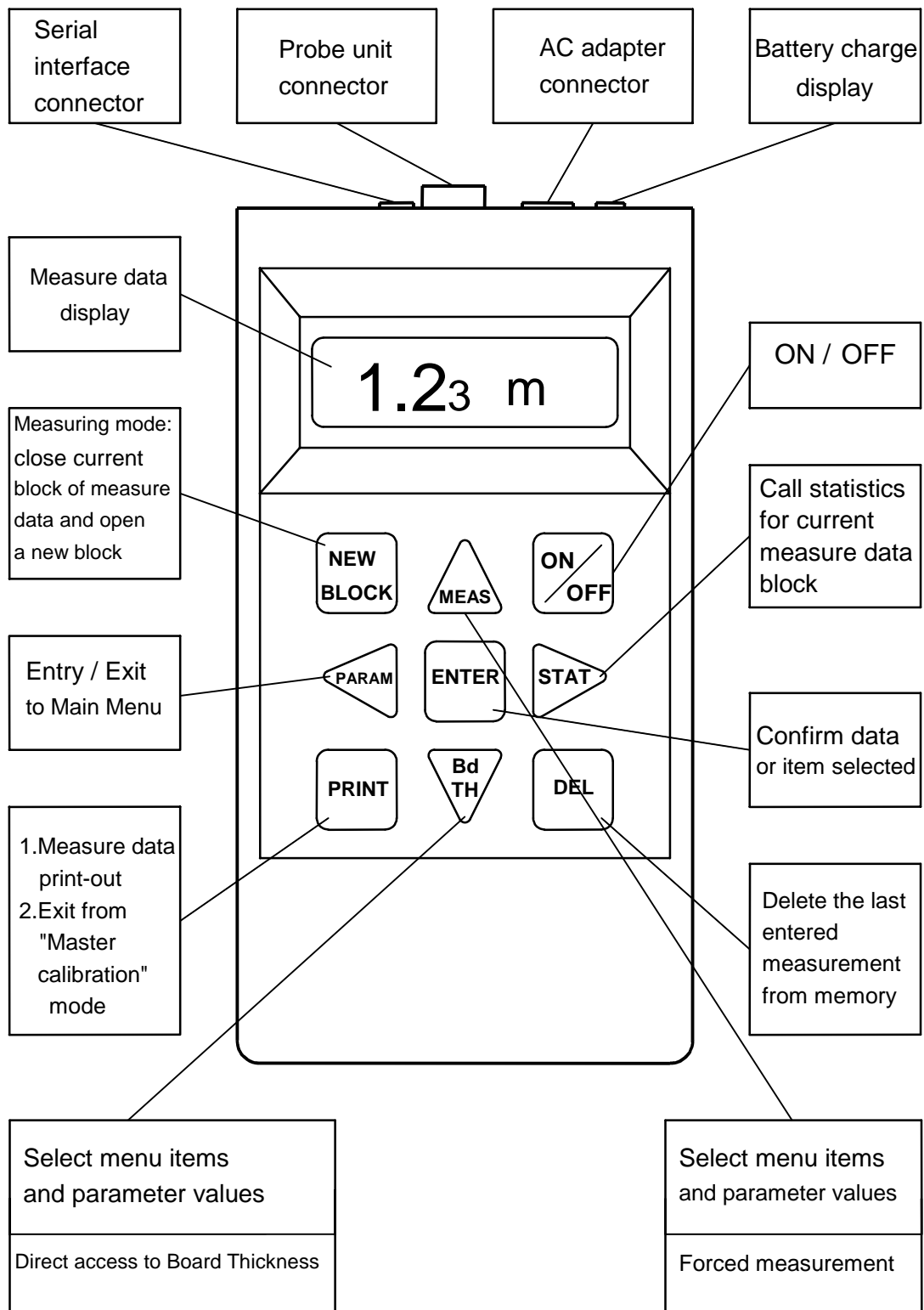


Fig.1. Front panel

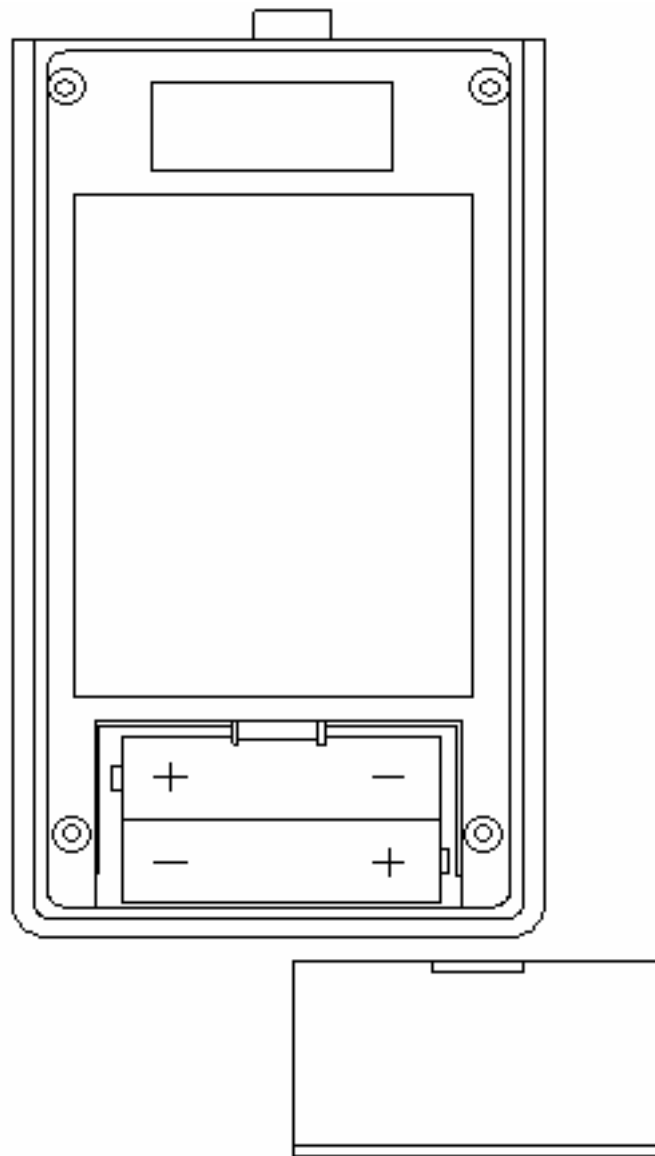


Fig.2. Rear panel. Battery compartment cover is open

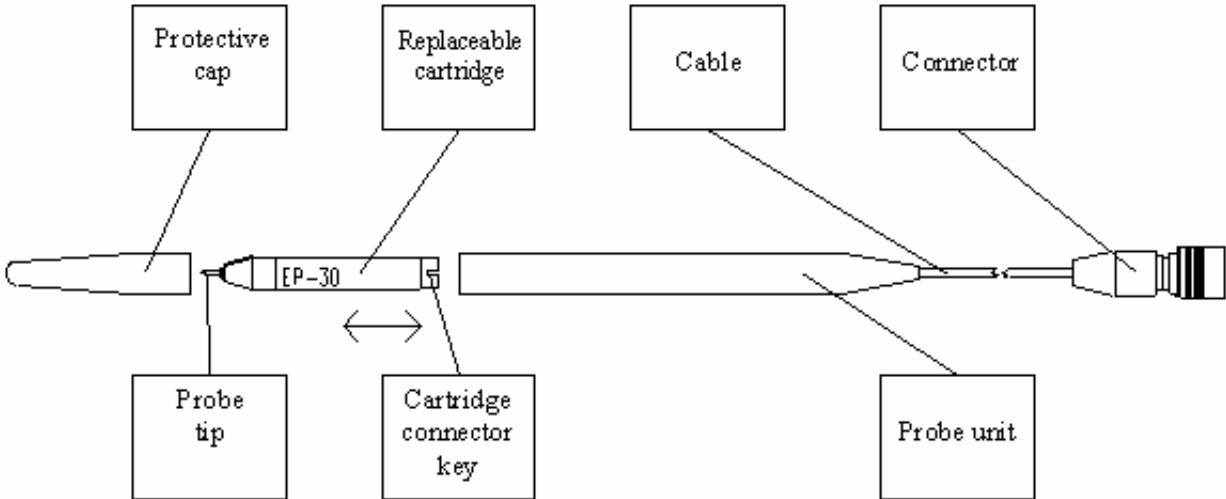


Fig. 3. Probe unit with replaceable cartridge

6. FACTORS INFLUENCING THE MEASUREMENT

There are a few factors which influence the copper thickness measurement in plated holes while applying the INTROMET ITM-52.

The main factors are as following:

6.1. Geometric effects

The influencing geometric factors are:

PCB thickness, hole diameter, copper cladding thickness on PCB and dimensions of inner copper traces in the case of multilayer PCB.

The **PCB thickness** influence is eliminated by entering board thickness actual value via the keyboard before measuring. Board core thickness variations within a tolerance limit of 10% result in copper thickness reading variations of approx. 3%, independent of the copper cladding thickness.

The hole 0.8 mm to 2.0 mm diameter variation causes an additional error of the readings taken with "EP-30" probe, not more than (1...2) μ . The measure errors for (0.45-0.6) mm and (0.6-0.8) mm hole diameters are still less.

The measurement reliability can be improved by instrument calibration applying standards with known copper thickness in the through-holes. The copper thickness in the standard PTH may be determined, for instance, through the metallographic cross-section technique. However, the actual errors of standard certification should be properly taken into account.

The effects of **copper cladding thickness** as well as the dimensions of **contact pads, outer and inner** (for multilayer PCB), **copper traces** of etched PCB are usually negligible for commonly produced PCB. However, the copper thickness reading for the hole without contact pads around it may be significantly less than the real value. In this case, measure result may be corrected through multiplying the reading by an experimentally defined correcting coefficient. The correction is not necessary if the contact pad diameter is greater than twice the hole diameter, according to IEC 326-3.

6.2. Electric conductivity

The electric conductivity of electroplated or electrolyze deposited copper depends basically on the plating bath conditions and chemistry.

The copper electric conductivity in the most applicable plating processes equals approx. (50 \pm 3) MS/m or (86 \pm 5,3)% IACS. The value of 50.0 MS/m is taken as the base one for the preliminary calibration of the instrument.

Note

1 MS/m = 10^6 S/m = 10^6 1/(Ohm · m);

100% IACS = 59.5 MS/m - electric conductivity of pure copper (20° C)

1 MS/m = 1.72% IACS;

1% IACS = 0.58 MS/m

If the copper electric conductivity at the User's site differs significantly from the base value of 50.0 MS/m and is definitely known, User can change the conductivity value via the keyboard (Direct method, Chap. 9.2.4.1).

If the actual value of the electric conductivity is unknown, it can be entered through the Indirect method (see Chap. 9.2.4.2) applying the standards with known copper thickness produced at the User's.

6.3. Tin - Lead alloy coating

Due to the electric conductivity of tin-lead alloy is much lower than of the copper conductivity, a 10 μ thickness Sn-Pb layer results in an increase in the copper thickness measurement of approx. 10% when the copper thickness is approx. 25 μ . This effect decreases with increasing of copper plating thickness.

That is why the tin-lead coating influence can be stated as a negligible one.

6.4. Temperature

The copper electric conductivity is temperature dependent. The higher the temperature, the lower the electric conductivity. Assuming the electroplated copper has the same temperature coefficient as the pure copper, a 10° C change in temperature will result in the 4% change of conductivity, which should be taken into consideration during calibration.

Example:

- ◆ Temperature of the standard at time of calibration : 25° C
- ◆ Temperature of the board under test : 30° C
- ◆ Change of conductivity : -2%

As the base value 50.0 MS/m of the electric conductivity is considered for base calibration, User enters 49 MS/m value for Direct method correction (see Chap. 9.2.4.1).

For Indirect correction (see Chap. 9.2.4.2) User can apply the standard board with the same temperature as the board under test.

RECOMMENDATIONS

To make sure the instrument readings are correct compare the readings taken with the results of measurements in the same holes by another technique, e.g., by microscope when the cross-section method is applied. This comparison can be useful when User starts instrument application.

If the INTROMET readings differ from the measure results of an arbitrary method both systematically and significantly, it is possible that the actual electric conductivity value differs significantly from the base value of 50.0 MS/m. In this case User can apply Direct or Indirect methods of reading correction through entering the actual value of conductivity. Entering the lower value of conductivity User increase the readings and vice versa.

If the results differ significantly but are variable we recommend you to contact us. We will help you to determine the cause and to adapt the instrument to your conditions.

In any case, be careful in evaluating the standard reliability and measurement errors of an arbitrary method, e.g. of a cross-section method. These above mentioned errors may be significantly more in value than the errors of the INTROMET instrument.

Caution !

To prevent erroneous measurements don't use the instrument (especially, the probe tip) close to power electromagnetic disturbance sources (power electromagnets, motors, high voltage power lines, transmitters, digital telephones and so on)

7. START UP

Take the instrument out of the carrying case and mount it, most conveniently for you, on desktop or fixed on hand.

Take the probe unit out of the carrying case. Plug the probe unit cable connector into the probe socket on the upper plate of instrument and remove the protective cap.

Ferrite beads attached must be placed on the probe cable (at two ends of the cable: close to the probe unit and to the probe connector) to ensure correct readings in hard electromagnetic disturbance environment.

Note

If you are going to measure in the holes with diameter laying in the range of (0.6-0.8) mm (0.024"-0.032"), install the cartridge "EP-25" into the probe unit. If you are going to measure in Extra Small range of hole diameters: (0.45-0.6) mm (0.018"-0.024"), apply the optional probe unit "EP-20".

Turn on the instrument by pressing "ON/OFF" key.

Just after been turned on, the instrument is ready to measure with the default BASE SETTINGS:

- calibration characteristic - Base;
- copper plating thickness indication - in μ ;
- board thickness - 1.6 mm;
- copper electric conductivity - 50.0 MS/m;
- measure data is stored;
- out of tolerance measured copper thickness sound and visual alarm is on;
- the lower limit of copper thickness - 15.0 μ ;
- the upper limit of copper thickness - 35.0 μ .

Any settings can be changed (excepting "measure data is stored") through the Main Menu of the instrument and held on for the next measurement sessions.

8. MEASURING OPERATION

"Measuring" is the main mode of the instrument operation. The instrument is ready to measure just after been turned on.

Two modes of measuring are available:

1. Auto start measuring mode.
2. Free-running display mode.

In the Auto start measuring mode a measurement is taken automatically at the moment when the probe tip is inserted into a hole. The reading appears on the main display and is stored in the instrument memory.

In Free-running display mode measurements are performed continuously in the cycle of 1 S and display. Measurements are not stored in the instrument memory.

8.1. Measure data storage

When measurements are performed in the Auto Start measuring mode sequences of measurements are integrated in BLOCKS in the instrument memory. Month, date, hour and minute of the BLOCK creation form its initial name. Later User can change a block name for any desired (Chap. 11.2.). Data blocks can be called out for display, printing and removal from the instrument memory by their names. The block created during the current measuring session, is named ACTIVE. When measuring session has been completed and "**NEW BLOCK**" key pressed, the current block is closed (becomes non-active) and a new data block opens and becomes ACTIVE. If the "**NEW BLOCK**" key not pressed after measuring session, the current block stays ACTIVE.

Thus, after the instrument is turned on, the ACTIVE BLOCK is the one which was current before turning off.

All the measurement data blocks are combined into 8 FILES with initial names: APPL0 ... APPL7. File names can be changed for desired too (Chap. 9.2.2).

Each file has one block as an ACTIVE one.

The instrument has two groups of preliminary settings.

1. Actual for all the data files - global settings:
 - built-in clock (Chap. 9.1.1)
 - measure system unit (Chap. 9.1.2)
 - sound and visual alarm on/off (Chap. 9.1.3)
 - backlight on/off (Chap. 9.1.4)
 - print-out parameters (Chap. 9.1.5).

2. Actual for the individual file only - file settings:

- board thickness (Chap. 9.2.3)
- copper electric conductivity σ (Chap. 9.2.4)
- copper plating thickness tolerance limits: upper and lower (Chap. 9.2.5).

According to the above mentioned, measure data can be stored in different files according to the calibration parameters: board thickness, copper conductivity σ and plating tolerance limits.

Measure data can be removed from the instrument memory in the following ways:

- the last measurement taken in the ACTIVE block through pressing “DEL” key in the measuring mode (see Chap. 8.3)
- an individual measurement in the open block through pressing “DEL” in “BLOCK/VEIW” mode (see Chap. 11.3);
- an individual block separately in the selected file through command “BLOCK/Deleting” (see Chap. 11.5);
- all the blocks of the selected file simultaneously through command “FILE/Clear” (see Chap. 9.2.7).

8.2. Control through Main Menu

The instrument operates under the control of the special software embedded in the instrument program memory. Software provides User to control the instrument operation, to make various parameter settings via keyboard. The structure of the program is presented in Fig. 4.

The program is built as a system of menus and submenus of the different levels. These menu items are presented on the main display during the instrument operation.

Main Menu (Top level).

Items: FILE, CAL, BLOCK and SETUP form the Main Menu.

The items of the Main Menu present menus of the second level which are lists of commands and submenus.

To enter the Main Menu from Measuring mode, press “PARAM” key.

To select the item required User moves through the Main Menu using “↑” and “↓” “Arrow” keys. The list of items can be scrolled through like a “closed ribbon”. This movement is indicated on the main display through changing item names displayed. To entry the item required, select the item and confirm the selection by pressing “ENTER” key.

To return from the Main Menu into Measuring mode, press “PARAM” key again.

Menus (Second level).

Items of the second level are arranged in the lists of submenus and groups of commands according to the item of Main Menu as a heading.

To select the item of the menus, enter the proper item of Main Menu and select the required item of the second level applying vertical arrow keys ↑ and ↓.

To confirm the item selection press “ENTER” key.

To exit from menu to Main Menu press “PARAM” key.

Submenus and commands.

Submenus and commands are the items of the second level menus. By selecting these items User can set up various parameters: PCB parameters, tolerance limits, alarms, clock and so on, look through the measure data stored in memory or delete some measure data from the memory if needed.

- Inside submenus vertical arrow keys “↑” and “↓” are used
- to scroll the file/ block lists of contents;
 - to change parameter values up and down.

In the submenus when one of the items in the row on display is highlighted via “negative picture”, the keys “**PARAM**” and “**STAT**” change their meaning to the horizontal arrows “←” and “→”. These horizontal “arrow” keys are used for selecting items inside the submenus only.

To exit from submenu press “**ENTER**” key.

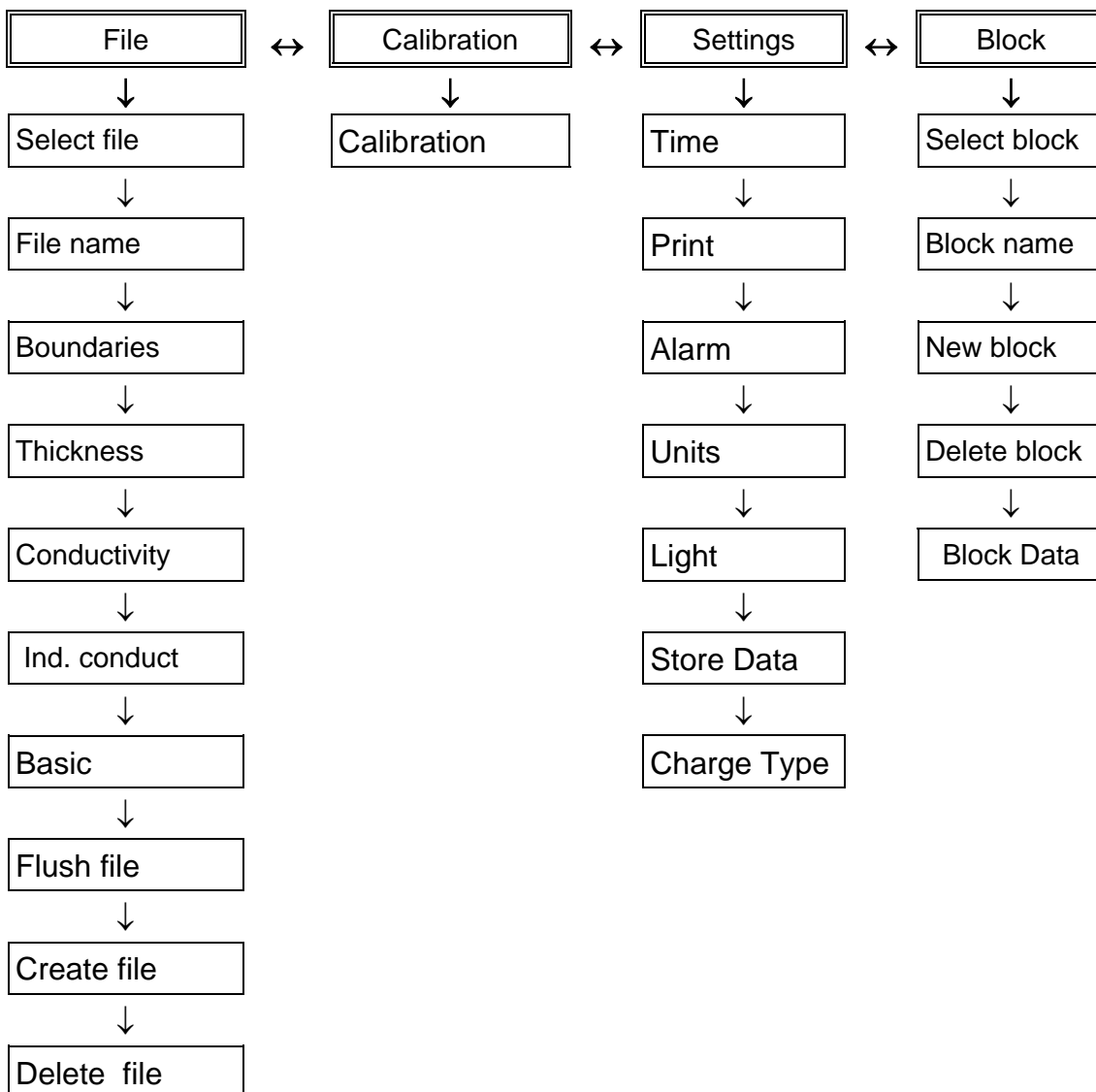


Fig. 4 Structure of Main Menu.

8.3. Measuring in Auto Start Mode

In this mode a current measurement is taken at the moment when the probe tip is inserted into a hole up to the stop. The instrument indicates the measurement by a short-time sound, displays the reading and holds it till next measurement. The measure data is stored in the ACTIVE block of the current file.





Functions available through key pressing:

- “**NEW BLOCK**” - close the current block and open a new one which becomes ACTIVE;
- “**PARAM**” - entry into Main Menu;
- “**PRINT**” - transfere the measured data of the ACTIVE block to printer or computer via infra-red port;
- “**MEAS**” - force the measurement when copper plating thickness in a hole is very low: 2...5 μ (measurement auto start may not work). Press the key holding probe tip in the hole;
- “**Bd TH**” - entry directly into “Board thickness” item of Main menu;
- “**STAT**” - display statistics of the ACTIVE block data;
- “**DEL**” - delete the measurement performed the last in order.

In the Auto Start Mode a measurement is taken in the manner as it is illustrated in the following example:



Attention

Please, make sure there is free space under the board, so the probe tip when inserted into the hole down to the stop could protrude through the hole by 1...1.5 mm (0.04"-0.06") on the board opposite side

KEY	DISPLAY	OPERATION
1. ON/OFF	Self calibration	 Turn on the instrument. Probe tip is in air. “Self calibration” indicates for 10 seconds.
2.	Def. File 1 C=50.0MS/mT=1.50 mm Min:15.0 μ Max:35.0 μ	 Instrument is ready to measure.
3.	T=1.5 C=50 25.3μ(*)	 Insert probe tip into the hole under test. Sound signal indicates the measurement is taken and reading appears on display. Measurement is stored in active block of a current file
4.	T=1.5 C=50 25.3μ(*)	 Take probe tip out of the hole. Display holds the reading
5.		Repeat Operations 3, 4 for another hole to be tested (***)












NOTE

To delete the last-in-order measurement, press "DEL" key. Erroneous reading disappears from display and memory.
 The last measurement of the block cannot be deleted. For this measurement removal use "BLOCK/Deleting" routine

- | | | | | |
|--------|---------------|-------------------------|---|---|
| 6. DEL | T=1.5
C=50 | 35.3 $\mu^{(*)}$ |  | Press "DEL" key to delete measurement taken the last in order |
| 7. | T=1.5
C=50 | 0.0 μ |  | Erroneous measurement disappears from display. |

NOTE

For ACTIVE block statistics calling, press "STAT" key. Active block statistics display

- | | | | |
|-----------|------------------|---|--|
| 8. STAT | Data Amount |  | Number of measurements in block displays |
| | N= 9 | | |
| 9. ↑ | Average |  | Average value of block measurements displays |
| | 26.2 μ | | |
| 10. ↑ | Minimum |  | Minimum value of block measurements displays |
| | 49.1 μ | | |
| 11. ↑ | Maximum |  | Maximum value of block measurements displays |
| | 25.6 μ | | |
| 12. ↑ | Range |  | Range value of block measurements displays |
| | 1.0 μ | | |
| 13. ↑ | Deviation |  | Standard deviation of block measurements displays |
| | 0.3 μ | | |
| 14. ↑ | Coeff.Var. |  | Coefficient of variation of block measurements displays |
| | 0.69 % | | |
| 15. ↑ | CP |  | Coefficient CP displays |
| | 24.005 | | |
| 16. ↑ | CR |  | Coefficient CR displays |
| | 0.042 | | |
| 17. ↑ | CPK |  | Coefficient CPK displays |
| | -14.068 | | |
| 18. Param | T=1.5
C=50 |  | Return to measuring mode. Instrument is ready to measure |
| | 0.0 μ | | |

NOTE

For transferring the active block data via IR-port and press "**PRINT**" key

19. PRINT

PRINTING ...



Measure data is being transferred out. After transferring completed, string "PRINTING" disappears from display

NOTE

To hold the current block still active do not press "**NEW BLOCK**" key, (e.g. for next measurement storage)

20. NEW
BLOCK
21.

Block created



Active block is closed. A new block is created.

T=1.5
C=50



New block is active.

0.0 μ

(*) All the values are for illustration only.

(**) When turned on for the first time, the instrument stores the base calibration characteristic and the base PCB parameters: copper special conductivity $\sigma=50$ MS/m and board thickness- 1.6 mm (see Chap.10 and Chap. 9). Current file name "APPL 7" displays.

NOTE

The small radial displacements of the probe tip in a hole under test cause slight variations in copper plating thickness readings. To prevent these variations User can apply a Desktop Stand DPS-3 (See Chap. 3.2).

The plating defect, such as a crack of the plated copper or a large bare spot on hole sleeve can be easily detected through sharp decrease in copper thickness readings.

When holes of some area on the plate of PCB are tested and mean value of copper plating thickness in these holes is calculated you can detect the hole with defective plating through significant (25...40)% decrease of the instrument reading (against the mean value)

Attention

The instrument is turned off automatically in 4 minutes after the last measurement or key pressing. Signal sounds before turn-off

8.4. Measuring with Free-running display

In the Free-running display mode measurements are executed continuously in the cycle of approx. 1 S and the readings display. The readings are not stored in the instrument memory in opposite to the Auto Start mode.

While measuring, actual are the settings, which are preliminary, set in the current file.

NOTE





When copper plating in a hole is very low or probe tip is out of a hole, "AIR" displays and measurement is not taken. To force the measurement, press "**MEAS**" arrow key, holding probe tip in the hole under test

Functions available through pressing keys: "**PARAM**" - entry into Main Menu.

This mode is convenient, particularly, for plating defect detection.

The probe is sensitive to axis rotation. This is beneficial to detect short circular cracks in copper deposit, which cause fluctuations in the instrument readings while the probe rotates. To perform this operation effectively User can apply the Desktop Stand DPS-3 (see Chap. 3.2).

Measuring with Free-running display is executed in the following manner:

KEY	DISPLAY		OPERATION
1. ON/OFF	Self calibration		Turn the instrument on
2. ENTER	Def. File 1 C=50.0MS/mT=1.50 mm Min:15.0μ Max:35.0μ		Instrument is ready to measure.
3.	T=1.5 C=50 25.3μ(*)		Insert probe tip in the hole under test down to stop. Reading displays. Signal sounds when measurement taken
4. ENTER	T=1.5 C=50 25.3μ(*)		Take probe tip out of hole. The instrument is on Free-running display mode

(*) Values are for illustration only.

NOTE

When probe tip inserted, measurements are taken continuously in cycle of 1 s. If a measurement is accidentally taken while the probe tip is moving out of hole under test, it may cause the reading sufficiently different from the actual copper thickness value. That's why, take readings executed only when probe tip is inserted down to the stop

9. PRELIMINARY SETTING

The instrument is supplied with the default parameter settings made at the Manufacturer's. When any settings are to be changed, User can easily do the changes required through the proper items of the Main Menu.

It is important to remember there are **two groups of settings** in the instrument:

1. **Global settings** - actual for all the instrument measurements and all the data files in the instrument memory - are changed through "SETUP" item of Main Menu:

PARAMETER		DEFAULT VALUE
- built-in clock	(Chap. 9.1.1)	Greenwich Mean
- measure unit system	(Chap. 9.1.2)	Metric
- sound alarm turning on/off	(Chap. 9.1.3)	On
- backlight delay	(Chap. 9.1.4)	Off
- print-out parameters	(Chap. 9.1.5)	All On

2. **File settings** - actual for the individual data file only - are changed through "FILE" menu of the Main Menu:

PARAMETER		DEFAULT VALUE
- file name	(Chap. 9.2.2)	Default File
- PCB thickness	(Chap. 9.2.3)	1.6 mm
- copper electric conductivity σ	(Chap. 9.2.4)	50 MS/m
- copper plating thickness tolerance limits: lower and upper	(Chap. 9.2.5)	15 μ ÷ 35 μ

Before the measurements are performed check up the preliminary settings and set the proper values for parameters if needed

9.1. Global settings











Such settings are actual for all the measurements the instrument makes, stores and displays and provide the convenience of the instrument usage. They work in all the files of the instrument memory.

9.1.1. Clock setting

The instrument has a built-in clock with automatic correction for leap-years. The measure data blocks in the memory are distinguished by the initially. Date and time of the measurements taken are presented in the print-out listing.

The instrument is supplied with the built-in clock set according to Greenwich Mean time.

Date and time are corrected accurate to 1 S through "SETUP/Clock" item of the Main Menu in the following manner:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑/↓	Settings		Select "Settings" menu
3. ENTER	Settings → Print		Entry to "Settings" menu
4. ↑/↓	Settings → Time		Select "Time" item
5. ENTER	<u>6</u> -Aug-2 ^(*) 16:23:45		Entry to "Time" submenu. Date is highlighted and ready for correction initially
6. ←/→	6-Aug-2 ^(*) 16: <u>23</u> :45		Select one of items of submenu for correction. Selected item is highlighted through inverse picture
7. ↑/↓	6-Aug-2 ^(*) 16: <u>44</u> :45		Correct the item value. Repeat operations 6, 7 for other items if needed
8. ENTER	Settings → Time		Corrected values stored. Return to "Settings" Menu.
9. PARAM	Settings		Return to Main Menu
10. PARAM	T=1.5 C=50 0.0 μ		Exit from the Main Menu. Instrument is ready to measure with new clock settings

(*) Time setting values are for illustration only.










9.1.2. Measure unit system setting

The instrument is capable to display the readings for the copper thickness either in metric (μ) or in Imperial units (mils).

$$1 \text{ mil} = 0.001 \text{ inch} = 25.4 \mu$$

If metric system chosen, copper electric conductivity σ is presented in MS/m and when Imperial system is in use, σ displays in %% IACS.

Convenient measure unit system selection is executed through the "SETUP/Unit" item of Main Menu in the following manner:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. \uparrow/\downarrow	Settings		Select "Settings" menu
3. ENTER	Settings → Print		Entry to "Settings" menu
4. \uparrow/\downarrow	Settings → Units		Select "Units" item
5. ENTER	Metric		Entry to "Units" submenu. Date is highlighted and ready for correction initially
6. \uparrow/\downarrow	English		Select Imperial units (mils)
7. ENTER	Settings → Units		Return to "Settings" Menu.
8. PARAM	Settings		Return to Main Menu
10. PARAM	T=1.5 C=50 0.0 m		Exit from the Main Menu. Instrument is ready to measure with new clock settings

9.1.3. Turning on/off the sound and visual alarm

The indication of the situation when the reading is out of the tolerance limits can be turned on/off through “Settings|Alarm” item of the Main Menu for User’s convenience.










If sound and visual alarm is turned on, a picture of the bell displays in the left lower corner of the main display in the Measuring Mode.

A specific signal sounds and special symbols display when a reading is out of the tolerance limits which can be set preliminary.

When the copper thickness in a hole under test is less than the lower limit the “TL” characters display in the upper left corner of the main display.

When the copper thickness in a hole under test is over than the upper limit the “TH” characters display in the upper left corner of the main display.

Turning on the sound and visual alarm is executed in the manner illustrated in the following example:

KEY	DISPLAY	OPERATION
1. PARAM	File	 Entry into Main Menu
2. ↑/↓	Settings	 Select "Settings" menu
3. ENTER	Settings → Print	 Entry to "Settings" menu
4. ↑/↓	Settings → Alarm	 Select “Alarm” item
5. ENTER	On	 Entry to “Alarm” submenu.
6. . ↑/↓	Off	 Sound and visal alarm is turned off.
7. ENTER	Settings → Alarm	 Corrected values stored. Return to "Settings" Menu.
8. PARAM	Settings	 Return to Main Menu
10. PARAM	T=1.5 C=50 0.0 μ	 Exit from the Main Menu. Instrument is ready to measure with new clock settings

If needed to turn on the alarm, repeat the operations 1...8 in the same way once more.










NOTE

Alarm system does not work if there is no copper plating in the hole at all

9.1.4. Backlight delay setting

The usage of the display backlighting demands a sufficient power consumption and results in decreasing the time of the instrument operation before the batteries are discharged when the instrument is supplied from batteries. For saving the battery energy User can set an Automode of backlighting. The delay between the moment of the last measurement taken or any key pressing and the moment of backlight turn-off equal 6 sec in this mode. The next measurement or any key pressing (e.g. arrow key) turns on the backlight.

Setting the backlight delay is executed through the "Setting|Backlight" of the Main menu in the manner illustrated in the following example:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑/↓	Settings		Select "Settings" menu
3. ENTER	Settings → Print		Entry to "Settings" menu
4. ↑/↓	Settings → Light		Select "Light" item
5. ENTER	On		Entry to "Light" submenu.
6. . ↑/↓	Auto		Automode is turned on.
7. ENTER	Settings → Light		Corrected values stored. Return to "Settings" Menu.
8. PARAM	Settings		Return to Main Menu
9. PARAM	T=1.5 C=50 0.0 μ		Exit from the Main Menu. Instrument is ready to measure with Automode of backlighting

9.1.5. Print-out setting

Measure data can be printed out to an external computer or a printer through a serial interface.

Measure data block print-out (if a printer connected) is available via pressing "**PRINT**" key in two modes:

- directly while measuring (from ACTIVE block)
- through "BLOCK" item of the Main Menu while processing the measure data stored in the instrument memory afterwards (from the block preliminary selected).

The print-out listing received will present the measure data of the current block:

1. The title (always printed)

- the instrument Manufacturer name: INTRON PLUS
- the instrument type: INTROMET ITM-52
- name of file (number)
- block name (date and time of block creation)
- upper tolerance limit value
- lower tolerance limit value
- thickness of board
- conductivity of copper plating

2. Block measure data in digital format:

Parameters: Table on

3. Block measure data in graphical format:

Parameters: Graph on

4. Statistics for block measure data:

Parameters: Statistics on

5. Histogram for block measure data;

Parameters: Histogram on

Setting the proper parameters "ON" or "OFF" User defines the contents of measure data print-out listing.

Below come examples of listings in following formats:

- 1 - Histogramm off; Statistics off; Graph off; Table on
- 2 - Histogramm off; stt: off; Graph on; Table on
- 3 - Histogramm on; Statistics on; Graph off; Table off.

Example 1 (*)

Measure data block print-out in digital format :

Parameters: Histogramm off; Statistics off; Graph off; Table on.

INTRON PLUS INTRONET ITM-52

Product:

Name:

--FINAL RESULT--

FILE: Def. File 8 BLOCK: 06/23/95 15:11

TH = 35.0 μ TL = 15.0 μ Board = 1.60 mm Cond = 50.0 M

11.0 μ 15.4 μ 15.4 μ 27.2 μ 27.4 μ 27.2 μ 43.1 μ 43.3 μ 66.1 μ

NOTE:

- FINAL RESULT- : type of printing

APPL 7 : file name containing the block 04/11/95 18:31

Example 2 Measure data block print-out in graphical format:

Parameters: Histogramm off; Statistics off; Graph: off; Table on.

INTRON PLUS INTRONET ITM-52

Product:.....

Name:.....

--FINAL RESULT--

File: Def. File 4 BLOCK: 06/28/95 12:02

TH = 32.0 μ TL = 12.0 μ Board = 1.60 mm Cond = 50.0 M

			12.0μ		32.0μ
1	03.1μ		:<<:		: : 03.1μ
2	09.3μ		:<<:		: : 09.3μ
3	09.2μ		:<<:		: : 09.2μ
4	14.1μ		: :	*	: : 14.1μ
5	14.1μ		: :	*	: : 14.1μ
6	18.9μ		: :	*	: : 18.9μ
7	18.8μ		: :	*	: : 18.8μ
8	18.8μ		: :	*	: : 18.8μ
9	30.2μ		: :		* : : 30.2μ
10	29.5μ		: :		* : : 29.5μ

NOTE

12.0 μ - lower tolerance limit value

32.0 μ - upper tolerance limit value

<<: - measurement is below the lower limit

:>> - measurement is over the upper limit.

Example 3 Measure data block print-out with histogram and statistics:
 Parameters: Histogramm on; Statistics on; Graph: off; Table off

INTRON PLUS INTROMET ITM-52

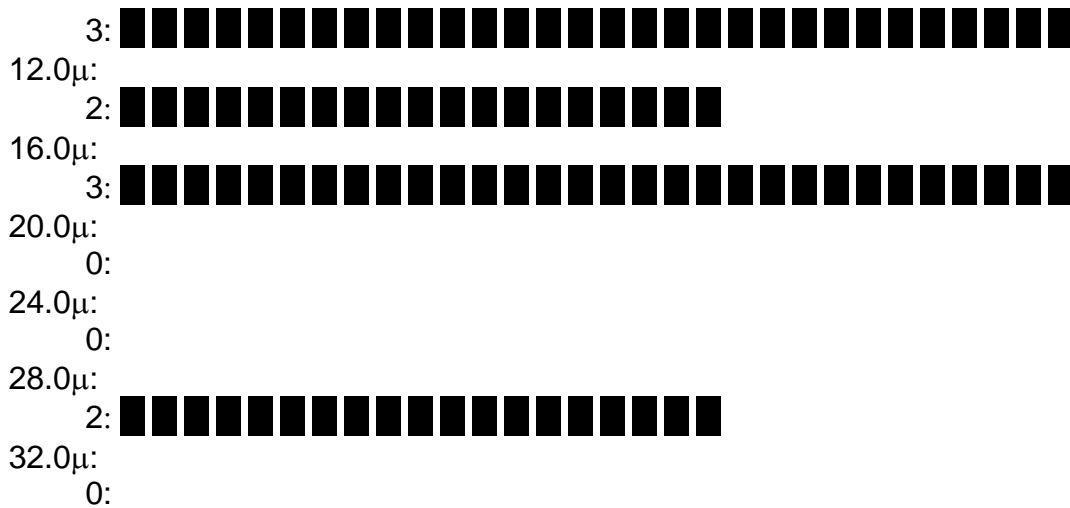
Product:.....

Name:.....

--FINAL RESULT--

File: Def. File 3 BLOCK: 06/28/95 12:02
 TH = 32.0μ TL = 12.0μ Board = 1.60 mm Cond = 50.0M
 Mean = 16.6μ +/- = 27.1μ N = 10 Std.Dev. = 08.6μ Coeff.Var. = 51.8% Min.
 Read = 03.1μ Max. Read = 30.2μ CP = 00.38 CR = 02.60 CPK = 00.17

HISTOGRAM



- 2: **; 3: ***** - Histogram column graphical image with interval quantity presented
- Mean - Copper thickness mean value in μ (see Chap. 13)
- +/- - the range of measurements in μ
- N - number of measurements in the current block
- Std.Dev. - Standard deviation of measuring series (see Chap. 13)
- Coeff.Var. - Coefficient of variation (COV) (see Chap. 13)
- Min. Read. - Minimum value of block measurements in μ
- Max. Read. - Maximum value of block measurements in μ
- CP, CR, CPK - coefficients CP, CR, CPK accordingly

Block measure data print-out parameter setting is executed through the “Setting|Print” of the Main Menu in the following manner:

KEY	DISPLAY	OPERATION
1. PARAM	File	Entry into Main Menu
2. ↑ / ↓	Settings	Select “Settings” menu
3. ENTER	Settings → Print	Entry in “Settings” menu
4. ENTER	Print → Histogramm	Entry in “Print” submenu.
5. ENTER	On	Entry to "Histogramm " item. Histogramm is on
6. ↑ / ↓	Off	Histogramm is on.
7. ENTER	Print → Histogramm	Histogramm off confirmed Items “Statistics”, “Table” and ”Graph” may be selected by ↑ / ↓ keys.
8. PARAM	Settings → Print	New print settings stored. Return to “Settings” menu
9. PARAM	Settings	Return to Main Menu
10. PARAM	T=1.5 C=50 0.0 μ	Exit from Main Menu. Instrument is ready to print out

(*) The chosen item name is for illustration only.

Attention!










Unit serial interface settings are as follows(can not be changed):

Baud	9600
Parity	None
Wordlength	8
Stopbits	1

9.1.6. Data storing

The instrument has an ability to turn on/off automatic data storing in auto start measuring mode.

Setting the data storing mode is executed through the “Setting|Store Data” of the Main menu in the manner illustrated in the following example

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑ / ↓	Settings		Select “Settings” menu
3. ENTER	Settings → Print		Entry in “Settings” menu
4. ENTER	Settings → Store Data		Select in “Store Data” item
5. ENTER	On		Entry to "Store Data" item. Data storing is on
6. ↑ / ↓	Off		Data storing is off
7. ENTER	Settings → Store Data		Return to “Settings” menu. Data storing off confirmed
8. PARAM	Settings		Return to Main Menu
9. PARAM	T=1.5 C=50 0.0 μ		Exit from Main Menu. Instrument is to measurements

9.1.7. Charge type

There are four charge modes in the instrument:












Fast Charge

Normal Charge – full charge for 4 hours

Slow Charge – full charge for 14 hours

No Charge – recommended if nonrechargeable batteries are using.

Setting acceptable charge type is executed through the “Setting|Charge type” of the Main menu in the manner illustrated in the following example:

KEY	DISPLAY	OPERATION
1. PARAM	File	 Entry into Main Menu
2. ↑ / ↓	Settings	 Select “Settings” menu
3. ENTER	Settings → Print	 Entry in “Settings” menu
4. ↑ / ↓	Settings → Charge type	 Select in “Charge type” menu
5. ENTER	NoCharge	 Entry to "Charge type" menu. “NoCharge” item is selected
6. ↑ / ↓	Fast Charge	 “Fast Charge” item is selected
7. ↑ / ↓	Normal Charge	 “Normal Charge” item is selected
8. ↑ / ↓	Slow Charge	 “Slow Charge” item is selected
9. ENTER	Settings → Charge type	 “Slow Charge” mode is confirmed Return to “Settings” menu
10. PARAM	Settings	 Return to Main Menu
11. PARAM	T=1.5 C=50 0.0 μ	 Exit from Main Menu. Instrument is to measurements








9.2. File settings

File setting group of parameters contains the parameters which present directly the features of PCBs themselves and PCB manufacturing process: board thickness, copper special electric conductivity and tolerance limits on copper plating thickness. So, User can store the measurements taken in the different files carrying the settings in accordance with the thickness of boards under test, plating process features and tolerance requirements on copper plating thickness.

Over the above, entering the actual values for board thickness and copper conductivity σ improves the reliability of the instrument measurements.

9.2.1. Definite file selection












As each file has its specific file settings so before measuring or file setting User is to call the file where measurements are to be stored or file settings be entered. The definite file calling out is executed through "FILE/Select" item of the Main Menu in the following manner:

KEY	DISPLAY	OPERATION
1. PARAM	File 	Entry into Main Menu
2. ENTER	File  → Select file	Entry in "File" menu
3. ENTER	Def. File 2  C=50.0MS/mT=1.50mm Min:15.0 μ Max:35.0 μ	Entry in "File/Select" submenu. Current file name and its main parameters display
4. \uparrow/\downarrow	APPL 1 (*)  C=50.0MS/mT=1.50mm Min:15.0 μ Max:35.0 μ	Select the file required
5. ENTER	File  → Select file	Required file selected. Return to "File" menu
6. PARAM	File 	Return to Main Menu
7. PARAM	T=1.5  C=50 0.0 μ	Exit from Main Menu. The instrument is ready to store measurements in a new selected file

(*) Values are for illustration only.

9.2.2. File name setting











Initial file names Def. File 0...7 may be changed for any desired through "File/Name" item of the Main Menu in the manner illustrated in the following example:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ENTER	File → Select file		Entry into "File" menu
3. ↓	File → File name		Select "File Name" item
4. ENTER	File name: <u>Def.</u> File 2		Entry into "Name" item. Current file name displays. First position of name is highlighted
5. ↑ / ↓	File name: <u>C</u> ef. File 2		Set a new character on the first position
6. →	File name: C <u>e</u> f. File 2		Choose another position to be changed
7. ↑ / ↓	File name: C <u>f</u> f. File 2		Repeat operations 5 and 6 for all other positions to be changed. Current position is highlighted
8. ENTER	Name changed		New file name stored
9.	File → File name		Return to File Name item
10. PARAM	File		Return to File Menu. Instrument is ready to measure in the file with a new name
11. PARAM	T=1.5 C=50 0.0 μ		Instrument is ready to measure in the file with a new name

(*) Names are for illustration only.

9.2.3. Board thickness value setting

Board thickness value is entered through "File/Board" item of the Main Menu in the manner illustrated in the following example:

KEY	DISPLAY	OPERATION
1. PARAM	File	 Entry into Main Menu
2. ENTER	FILE → Select file	 Entry into "File" menu
3. ↑ / ↓	FILE → Thickness	 Select "File Thickness" item
4. ENTER	Board thickness: 01.6 mm (*)	 Entry into "Thickness" submenu. Current board thickness value displays
5. →	Board thickness: 01.6 mm (*)	 Digit to be changed highlights
6. ↑ / ↓	Board thickness: 01.5 mm (*)	 Set a new board thickness value
7. ENTER	Stored	 New board thickness value stored.
8.	FILE → Thickness	 Return to "File" menu
9. PARAM	File	 Return to Main Menu. The instrument is ready to measure with a new board thickness setting
10. PARAM	T=1.5 C=50 0.0 μ	 The instrument is ready to measure with a new board thickness setting

(*) Values are for illustration only.

NOTE











You can enter "File|Thickness" item of the Main Menu directly from measure mode by pressing "Bd/Th" key

9.2.4. Copper electric conductivity σ value setting

If the electric conductivity of copper σ in PTH differs from the base value of 50.0 MS/m (86% IACS) significantly, the actual conductivity value is to be entered before measuring. It can be done through Direct or Indirect methods (see Chap. 6.2) through the "FILE" item of the Main Menu.

9.2.4.1. Electric conductivity value setting. The Direct method

The Direct method proposes entering the value of the conductivity σ directly. The electric conductivity σ correction through Direct method is executed through "FILE/Cond" item of Main Menu in the manner illustrated in the following example:























KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ENTER	FILE → Select file		Entry in "File" menu
3. ↑ / ↓	FILE → Conductivity		Select "File Conductivity" item. Current conductivity σ value displays (in MS/m or %% IACS)
4. ENTER	Conductivity: 50.MS/m (*)		Entry to "File Conductivity" item. Current conductivity σ value displays
5. →	Conductivity : 50.MS/m (*)		Digit to be changed highlights
6. ↑ / ↓	Conductivity: 51.MS/m (*)		Set a new conductivity value
7. ENTER	Stored		New conductivity value stored
8.	File → Conductivity		Return to "File" menu
9. PARAM	File		Return to Main Menu
10. PARAM	T=1.5 C=50 0.0 μ		The instrument is ready to measure with a new copper electric conductivity σ

(*) Conductivity values are for illustration only.

9.2.4.2. Electric conductivity σ value setting. The Indirect method

The Indirect method proposes of the actual electric conductivity σ value correction through the measurements made in the standard holes with the known copper plating thickness.

The electric conductivity σ correction through the Indirect method is executed through "File|Indir.Cond" item of the Main Menu in the manner illustrated in the following example:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ENTER	File		Entry into "File" menu
3. \uparrow/\downarrow	\rightarrow Select file		Select "File Indir. Cond" item
	File		
4. ENTER	\rightarrow Indir. Cond		Entry to " Cal. points" submenu.
	Cal. Points		
5.	<input type="text"/>		Insert probe tip into the hole with known copper thickness. Instrument makes measurement. Take probe tip out of the hole
	Cal. Points		
6.	<input type="text"/>		Repeat measurements in the hole 4 more times
	Cal. Points		
7.	<input type="text"/>		Mean value of the measurements displays
	Cal. points		
8. \rightarrow	$31.2\mu^{(*)}$		Digit to be changed highlights
	Cal. points		
9. \uparrow/\downarrow	$3\ 1.2\mu^{(*)}$		Set the known value of the copper thickness in the standard hole
	Cal. points		
10. ENTER	$32.2\mu^{(*)}$		Copper electric conductivity σ value corrected. Return to "File" menu
	File		
11. PARAM	\rightarrow Cond Ind		Return to Main Menu
	File		
12. PARAM	T=1.5		Instrument is ready to measure with electric conductivity σ equal to copper conductivity in the hole
	C=50		
	0.0 μ		















(*) Copper thickness values are for illustration only.

9.2.5. Copper thickness tolerance limit setting

The upper and lower limits on the copper plating thickness in PTH are entered for tolerance control. If the required limit values entered and the current measurement is out of tolerance, the instrument will indicate this situation through sound alarm.

The sound and visual alarm may be turned off through "SETUP/Alarm" item of Main menu.

Setting of the copper thickness tolerance limits is executed in the manner illustrated in the following example:

KEY	DISPLAY	OPERATION
1. PARAM	File 	Entry into Main Menu
2. ENTER	File  → Select file	Entry into "File" menu
3. ↑/↓	File  → Boundaries	Select "Boundaries" submenu
4. ENTER	Boundaries  →Minimum	Entry to "Boundaries Minimum" submenu.
5. ENTER	Min. boundary:  15.0 μ	Current lower limit displays
6. →	Min. boundary:  1 <u>5</u> .0 μ	Digit to be changed highlights
7. ↑/↓	Min. boundary:  1 <u>6</u> .0 μ	Set a new upper limit value
8. ENTER	Stored 	New limit values stored.
9.	File  → Boundaries	Return to "Boundaries" submenu
10. ENTER	Boundaries  →Minimum	Entry to "Boundaries Minimum" submenu.
11. ↑/↓	Boundaries  →Maximum	Entry to "Boundaries Maximum" submenu Execute p.p. 5-8 to set new upper tolerance limit.
12. ENTER	File  → Boundaries	Return to "File" Menu
13. PARAM	File 	Return to Main Menu.
14. PARAM	T=1.5 C=50 0.0 μ 	The instrument is ready to measure with new tolerance limits








(*) Tolerance limit values are for illustration only.

9.2.6. Return to the default file settings

All the file parameters can be returned to the default base values through "FILE/Default" item of the Main Menu:

- PCB thickness 1.6 mm
- copper special electric conductivity σ 50 MS/m
- copper plating thickness tolerance limits: upper 15 μ
lower 35 μ .

Return to the default file setting is executed in the following manner:








KEY	DISPLAY	OPERATION
1. PARAM	File	 Entry into Main Menu
2. ENTER	FILE: → Select file	 Entry into "File" menu
3. ↑/↓	File → Basic	 Select "Basic settings" command
4. ENTER	Stored	 Confirm "Basic setting" command through pressing "ENTER" key. Basic file settings are entered in the instrument memory
5.	File → Basic	 Default file settings stored. Return to "File" menu
6. PARAM	File	 Return to Main Menu
7. PARAM	T=1.5 C=50 0.0 μ	 Exit from Main Menu. The instrument is ready to measure with default file settings

(*) Number of file is for illustration only.








9.2.7. File measure data removal

Selected file can be cleared (all blocks of the file are deleted) through "FILE/Clear" item of Main Menu. After the deleting, a new active file is created in the file.

Clear file procedure is executed in the following manner:








KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ENTER	File → Select file		Entry into "File" menu
3. ↑ / ↓	FILE: → Delete file		Select "Delete file" command
4. ENTER	File deleted		Confirm "Delete file" command through pressing " ENTER " key. All blocks of the file are deleting. A new active block is created
5.	File → Delete file		After deleting return to "File" menu
6. PARAM	File		Return to Main Menu
7. PARAM	T=1.5 C=50 0.0μ		Exit from Main Menu. The instrument is ready to measure with default file settings

9.2.8. File flushing

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ENTER	File → Select file		Entry into "File" menu
3. ↑ / ↓	FILE: → Flush file		Select "Flush file" command
4. ENTER	Def. File 2 (*) File erased		Confirm "Delete file" command through pressing " ENTER " key. All blocks of the file are deleting. A new active block is created
5.	File → Flush file		After deleting return to "File" menu
6. PARAM	File		Return to Main Menu
7. PARAM	T=1.5 C=50 0.0μ		Exit from Main Menu. The instrument is ready to measure with default file settings

(*) File name s for illustration only.

9.2.9. Creation of new file

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ENTER	File → Select file		Entry into "File" menu
3. ↑/↓	FILE: → Create file		Select "Create file" command
4. ENTER	Def. File 7 (*) File created		Confirm "Create file" command through pressing "ENTER" key. All blocks of the file are deleting. A new active block is created
5.	File → Create file		After deleting return to "File" menu
6. PARAM	File		Return to Main Menu
7. PARAM	T=1.5 C=50 0.0μ		Exit from Main Menu. The instrument is ready to measure with default file settings

10. CALIBRATION

10.1. Calibration techniques available

The INTROMET is ready to measure just after been turned on by pressing "ON/OFF" key. When the probe unit with cartridge is connected and the probe tip is in air, the instrument performs the zero setting by itself. The instrument stores the calibration made during the last session.

To receive the correct measurements a calibration procedure should be made every time if one of the influencing factors described in Chap. 6: PCB geometry, copper electric conductivity, temperature and so on change significantly.

To make sure the instrument is in order and ready to measure User can insert the probe tip into the proper hole of the supplied reference standard RS-51 and compare the reading with the data marked on the standard. For the additional probe "EP-25", use the only hole with approx. 15 μ copper thickness.

Two calibration techniques are available:

- Base calibration;
- Master calibration.

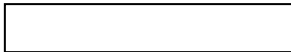
10.2. Base calibration

Base calibration is performed in two points : the "air" point and the "Cu-infinity" point applying the supplied calibration unit. This technique is used as a usual method covering the most practical tasks. Base calibration characteristic is stored in the instrument memory.


Base two points calibration is executed through "CAL" item of Main Menu in the following manner:

KEY	DISPLAY	OPERATION
1. ON/OFF	Self calibration	Turn on the instrument. Probe tip is in air
2.	Def. File 8 C=50.0MS/m T=1.50 mm Min: 15.0 μ Max: 35.0 μ	Current file name indicated Current values of file settings indicated In lower part of display
3. PARAM	File	Entry into Main Menu
4. \uparrow / \downarrow	Calibration	Select item "Calibration "

5. ENTER CALIBRATION A long-time sound signal indicates the entry into "Calibration" program



6. CALIBRATION Insert the probe tip into the hole from the proper side of the calibration unit or Calibration Standard for Extra Small probe




NOTE
 "EP-30" cartridge is inserted into the hole marked "EP-30" and
 "EP-25" cartridge - into the hole marked "EP-25"
 "EP-20" probe - into the hole marked "EP-20"

A short-time sound indicates the measurement is stored. Instrument is waiting for another probe tip insertion. Take the probe tip out of the calibration hole

7. CALIBRATION Repeat Operation 5 four more times until all rectangle became shaded



8. Calibration Calibration is completed. Return to Main Menu

9. PARAM T=1.5 C=50  Exit from the Main Menu. The instrument is ready to measure

0.0 μ

(*) Number of file is for illustration only.

10.3. Master calibration

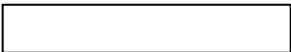
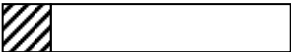
Master calibration is a three or more points calibration based on the known copper thickness standards produced at the User's. This calibration is required only when there is any doubt regarding the instrument measure reliability (see Recommendations on Page 18). In any other case it is not necessary since the Base calibration characteristic is stored constantly in the instrument memory.

WARNING

Master calibration should be performed by only an experienced user of the instrument. More points are used for Master calibration - more reliable the measurements taken

Before Master calibration performance enter the board thickness value (see Chap. 10.2) and the electric conductivity σ value (see Chap. 10.3.1) for the standard board made at the User's.

The Master calibration routine based on the standards made at the User's is executed in the following manner:

KEY	DISPLAY	OPERATION
1. ON/OFF		Turn off the instrument (if it was on)
2. DEL + ON/OFF	PARAM for calibr ENTER for return NEW for clear	Holding "DEL" key pressed, press "ON/OFF" key. Probe tip is in air.
3. PARAM	Point 1 0.0 μ 	Insert probe tip into the first hole of the standard. A short signal sounds. Measurement performed
4.	Point 1 14.9 μ (*) 	Insert probe tip into the hole with known copper thickness until filling of the white bar. Ordinal number of measurement and current measure result display

NOTE

If measurement is taken improperly, User can delete the last measurement by pressing "DEL" key. In this case, current measure result disappears from display

- 5. Point 1 14.7 μ (*)
15.1μ(*) Mean value of the serial measurements for current hole displays in lower string
- 6. ↑ / ↓ Point 1 14.7 μ (*)
16.4μ(*) Correct the actual copper thickness value in the current hole
- 7. ENTER Point 2 0.0 μ
 The first calibration point is entered
- 8. Repeat Operations 4...7 for other (3 or more) holes with known copper thickness
- 9. MEAS New calibration characteristic entered.
Instrument restarts

(*) The copper thickness values and quantity of measurements are for illustration only.

NOTE
If Master Calibration has been completed and the instrument is turned on for the next time, the last entered Master Calibration is actual but not the Base calibration.

10.4. Return to Base calibration

Attention
To return to the base calibration characteristic the instrument is to be turned off while being in the "Master Calibration" mode

The return routine is executed in the following manner:

KEY	DISPLAY	OPERATION
1. ON/OFF		Turn off the instrument (if it was on)
2. DEL + ON/OFF	PARAM for calibr ENTER for return NEW for clear	Holding " PARAM " key pressed, press " ON/OFF " key. Hold " PARAM " key until "MASTER" appears on the display. Entry to "Master Calibration" routine
3.		Press " NEW BLOCK " key. Instrument restarts and returns back to Base calibration characteristic.









11. MEASURE DATA PROCESSING

Measure data stored in the instrument memory is available for processing. The data may be displayed, deleted, transferred to an external printer/computer. Statistics parameters of the measure data blocks may be displayed and printed out. These functions are available directly during the measuring session for the ACTIVE block and whenever through “BLOCK” item of Main Menu. Please check either selected block belongs to the proper file as referred in paragraph 17.

11.1. Block data selection

The data block is to be selected before processing. The measurements are grouped in BLOCKS according to the time of their performance. The data block is selected through the name which initially contains the date and time when the block was created.

Definite block is selected through “BLOCK/Select” item of Main Menu in the manner illustrated in the following example:













KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑ / ↓	Block		Select “Block” menu
3. ENTER	Block → Select block		Entry in “Block” menu
4. ENTER	Block: 6 10:22 ^(*)		Entry in “Block Select” item. Active block creation date, hours and minutes display
5. ↑ / ↓	Block: 6 9:44 ^(*)		Select the block required
6. ENTER	Block → Select block		The required block selected. Return to “Block” menu
7. PARAM	Block		Return to Main Menu
8. PARAM	T=1.5 C=50 0.0μ		The instrument is ready to measurements

(*) Block names are for illustration only.

Staying in “BLOCK” menu User can display a individual measurement and statistics of the block opened.

11.2. Block name setting






Initial block name can be changed for any desired through “BLOCK/Name” item of Main menu in the following manner:

KEY	DISPLAY	OPERATION
1. PARAM	File	 Entry into Main Menu
2. ↑/↓	Block	 Select “Block” menu
3. ENTER	Block → Select block	 Entry in “Block” menu
4. ↑/↓	Block → Block name	 Choose “Block Name” item
5. ENTER	Block name <u>B</u> lock 6 10:22(*)	 Entry in “Block Name” item. Current block name displays. The first position of name is highlighted
6. ←/→	Block name Block <u>6</u> 10:22(*)	 Choose another position to be changed
7, ←/→	Block name Block <u>7</u> 10:22(*)	 Set a new character for the position to be changed
8.	Block name Block 7 11: <u>3</u> 4(*)	 Repeat operations 6 and 7 for all other positions to be changed. Current position is highlighted
9. ENTER	Name Changed	 A new name of the block is stored.
10.	Block → Block name	 Return to “Block” menu
11. PARAM	Block	 A new name of the block is stored. Return to Main Menu
12. PARAM	T=1.5 C=50 0.0 μ	 The instrument is ready to measurements

(*) Block names are for illustration only.





11.3. Block data display

The individual measurements in the selected block are displayed through "Block|Block Data" item of Main menu in the following manner:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑ / ↓	Block		Select "Block" menu
3. ENTER	Block → Select Block		Entry in "Block" menu
4. ↑ / ↓	Block → Block Data		Choose "Block Data" item
5. ENTER	N=3(*) point=4.29 m		Entry in "Block Data" item. Last measurement (N3) is indicated

Attention

To delete any measurement in block, press the "DEL" key. The very last measurement of the block cannot be deleted. For this measurement removal use "BLOCK/Deleting" routine

6. ↑ / ↓	N=1(*) point=4.35 m		Choose another measurement to be displayed
7. PARAM	Block → Block Data		Return to "Block" menu
8. PARAM	Block		Return to Main Menu
9. PARAM	T=1.5 C=50 0.0μ		The instrument is ready to measurements

(*) Values and measurement numbers are for illustration only.

NOTE


After a single measurement removal, the next measurement takes the order number of the removed one. The same number stays on display. When the last-in-order measurement of the block removed the order number of the next measurement decreases

11.4. Block data statistics display

Statistics of data block can be displayed through pressing “STAT” key while being in the “BLOCK” item of the Main Menu.

Block to be displayed: active block of the current file (as a default) or selected through “BLOCK/Select”.

Statistics of block measure data display is executed in the following manner:

1.	Blk: 06/19 08:20 ^(*)		Entry “Block” item of the Main Menu
	→ Select		
2. STAT	NUM	006	Number of block measurements display
3. ↓	MEAN	31.0 μ	Mean value of block measurements display
4. ↓	StdDev	05.2 μ	Standard deviation of block measurements display
5. ↓	MIN	20.1μ	Minimum value of block measurements display
6. ↓	MAX	29.0 μ	Maximum of block measurements display
7. ↓	RANG	8.9 μ	Variation range (MAX-MIN) of block measurements display
8. ↓	CP	00.34	Coefficient CP display
9. ↓	CR	00.12	Coefficient CR display
10. ↓	CPK	01.34	Coefficient CPK display
11. ENTER	Blk: 06/19 08:20 ^(*)		Return to “BLOCK” menu
	→ Select		
12. PARAM	BLOCK		Return to Main Menu
13. PARAM	T=1.5		Exit from Main Menu
	C=50		










0.0μ

(*) Values are for illustration only.

11.5. Block data removal

A whole block of the current file may be removed from the instrument memory through “File|Deleting” item of the Main Menu. When the last block of the selected file is removed a new block is created and becomes ACTIVE.

The individual block removal routine is executed in the following manner:









KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑/↓	Block		Select “Block” menu
3. ENTER	Block → Select block		Entry in “Block” menu
4. ↑/↓	Block → Delete block		Select “Delete block” item.
5. ENTER	Block deleted		Active the block is deleted
6. ENTER	Blk: 06/19 08:20 ^(*) → Select		The required block selected. Return to “BLOCK” menu
7.	Block → Delete block		Automatic return to “Block” menu
8. PARAM	Block		Return to Main Menu
9. PARAM	T=1.5 C=50 0.0μ		Instrument is ready to measure

Attention

The above routine causes the deletion of the block from preliminary selected file. To delete a block from another file you need to select the given file beforehand, according to Chap. 8.1.

11.6. Create block

New block creation realizes through “Block|Block Data” item of Main menu in the following manner:

KEY	DISPLAY		OPERATION
1. PARAM	File		Entry into Main Menu
2. ↑ / ↓	Block		Select “Block” menu
3. ENTER	Block → Select block		Entry in “Block” menu
4. ↑ / ↓	Block → New block		Select “Delete block” item.
5. ENTER	Block 7 12: 6 ^(*) Block created		Active the block is deleted
6.	Block → New block		Automatic return to “Block” menu
7. PARAM	Block		Return to Main Menu
8. PARAM	T=1.5 C=50 0.0 μ		Instrument is ready to measure

(*) New block name

Attention

New block creation is possible through the key “NEW BLOCK”. New block opens and previous closes by pressing this key in measurement mode.

12. STATISTICAL TERMS

12.1. Mean value

The MEAN value is the sum of all measurements of a series divided by the number of measurements:

$$\text{MEAN} = \frac{(T_1 + T_2 + \dots + T_n)}{N} = \frac{\sum_{n=1}^N T_n}{N}$$

where: T_n = individual measurement
 N = number of measurements

12.2. MIN, MAX and Range

Minimum (MIN) and Maximum (MAX) are the extreme values of a measurement series. The difference between minimum and maximum is called the RANGE (RANG).

12.3. Standard Deviation

The standard deviation is a measure for the spread of a measurement series. The square root of the result is the STANDARD DEVIATION :

$$\text{Std. Dev.} = \frac{\sqrt{(T - T_1)^2 + (T - T_2)^2 + \dots + (T - T_n)^2}}{(N - 1)}$$

where: T = mean value
 T_n = individual value
 N = number of measurements

12.4. Coefficient of Variation (COV)

The coefficient of variation is the standard deviation from the mean value in percent. The COV is sometimes also referred to as the relative standard deviation:

$$\text{Coeff. Var.} = \frac{\text{Std. Dev}}{T} \times 100\%$$

12.5. Capability statistics coefficients

12.5.1. Coefficient CP

$$CP = \frac{T}{6\sigma}$$

where: Standard Deviation of results $\sigma = \sqrt{\frac{\sum_{i=1}^n (\bar{X} - X_n)^2}{n-1}}$

$$T = (\text{Upper specification limit}) - (\text{Lower specification limit})$$

12.5.2. Coefficient CR

$$CR = 1 / CP$$

12.5.3. Coefficient CPK

$$CPK_1 = \frac{(\text{Upper specification limit}) - (\text{Mean})}{3\sigma}$$

$$CPK_2 = \frac{(\text{Mean}) - (\text{Lower specification limit})}{3\sigma}$$

If $CPK_2 < CPK_1$, then $CPK = CPK_2$.

If $CPK_1 < CPK_2$, then $CPK = CPK_1$.

13. *HAND-HELD PROBE GUIDE OPERATION*

1. Put the movable part of the guide up to the stop and hold it in this position (see Fig. 5).
2. Release the fastening nut on the movable part by 2...3 turns counter-clockwise.
3. Insert the probe unit into the guide to place the probe tip extending outward the plane of the guide supports.
4. Turn the fastening nut clockwise up to the stop.
5. Allow the movable part move down until it bears up against the immovable part of the guide. The cone part of the probe unit is to expand outward the plane of supports.
6. While measuring, hold the guide with probe fastened perpendicular to the PCB plate. Insert the probe tip into the hole under test down to stop. The movable part goes up for 5...10 mm. Avoid the hole inside surface touch with the probe tip. Place the guide bearing up against the board plate with all three supports.

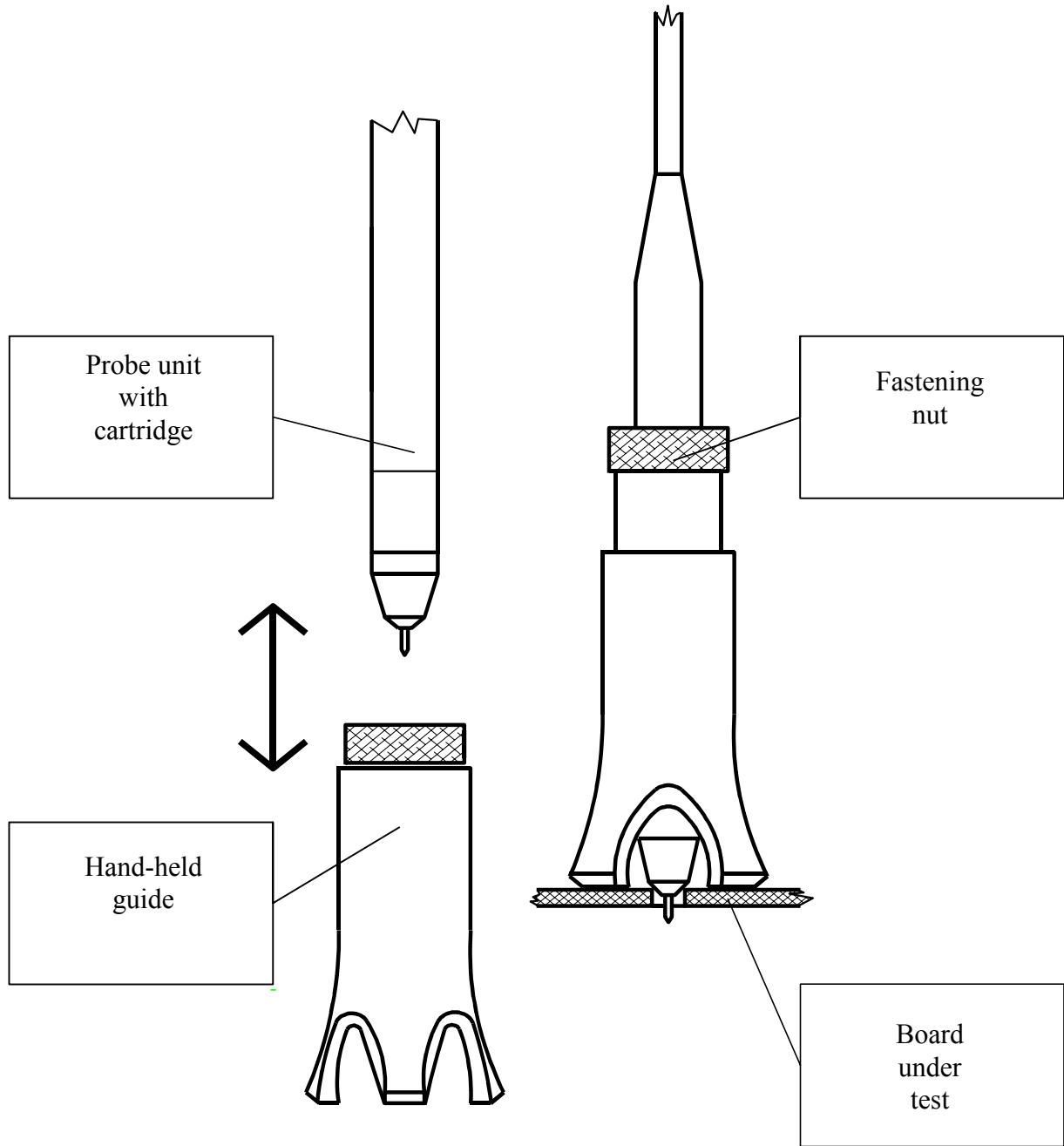


Fig. 4. Hand-held guide application

14. CARTRIDGE REPLACEMENT

If the probe cartridge "EP-30" or "EP-25" is to be replaced with another cartridge, calibration is necessary to be executed (see Chap. 10.2)

To remove the probe cartridge from the probe unit (see Fig. 3):

- hold the probe cartridge firmly in one hand;
- hold the probe unit close to the upper part by the other hand;
- pull the cartridge in the direction of the probe tip without twisting.

Attention

When replacing the cartridge, be careful not to damage the probe tip. Do not twist the cartridge while it is being replaced from the probe unit. Twisting the cartridge will damage the connector

To plug the probe cartridge in the probe unit:

- insert the cartridge into the probe unit down to stop;
- rotate the cartridge to align the connector keys;
- plug in the cartridge with slight effort.

15. NiCad BATTERIES REPLACEMENT

For batteries replacement, put the instrument out of the protective covers.

Attention

Usage of rechargeless batteries instead of rechargeable ones is prohibited.

To prevent the data memory destroying, the instrument is to be connected to power line through the AC adapter during the batteries replacement.

Battery replacement is executed according to Fig. 2.

16. **ERRORS**

DISPLAY	ERROR AND REASON	OPERATION
ERR 001	Measure result < 0. 1. Forced measurement in air or very low Cu 2. Improper calibration: Base or Master 3. Incorrect file settings: conductivity or board thickness	Press " ENTER ". Zero result display. Press " DEL ". Check up the unit operation with RS reference standard. If not recovered: - turn off the unit; turn it on and repeat the calibration properly - enter correct file settings.
ERR 002	Data memory destroyed. All files clear. Return to base parameters 1. Breakdown in power supply: low voltage or while battery change	Execute the calibration properly. Enter correct file and global settings
ERR 003	Data memory is overloaded.	Turn off the unit; turn it on again and delete some blocks unneeded
ERR 004	Master calibration execution error 1. Less then 3 points entered 2. Incorrect measure data entered	Repeat Master calibration properly. Enter 3 or more calibration points.
ERR 005	"Air" calibration error	Turn off the unit and turn it on again. If not recovered , replace the cartridge. If not recovered, contact Manufacturer
ERR 006	Self test not passed. Unit failure	Turn off the unit and turn it on again. If not recovered , contact Manufacturer.

17. MEASURE DATA STORAGE STRUCTURE

FILE 0	FILE 1	FILE 7
PCB Parameter settings	PCB Parameter settings	PCB Parameter settings
Block 1	Block 1	Block 1 ^(*)
Block 2	Block 2	
Block 3	Block 3 ^(*)	
Date and time of creation		
Measurement 1		
Measurement 2		
.....		
Measurement n		
Block 4		
.....		
Block m ^(*)		

(*) Active blocks

(**) While turned on for the first time, the instrument will store measurement data into FILE 0 (Block 1) with base parameter settings:

- board thickness - 1.6 mm;
- electric conductivity - 50 MS/m;
- upper tolerance limit - 35.0 μ;
- lower tolerance limit - 15.0 μ.

18. TROUBLE SHOOTING

Malfunctions	Reason
No display	<ul style="list-style-type: none">- Instrument is not turned on- Instrument is turned off automatically- Batteries discharged
Instrument turned off automatically	<ul style="list-style-type: none">- No measurement or key pressed for the last 4 minutes. Turn on the instrument- Batteries discharged. Charge the batteries- Occasional electrostatic discharge. Turn on the instrument again
"BAT LOW" display	<ul style="list-style-type: none">- Batteries need to be recharged
Instrument doesn't measure	<ul style="list-style-type: none">- Copper plating thickness insufficient or sufficient plating defects. Press "MEAS" key- Probe out of order. Change for the proper one
Erroneous measurement	<ul style="list-style-type: none">- Incorrect board parameter settings: board thickness, electric conductivity, improper probe is used- Calibration error. Repeat calibration- Probe not inserted up to the stop
Unexpected characters display	<ul style="list-style-type: none">- Program break-down. Contact our local representative

19. SPECIFICATIONS

Model:	INTROMET ITM-52
Probes with Cartridges:	"EP-30" - base, "EP-25" - additional, "EP-20" - optional
Hole diameter:	0,8 mm - 2,0 mm (0.032" to 0.08") - main range 0,6 mm - 0.8 mm (0,024" to 0.032") - additional range 0,4 mm - 0.6 mm (0,016" to 0.024") - Extra Small range
Board thickness:	1.0 mm - 2.4 mm (0.04" to 0,96")
Temperature range:	+5° C...+40° C (4° F...110° F)
Data memory:	8 files for up to 15000 measurements
Measuring range:	2 μ ...100 μ (0.1 mil ...4.0 mil) for hole diametr 0.6...0.8 mm 2 μ ...50 μ (0.1 mil ...2.0 mil) for hole diametr 0.4...0.6 mm
Accuracy/Precision:	1.0 μ
Power supply:	Two rechargeable batteries of AA size
Contents of shipment:	Probe unit with two cartridges: EP-30 and EP-25, calibration unit, probe guide HPH, reference standard RS-51, AC adapter, Operating Manual
Options:	Extra Small Range probe unit "EP-20" set; Mechanical Hole Diameter Gauge; Spare cartridges "EP-30" and "EP-25"

20. DELIVERY LIST

➤ Basic unit of the ITM-52	S/N _____	1 pc.
➤ Probe unit		1 pc.
➤ Cartidge EP-30		_ pc.
➤ Cartidge EP-25		_ pc.
➤ Probe EP-20		_ pc.
➤ Cartidge EP-30 S		_ pc.
➤ Cartidge EP-25 S		_ pc.
➤ Probe PR-100		_ pc.
➤ Probe guide HPH		_ pc.
➤ Calibration unit		_ pc.
➤ Reference standard		_ pc.
➤ AC adapter		1 pc.
➤ IR dapter		_ pc.

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