DETA DiCon Operation Manual

The DETA DiCon technical literature is also available on the Internet at www.advise-deta.com. Please contact ADVISE Technical Support if you have questions on the use of this product. Email: info@advise-deta.com

1. Contents

1. Introduction

Information

All technical data, instrument features and other information described in this operation manual are presented to the best of our knowledge and in accordance with the technical standards of the instrument at the time of printing.

We welcome any comments, suggestions or new ideas concerning the instrument itself and these operating instructions. Please address them to:

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Maintenance and service must be carried out by ADVISE personnel. A service contract is available for the users of DETA DiCon system.

This operating manual is provided to give the customer information on proper operation of the instrument. ADVISE will accept no liability for damage resulting from improper use.

Introductory note

Thank you for ordering the DETA DiCon v.1 instrument from ADVISE. The DETA DiCon is an instrument for measuring dielectric constant or permittivity of liquid samples. The system is based on the charging of a capacitor (concentric cylinder cell) under specified conditions of AC voltage and test frequency and the comparison of the cell capacitance with loaded liquid samples vs. the empty cell capacitance. The ratio of the respective capacitance values is the dielectric constant of the liquid substance. The DETA DiCon can perform the signal analysis for deriving capacitance values and determine the liquid substance dielectric constant at the predefined settings and also send the test conditions with the result to a text file for reporting. The liquid sample holder (cell) is constructed of bronze with the optimum geometry in order to evaluate the dielectric constant of liquid sample of conductivity below a limited value. As the DETA DiCon software is user friendly, simple to use and robust, it allows fast, reproducible and accurate measurements of the relevant dielectric property of liquid samples.

The DETA DiCon software allows the operator to design and apply the test conditions in order to evaluate the dielectric constant of liquid samples. The measurement is fast and if the procedure is followed properly the accuracy and reproducibility is guaranteed. The DETA DiCon system is configured to operate with a liquid sample holder. The instrument is equipped with a communication USB interface to the commanding netbook loaded with the DETA DiCon software.

2. Instrument specifications

Dielectric constant range	1 - 500
Test frequency (Hz)	1 to 10,000 (selectable within 1 Hz)
Accuracy of test frequency	±0.005% nominal
Test voltage (AC V)	1 to 10 (selectable within 1 V)
Accuracy of test voltage	±0.005% nominal
Maximum conductivity of sample (µS/cm)	100
Accuracy of measurement	±1%
Repeatability range	±0.05%
Measurement control	DETA DiCon software at dedicated netbook
Calibration	through standard capacitors at 10 pF and 100 pF in a supplied kit
Dielectric constant cell	Bronze cylinder of 70 mm length and 21.8 mm diameter (1.5 mm electrode spacing)
Sample holder	Glass specimen tube 75 x 25 mm with polyethylene stopper (Ampulla Ltd. in UK)
Minimum liquid volume for measurement at the probe (mL)	7
Operating temperature of hardware	20 to 50 °C

3. Instrument components

The DETA DiCon system comprises of:

- Measurement box with USB connection to computer
- Dielectric constant cell for liquid samples
- Sample holder
- Calibration kit
- Netbook loaded with the commanding DETA DiCon v.1.0 software
- USB cable
- 2 BNC terminated coaxial 50 Ω cables
- This operation manual

4. Safety information

Maintenance Obligation	The operator of the system must ensure that the instrument is operated in perfect condition at all times. In case of visible damage of any mechanical, electrical or electronic component of the system, the instrument manufacturer must be contacted
Proper set-up of the system	The operator should allocate a clean table top surface for the installation of the measurement box, the netbook and the sample holder. The instrument operation should be carried out through the supplied instruction and inspections.
Shut-down and disassembly	After use, the dielectric constant cell for liquid samples must be disassembled, cleaned and dried (with soft cotton tissue) for the next use and stored in the respective cases. Acetone can be used for wiping the metal and plastic parts. In occasions where the instrument will not be used for longer periods of time, it should be disconnected from the power supply. The measurement box should be switched off and unplugged for all maintenance work.
Electrical safety	The voltage used for the execution of the tests are harmless for any interaction with the operator and the laboratory environment. The measurement box is properly grounded for electrical safety.
Opening of electric box enclosure	The measurement box may be opened only by authorised and trained personnel of the system manufacturer.
Dielectric constant cell operation	The dielectric constant cell should be assembled before the test execution. The instructions at the software operation will guide the cell operation for the proper measurement sequence. Care should be taken when connecting and disconnecting the BNC connector to the centre electrode terminal to avoid damage of the connection.
Maintenance or Repair	The instrument is free of any harmful substances (e.g. radioactive, toxic, caustic or microbiological materials). The relevant instrument components can be shipped to the instrument manufacturer for repair with the above mentioned declaration.

5. Installation instructions

Instrument installation should be performed at first use and each time the instrument is moved from its position. The instrument installation involves the following actions:

1. Unpacking of measurement box, netbook and cell packs for placement on a clean and rigid bench surface.
2. Connection of the USB cable to the netbook and the measurement box.
3. Connection of power to the netbook and the measurement box.

The installed DETA DiCon system is shown at the following picture.

Left: DETA DiCon system components (measurement box, netbook with commanding software and assembled dielectric constant cell) installed on a tabletop surface.

Right: Assembled dielectric constant cell and calibration kit of DETA DiCon system.

6. Instrument operation instructions

Instrument operation actions should be made before starting a test.

For the dielectric constant measurement all DETA DiCon system components are required. The instrument operation involves the following actions:

1. Assembly of the dielectric constant cell (see separate section below) and placement of the cell in the sample holder.
2. Switching ON the measurement box (power ON/OFF switch at the rear panel of the box).
3. Powering up the netbook and launching of the DETA DiCon software (icon at the desktop).
4. Execution of the test preparation actions in the DETA-DiCon software (see details at the software operation instructions).
5. Adding suitable quantity of liquid to the sample holder and sliding slowly the dielectric constant cell into the sample holder until liquid comes out of the hole at the cover of the dielectric constant cell.
6. Executing the main measurement procedure in the DETA DiCon software.
7. At the end of the test, removing of the cell from the sample holder for disassembly and cleaning of the parts.
8. If another test follows, going to step 1 above.
9. Closing of the DETA DiCon software and switching OFF of the measurement box.

The DETA DiCon software consists of two phases:

1. The **"Test preparation" phase,** which allows the operator to define the parameters set for the execution of the test and prepare the performance of the test
2. The **"Main measurement" phase,** which includes the display of the measurement results and the reporting of the test performance.

The "Test preparation" phase

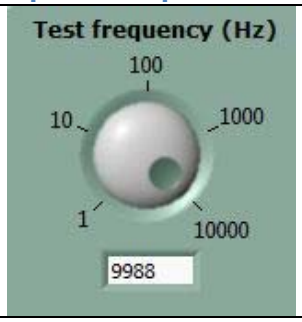
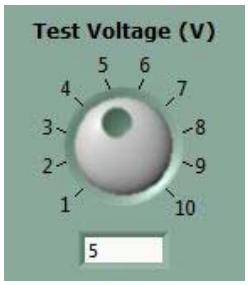
The DETA DiCon software starts by double clicking of the DETA DiCon shortcut icon on the netbook desktop. The system performs checking of hardware components assembly and license status and then falls into the idle phase waiting for the operator actions.

The test preparation is divided in two stages:

▶ TEST PARAMETERS DEFINITION

The operator needs to define the set of parameters required for the performance of the test. These parameters are: (i) the test frequency and (ii) the test voltage. For detailed description of these user interface items, see Table 1 below.

Table 1: Parameters settings by the operator during the 'Test preparation' phase

PARAMETER SETTINGS	Test frequency	Select (through the knob or the digital box) the test frequency for the measurement of dielectric constant. The default value is 10 kHz. At the start of the calibration process, the digital box will display the exact (within 1 Hz) frequency of the test.	
	Test voltage	Select (through the knob or the digital box) the test voltage for the measurement of dielectric constant. The default value is 5V. You can decrease the test voltage for measurement of liquids that exhibit conductivities close the limiting value (the limit conductivity LED lights up), so that the accuracy of the measurement is always at the nominal value (1%).	

▶ CALIBRATION PROCEDURES

The calibration procedures are described as follows.

- System calibration: Depending on the expected value of the dielectric constant the appropriate circuit is connected to the measurement box (using the provided cables). The rule is that for dielectric constant values lower than 10 the circuit labelled 10 pF is connected, otherwise the circuit labelled 100 pF

is connected. After the circuit is connected (two BNC terminated cables connect the calibration kit to the measurement box), the operator enters the circuit value (in pF) to the respective box and clicks on the top 'calibration' button. The successful system calibration is indicated by the green light at the respective LED.

- Cell calibration: The (assembled) dielectric constant cell is connected to the measurement box (using the provided cables). Then the operator clicks on the bottom 'calibration' button. The successful cell calibration is indicated by the green light at the respective LED. Also in case that both calibration procedures were completed successfully, the 'Cell state' LED lights up as wel as the 'Fine tuning' LED at the measurement box front panel.

For detailed description of these user interface items, see Table 2 below.

Table 2: Calibration procedures by the operator during the 'Test preparation' phase

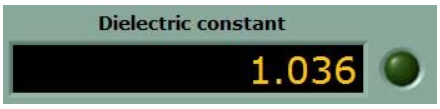
CALIBRATION PROCEDURES	System calibration	Enter the connected circuit capacitance value at the white box and click on the 'calibration' button'. The success is indicated by the green LED. If thr LED does not turn ON, check the connections. If the problem persists, consult technical advice.	
	Cell calibration	Connect the dielectric cell and click on the 'calibration' button'. The success is indicated by the green LED. The cell calibration is the measurement of the empty cell capacitance. If the LED does not turn ON, first check the connections and then clean the cell. If the problem persists, consult technical advice.	
	Cell state	At the completion of the calibration procedures, the cell state LED turns ON and the 'Fine tuned' LED at the measurement box front panel turns ON. This is needed for a measurement with highest degree of accuracy.	

SYSTEM STATUS INDICATORS	Measure-ment box front panel	The 'Active' LED indicates that the measurement box is switched ON. The 'Fine tuned' LED indicates that all calibration procedures were completed and a measurement can be performed.	

The "Main Measurement" phase

In this phase the system performs the data acquisition from the dielectric constant cell, calculates the cell capacitance and resistance and estimates the sample dielectric constant and conductivity. For the detailed description of the measurement results indicators see Table 3 below.

Table 3. Measurement indicators during the 'Main measurement' phase

MEASURE_MENT RESULTS INDICATORS	Dielectric constant	The indicator of the dielectric constant displays the respective measurement result in 3 decimal points. The LED next to the indicator turns ON (green) during the measurement time (as the electric field is applied to the dielectric constant cell). Also the sensor LED in the measurement box front panel indicates the measurement performance.	
	Conductivity	The indicator of the conductivity displays the respective measurement result in scientific format with 2 significant figures. The sample conductivity measurement is required in order to assess the accuracy of the dielectric constant determination. The LED next to the indicator turns ON (red) in the case that the conductivity goes above the set limit for high accuracy (this is 100 μS/cm).	

The procedure of measurement and results output can be followed by one the following paths:

- SINGLE MEASUREMENT
  - By clicking on the 'Run' button the system performs a single measurement: application of electric field to the cell and acquisition of response signals for the estimation of dielectric constant and conductivity of the liquid sample. The green LED next to the black dielectric constant box lights up during the application of the electric field and then the dielectric constant value is displayed together with the conductivity value. In case the accuracy of the measurement is not validated, the respective LED turns ON (red).

- CONTINUOUS MEASUREMENT
  - By clicking on the 'Run' button the system enters the loop of continuous measurements: application of electric field to the cell and acquisition of response signals for the estimation of dielectric constant and conductivity of the liquid sample. To stop temporarily the loop, the operator should click on the 'Hold' button, while to exit the loop and stop the measurements, the operator shoud click on the 'Stop' button. The green LED next to the black dielectric constant box lights up during the application of the electric field and then the dielectric constant value is displayed together with the conductivity value. In case the accuracy of the measurement is not validated for the performed measurement, the respective LED turns ON (red).

For detailed description of these issues, see Table 4 below.

Table 4: Performance of Measurements during the 'Main measurement' phase

SINGLE MEASURE-MENT MODE	Run	At the click of the 'Run' button a single measurement is performed and the measurement LED will turn ON once. The indicators will display the measured values. After this activity, the system is idle, waiting for the next measurement command.	
CONTINUOUS MEASURE_MENT MODE	Run	At the click of the 'Run' button a continuous measurement is performed and the measurement LED will turn ON and OFF at each measurement cycle. The indicators will display the measured values. As the measurements continue, the system is waiting for the next measurement command from the continuous run panel.	
	Hold	At the click of the 'Hold' button the continuous measurements are pausing and the measurement LED will turn OFF at the completion of the current measurement cycle. The indicators will display the measured values. The system is idle, waiting for a continuation command (depress the 'Hold' button) or a finishing command (press the 'Stop' button). Do not press the 'Run' button at this stage.	
	Stop	At the click of the 'Stop' button the continuous measurements will stop and the measurement LED will turn OFF at the completion of the current measurement cycle. The indicators will display the measured values. The continuous measurement mode is abandoned, the system is stopped and no further measurement can take place at the current session.	

- TEST REPORT
  - To get a printed version of the test conditions and the measurement result, the operator should click on the 'Create report' button. At the click of the button, the operator is prompted for the path and name of the text file containing the test information. For detailed description of these issues, see Table 5 below.

Table 5: Creation of test report during the 'Main measurement' phase

TEST REPORT ISSUE	Create report	At the click of the 'Create report' button the system is asking for the name and destination of the text file to be created. For ease of operation, a text file is formed. The file contains the time stamp of the measurement, the dielectric constant value displayed at the indicator and the cell state for the measurement.	

7. Software philosophy

There are several key principles which assist the DETA DiCon operator in the proper handling of the software so that data loss and unnecessary repeat of procedures can be avoided.

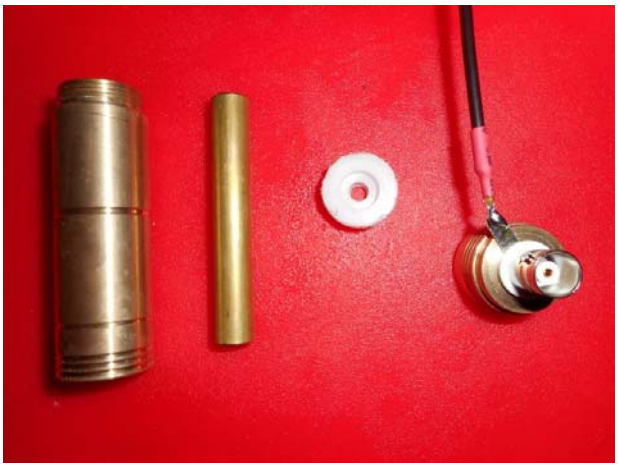
- All user input controls (for receiving data and selections from the user) are shown with white background
- The user input to these controls is received by the system only when the specific control loses focus, which occurs when the user clicks anywhere outside the control area or presses the RETURN button.
- Data validation is active for all controls as there is automatic data check (values between set limits) when the control loses focus
- All test results indicators (showing to the user the result of applied criteria) are shown with red background and yellow font
- The communication to the measurement box is active from all phases of software execution.

8. Handling of dielectric constant cell

There are two procedures concerning the dielectric constant cell for liquid samples:

(i) Assembly of the cell
(ii) Disassembly and cleaning of the cell

The dielectric constant cell parts are shown in the following picture.



From left to right: (i) the outer electrode, (ii) the inner electrode, (iii) the alignment disc and (iv) the cell cover / connector holder.

(i) The assembly of the cell is performed before a measurement routine is to be performed. All cell parts are stored in the dedicated protective box and they are taken from their place for the assembly procedure. The assembly procedure steps are shown in the following Table.

The steps in the order shown by the pictures involve:

1. Identifying the bottom end of the inner electrode so that it will be directed to meet the plastic bottom end of the outer electrode. Picture 1 shows the bottom end of the inner electrode, while picture 2 shows the top end of the inner electrode. The key difference is that the top end bears a shallower recess compared to the bottom end.
2. Inserting the inner electrode with correct direction (defined in step 1) into the outer electrode. The bottom end of the inner electrode should lock in place so that the electrodes get to the same level as shown in picture 3.
3. Shifting the inner electrode to be concentric to the outer electrode and then attaching the alignment disc in place as shown in picture 4. The disc should lock between the cylinders. The alignment disc may become part of the cell cover as shown in picture 5 and in this case it will be connected to the cylinders as described in step 4.
4. Placing the cell cover on top of the cylinders assembly and turn the cover until tight. The cell is now fully assembled as shown in picture 6.
5. Adding the liquid to be tested in the glass tube at the indicated quantity (approx. 7 mL) and then sliding slowly the assembled electrode inside the glass tube so that the liquid fills the gap between the cylinders and reaches the hole at the cell cover. As soon as the liquid comes out of the hole at the cell cover, the cell is completely filled and ready for the measurement.

Picture 1

Picture 2

Picture 3

Picture 4

Picture 5

Picture 6

(ii) The disassembly of the cell is performed **shortly after** a measurement routine has been completed. The cell is removed from the glass tube. The steps are in the reverse order compared to the assembly process. Each part can be cleaned with acetone and then wiped with a soft cloth before placed at the dedicated protective box. Care should be taken not to bend the cable connection to the outer electrode.

9. Warranty

ADVISE warrants DETA DiCon system against defects in materials and workmanship for 24 months from the date of installation. Consumable items such as glass tubes are not covered by the warranty.

ADVISE's obligation under the warranty shall be to repair at its facility or replace any products which finds to be defective. Items returned for warranty must be properly packaged, shipped prepaid and insured, and must be accompanied by a return goods number assigned by ADVISE Service.

ADVISE offers technical support and knowledge transfer on DETA DiCon and its technology under specifically arranged contract.

Note: Substitution, modification or mis-wiring of cables voids all warranties.