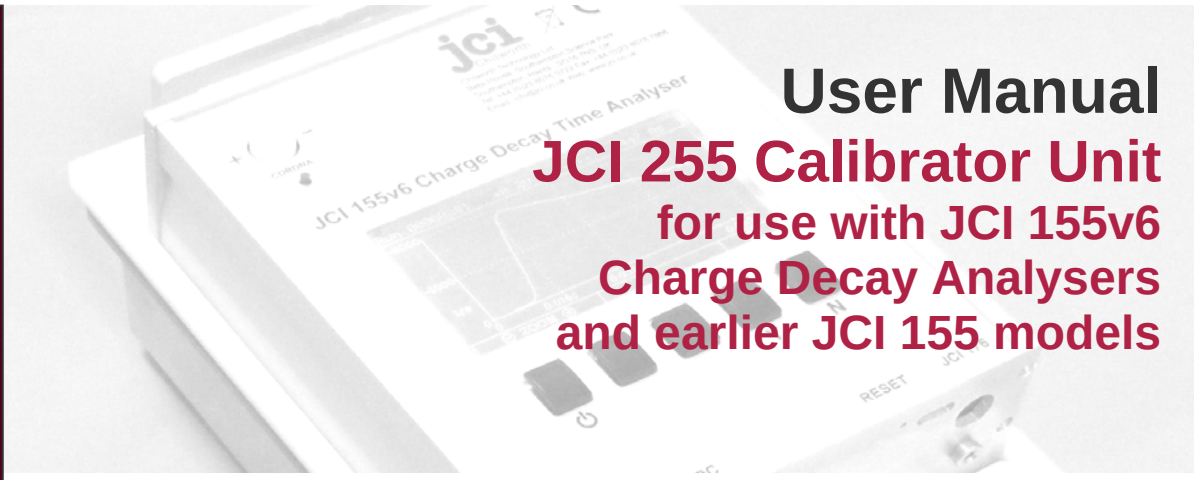

User Manual

JCI 255 Calibrator Unit

for use with JCI 155v6 Charge Decay Analysers and earlier JCI 155 models

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Declaration of CE conformance

Chilworth Technology Ltd, Beta House, Southampton Science Park, Southampton, SO16 7NS, UK declares, as designer and manufacturer of the JCI 255 Calibrator Unit, that the design and construction of this instrument conforms to the requirements of the EC Directive on Electromagnetic Compatibility (EMC) 89/336/EEC to Standards EN 50081-1:1992 and EN 50082-1: 1992. This instrument also conforms to the requirements of the Electrical Equipment (Safety) Regulations 1994 (S.I. 1994/3260).

Dr Stephen Rowe, for and on behalf of Chilworth Technology Ltd.

RoHS and WEEE Directives

JCI Chilworth electrostatic measuring instruments are not required to conform to the RoHS Directive because they come within Category 9 exemption.

To comply with the requirements of the EC WEEE (Waste Electrical & Electronic Equipment) Directive all JCI Chilworth instruments, at the end of their useful life, should be returned to Chilworth Technology Ltd for disposal or recycling in an environmentally appropriate way. Chilworth Technology Ltd is a member of the Producer Compliance Scheme ECONO-WEEE Ltd registration number WEE/KB1414VU.

Safety Warning

High voltages will be present on part of the JCI 255 Calibrator Unit when in use, and attention is drawn to Section 6 of this JCI 255 Calibrator Unit User Manual.

Of necessity the JCI 155v6 uses a high voltage power supply and if misused (i.e. used in ways other than described in the JCI 155v6 User Manual) it is possible that the user, or others in the immediate vicinity, could be exposed to live high voltage electrodes. Although contact with these electrodes could result in an uncomfortable electric shock, the current capability is such that it would not normally be deemed hazardous in its own right. However, the involuntary reaction to such a shock could expose the recipient to other hazards not associated with the instrument, or result in damage to delicate parts of the instrument. Hence, it is important that the instructions in the JCI 155v6 User Manual are understood and adhered to.

PRODUCT WARRANTY

All test instrumentation supplied by Chilworth Technology Ltd., is manufactured to the highest specification, and as such Chilworth Technology Ltd., warrants the product against defects in materials and workmanship for a period of twelve (12) months from the date of receipt at the Customer premises, on a return to base policy.

It is a necessary requirement of the warranty conditions that the instructions given in the user manual are read, understood and adhered to before putting the instrumentation into first use. If any doubt exists, please consult the manufacturer for further assistance. In such cases where the product is returned to Chilworth Technology Ltd., we will inspect the product on receipt to diagnose the fault, and will issue the Customer with an inspection and condition report.

If the product proves defective during the warranty period, Chilworth Technology Ltd., at its option, will repair the product at our facilities in Southampton, UK.

Provided the product has been used in accordance with the manufacturers guidelines and that the fault is due to a manufacturing defect or component failure and is not due to expected wear and tear caused by the operating environment in which it is used, this warranty covers all parts and labour, but specifically excludes any consumable parts supplied with the product and any shipping costs to Chilworth Technology Ltd.

Chilworth Technology Ltd. shall not be obliged under this warranty:

a) to repair damage resulting from attempts by personnel other than Chilworth Technology Ltd. representatives to install, repair or service the product unless directed by a Chilworth Technology Ltd. representative,
b) to repair damage, malfunction, or degradation of performance resulting from improper use or connection to incompatible equipment or memory,
c) to repair damage, malfunction, or degradation of performance caused by the use of non Chilworth Technology Ltd. supplies or consumables or the use of Chilworth Technology Ltd. supplies not specified for use with the product,
d) to repair an item that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product or degrades performance or reliability,
e) to perform user maintenance or cleaning or to repair damage, malfunction, or degradation of performance resulting from failure to perform user maintenance and cleaning as prescribed in published instruction/user manual,
f) to repair damage, malfunction, or degradation of performance resulting from use of the product in an environment not meeting the operating specifications set forth in the instruction/user manual,
g) to repair damage, malfunction, or degradation of performance resulting from failure to properly prepare and transport the product as prescribed in published product materials
h) to replace items that have been refilled, are used up, abused, misused, or tampered with in any way;
i) to support software not supplied by Chilworth Technology Ltd.;
j) to provide software or firmware updates or upgrades.

In the maintenance of the product, Chilworth Technology Ltd. may use new or equivalent to new parts, assemblies or products for equal or improved quality. All defective parts, assemblies, and products become the property of Chilworth Technology Ltd..

Any additional service identified and provided by Chilworth Technology Ltd. at the Customer's request shall be invoiced to Customer at Chilworth Technology Ltd.'s current rates for parts, labour and travel.

User Manual
JCI 255 Calibrator Unit
for use with JCI 155v6 Charge Decay Analysers and earlier JCI 155 models

For checking performance and formal calibration of JCI 155v6 Charge Decay Analysers (and earlier JCI 155 models) to BS 7506: Part 2: 1996

1. INTRODUCTION

This manual is written with particular reference to using the JCI 255 Calibrator Unit with the current JCI 155 model, the JCI 155v6 Charge Decay Analyser. The JCI 255 can also be used with earlier JCI 155 models, in which case reference should also be made to the relevant JCI 155 manuals.

JCI 155v6 Charge Decay Analysers (and earlier JCI 155 models) should be formally calibrated every 12 months to confirm the sensitivity for surface voltage measurement and decay time measurement performance. The JCI 255 Calibrator Unit conveniently enables these two aspects of calibration to be carried out to the procedure set out in BS 7506: Part 2: 1996 [1], and as described on the JCI Website [2], using measurements whose accuracy is traceable to National Standards.

The basic arrangement for calibration of JCI 155 instruments is to mount an isolated flat metal plate across the test aperture. To this plate calibrated voltages are applied for calibrating the fieldmeter response to a uniform voltage across the whole test aperture area. Combinations of calibrated good quality, high voltage resistors and capacitors are connected between the plate and earth to provide defined values of decay time constants. The practical arrangement is illustrated in Figure 1. The JCI 255 Calibrator Unit is shown in Figure 2 and Figure 3 shows a JCI 155v6 positioned on a JCI 255.

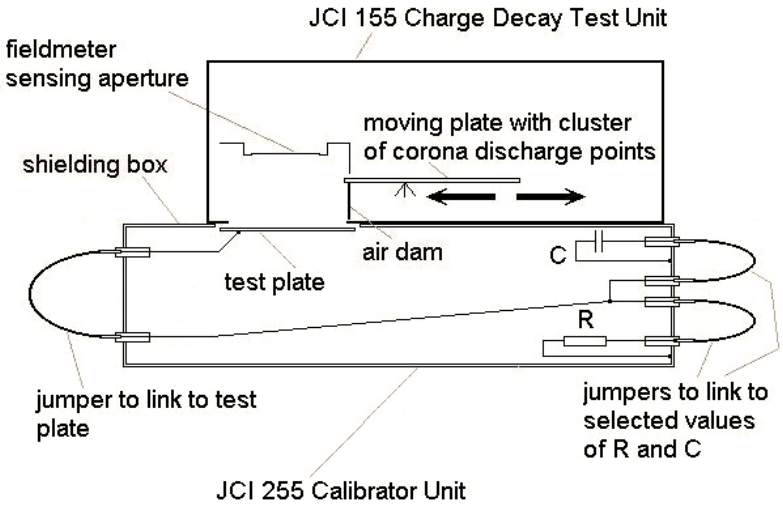

Figure 1: Diagram of JCI 155v6 Charge Decay Analyser on a JCI 255 Calibrator Unit

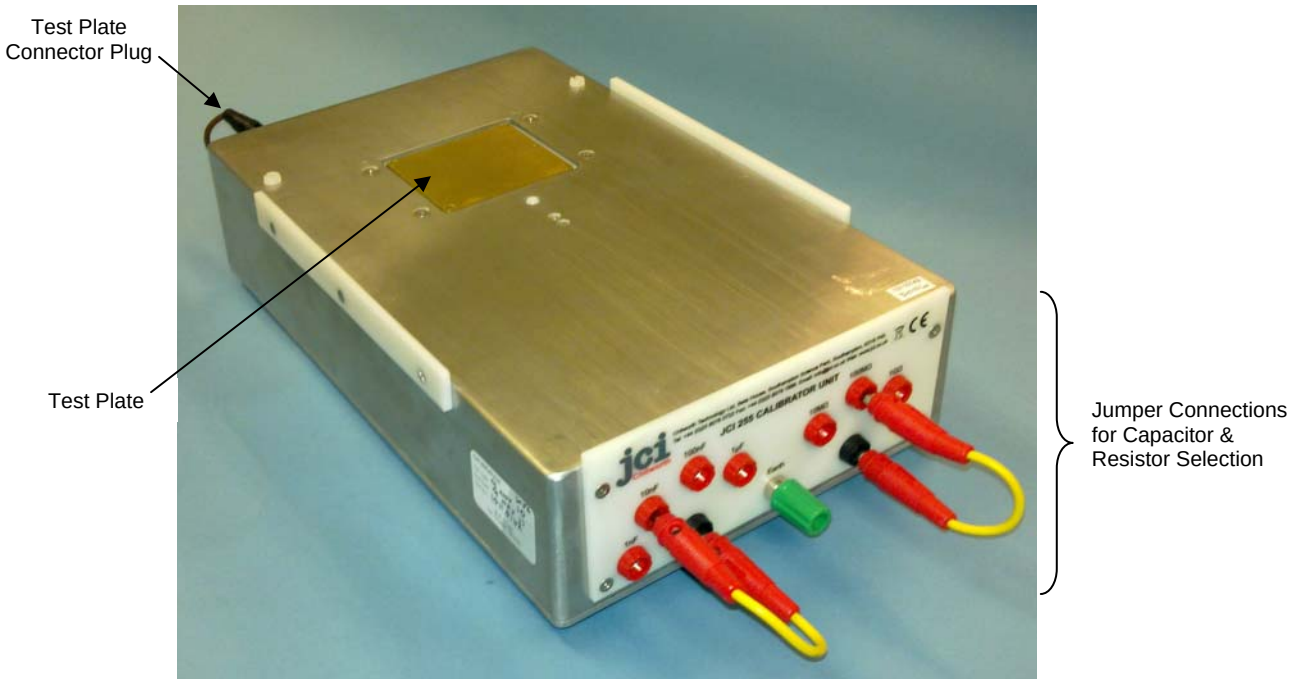

Figure 2: JCI 255 Calibrator Unit

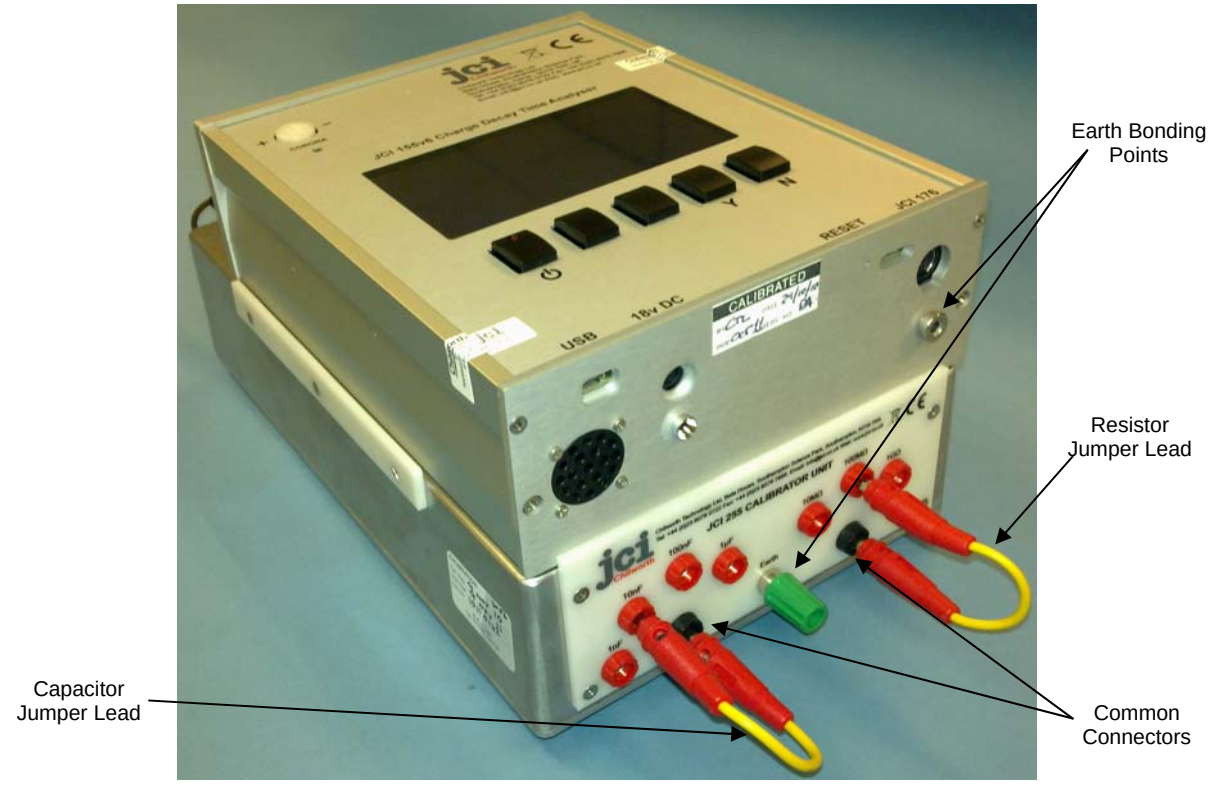

Figure 3: JCI 155v6 Charge Decay Analyser Positioned on the JCI 255 Calibrator Unit

Normally formal calibration is only required on an annual basis. The JCI 255 can, of course, also be used to spot check for correct operation of charge decay measuring instruments. Such spot checks should not be needed more frequently than, say, every 3 months or if the instrument may have suffered from poor handling or internal exposure to powders or liquids.

2. OPERATIONAL AND FEATURES OVERVIEW

The JCI 255, as illustrated in Figure 2, has side and end guides to precisely define the location for a JCI 155v6 Charge Decay Analyser resting on its upper surface. The JCI 155v6 is positioned so its test aperture is over the test plate. When the JCI 155v6 is placed in position it presses on a small Delrin "pip" projecting from the top surface of the box and this opens an earthing contact to the test plate. This is a safety feature. Once the JCI 155v6 is in place on the JCI 255, the earth bonding points on the two units (see Figure 3) should be connected. One of the bonding connectors should also be connected to a known good earth.

Two 4 mm socket connectors are located at the front end of the unit, mounted in good quality insulation: a plug in the upper socket is just visible in Figure 2. The upper connector is connected directly to the test plate and the lower one to the two common sockets on the back end of the JCI 255 (see Figures 1 and 3).

For voltage calibration a calibrated 0 V to ±1000 V power supply (not supplied) should be connected directly to test plate using the upper front end socket, while leaving the lower front end socket unconnected.

On the right hand side of the back end of the JCI 255 are connectors for three resistors, and on the left hand side connectors for four capacitors (see Figures 1 and 3). Nominal resistor values are 10 MΩ, 100 MΩ and 1000 MΩ, and nominal capacitor values 1 nF, 10 nF, 100 nF and 1000 nF. Actual calibration values of these components, traceable to National Standards, are provided with a new JCI 255 Calibrator Unit and again at each calibration check.

For decay time calibration the desired combination of resistance and capacitance is selected by connecting the appropriate resistor and capacitor sockets to their respective common sockets using the supplied jumper leads (as seen in Figure 3). The high voltage corona charging capability of the JCI 155v6 is used to apply sufficient charge to the test plate and resistor/capacitor combination, such that a suitable initial peak voltage is achieved for a decay test.

Actual decay time values (in milliseconds) can be calculated as the product of the calibrated resistor value (in MΩ) and the calibrated capacitor value (in nF). That is:

$$\tau = RC$$

where τ is the charge decay time (time to 1/e of the starting value) in ms, R the resistance in MΩ, and C the capacitance in nF.

Hence, a nominal 1 nF capacitor combined with a nominal 1000 MΩ resistor will give a charge decay time of about 1000 ms or 1 second).

3. CALIBRATION PROCEDUURE

Calibration of the JCI 155v6 Charge Decay Analyser should undertaken with reference to readings shown on the unit's own display (i.e. without reference to data generated on a computer running JCI Graph).

3.1 Settings for Calibration Checks

When charging the JCI 255 test plate using the JCI 155v6, care should be taken to achieve a peak voltage that is ideally between 400 V and 800 V. If the peak voltage is less than 100 V the charge decay result may be influenced by residual air ionisation and therefore fail to accurately reflect the characteristic decay of the selected resistor and capacitor combination. On the other hand, if the peak voltage exceeds 1000 V there is a risk of damaging the JCI 255 Calibrator Unit's capacitors. The peak voltage cannot be controlled precisely, though the broad range achieved can be set by the appropriate selection of corona voltages and corona charge durations using the JCI 155v6 setting controls. To some degree this will be by trial and error, though as an indication it is recommended that the values given in Table 1, below, would be good starting points.

Nominal Resistance (MΩ)	Nominal Capacitance (nF)	Nominal Charge Decay Time (s)	Recommended Corona Voltage* (kV)	Recommended Corona Duration* (ms)	Acceptable Charge Decay Time Error (s)
100	1	0.1	±9.0	20	±0.005
1000	1	1	±9.0	20	±0.05
1000	10	10	±9.0	100	±0.5
1000	100	100	±7.0	2.5 (secs)	±5
1000	1000	1000	±7.0	10 (secs)	±50

Table 1: Recommended Corona Settings

Table 1 includes a column of "Acceptable Charge Decay Time Error" values. If values are found outside these ranges it is recommended that the following checks are made:

a) Check that the JCI 255 Calibrator Unit is correctly connected.
b) Check that there is no dust or fibres bridging the gap around the test plate.
c) Check that the JCI 155v6 fieldmeter is not obviously contaminated (which might be indicated by an unstable or drifting zero).

It is also important to note that when using the JCI 155v6 to look at decay times of 0.1s an analysis start time of between 70mS - 100mS should be used to avoid the mechanical shake of the corona plate return from prejudicing the decay time reading. Reference section 3.4.3 (B) of the JCI 155v6 user manual.

***JCI155v6 Corona Settings**
How to set the corona voltage and time can be found in Section 6.2.2 of the JCI 155v6 User Manual. However, as indicated in the User manual, in normal operation the maximum available corona duration is 50 ms. Hence, to achieve the settings shown in Table 1 the JCI 155v6 must be used in a special Delimited Mode, which is available for calibration purposes.

The JCI 155v6 can only enter its Delimited Mode of operation from "Off". With the instrument turned off, hold the second from left button down while pressing the left hand button (marked "⏻" on the case) to turn the unit on (see also Figure 4). The JCI 155v6 will then start in Delimited Mode, enabling a much wider range of corona duration times, although the normal procedure for adjusting the settings as described in the User Manual is still applicable.

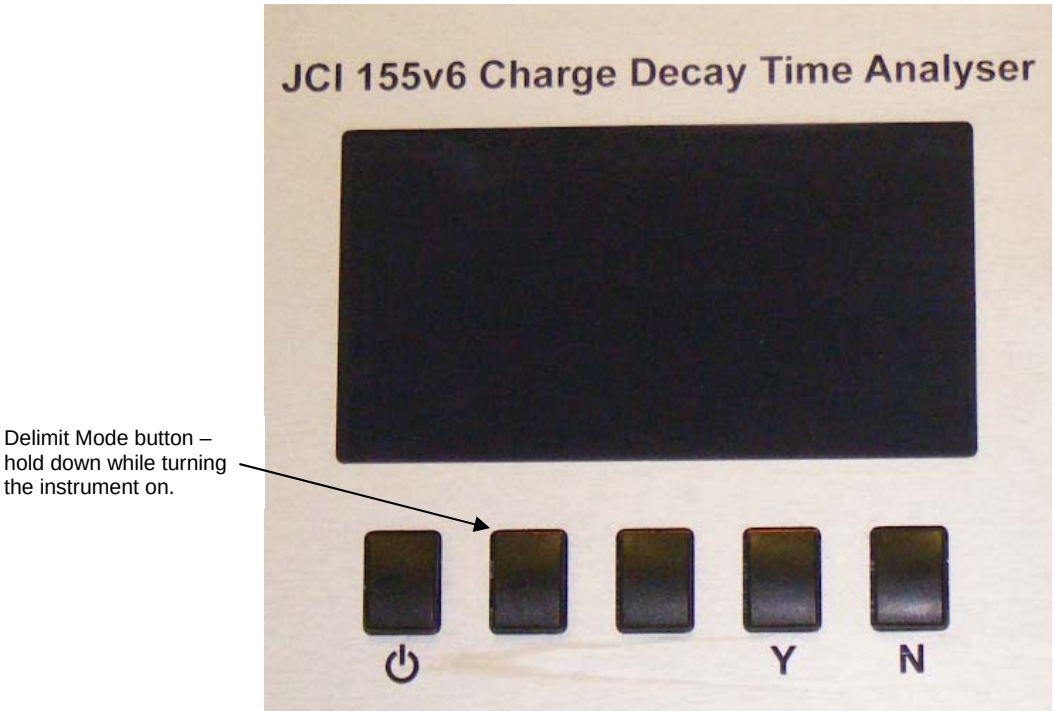

Figure 4: Delimit Mode Button on the JCI 155v6

3.3 Calibration Procedure

3.3.1 Voltage Sensitivity

i) Place the JCI 155v6 Charge Decay Analyser on the JCI 255 Calibrator Unit, ensuring that it is in good contact with the location guides. Bond the JCI 155v6 and the JCI 255 with a jumper cable between their respective earthing connectors (see Figure 3). One of the bonding connectors should also be connected to a known good earth.

ii) Remove the jumper (if connected) between the two 4 mm sockets at the front end of the instrument.

iii) Connect the upper socket on the front end of the unit to a high voltage supply with a calibrated voltage measurement facility (not supplied), and turn on the JCI 155v6 (see JCI 155v6 User Manual).

iv) Apply calibrating voltages from, say, 50 V up to 1000 V to the test plate and record the corresponding surface voltage readings on the JCI 155v6, as shown on the "Home" screen (see JCI 155v6 User Manual Section 6.2).

It is recommended that the accuracy of the voltage measurement should be better than 2.5% for both positive and negative polarity.

3.3.2 Charge Decay Time

i) Place the JCI 155v6 Charge Decay Analyser on the JCI 255 Calibrator Unit, ensuring that it is in good contact with the location guides. Bond the JCI 155v6 and the JCI 255 with a jumper cable between their respective earthing connectors (see Figure 3). One of the bonding connectors should also be connected to a known good earth.

ii) Ensure a jumper is linking the two connectors on the front end of the JCI 255 (connecting the resistor and capacitor common connectors to the test plate).

iii) Set the JCI 155v6 corona to 9kV and 20 ms duration (see JCI 155v6 User Manual).

iv) On the back end of the JCI 255, connect one jumper between the 1 nF connector and the capacitor common connector. Connect a second jumper between the 1000 MΩ connector and the resistor common connector. (See Figure 2 & 3). The nominal charge decay time should then be 1 s (see Table 1).

v) Initiate a test run with the JCI 155v6 Charge Decay Analyser. Check the initial peak voltage was between 100 V and 1000 V. If not, see Section 3.1 and Table 1 for guidance on adjusting the JCI 155v6 corona settings. If the peak voltage is acceptable record the charge decay time (time to 1/e of initial voltage).

vi) Repeat the above test (Step v) two more times.

vii) Switch the corona polarity and repeat Step v three times.

viii) Change the resistor and capacitor jumpers to select 1 nF and 100 MΩ (nominal charge decay time: 0.1 s). Repeat Steps v – vii.

ix) Repeat Step viii with different capacitor and resistor values until all six nominal charge decay times have been tested.

3.4 Reporting

It is recommended that the following information should be recorded in a Calibration Report or on a Calibration Certificate:

i) The name of the organisation carrying out the calibration check.

ii) Certificate or report number.

iii) Instrument operator or owner.

iv) Instrument serial number.

v) Date of calibration.

vi) Name and signature of authorised signatory / operator carrying out the test.

vii) Reference to the calibration method and relevant standard(s).

viii) Overall accuracy of calibration

ix) List of applied voltages and corresponding surface voltage values for both polarities

x) List of measured decay time values (average values and standard deviations) and list of actual decay time values calculated from the calibrated resistance capacitance values.

xi) Reference information on the date and place of calibration of the measuring instruments used and the accuracy of their calibration

4. MAINTENANCE AND TROUBLESHOOTING

Because very high value resistors are used to provide the longest decay time (1000 MΩ) it is important that all insulating surfaces are kept clean and gaps are free of dust, debris and dirt. The quality of the insulation should be checked before any calibration measurements are carried out by leaving the resistors and capacitors unconnected and applying a small amount of corona charge to the test plate and its connections (for instance -3 kV corona voltage for 20 ms). The decay time in this arrangement should be well over 100 s.

If the surface of the test plate becomes contaminated this may affect the initial form of the decay curve – for example over the first 50ms. This surface should be kept clean to avoid any such problems. It is also wise to examine the initial form of a few decay curves to check that no problems are arising as calibration tests proceed.

5. JCI 255 CALIBRATION

The JCI 255 Calibrator Unit is calibrated before dispatch and supplied with formal in-situ calibration of the resistors and capacitors. The unit should be formally recalibrated at 12 month intervals so the values of resistors and capacitors provide measurements of decay times that are traceable to National Standards. Recalibration should be with the test plate connected, so stray capacitance and any leakage resistance of connections is included. If practicable, it will be best to calibrate the resistors with the 1 nF capacitor in circuit, and to calibrate the capacitors with the 1000 MΩ resistor in circuit. This is to take account of any influence of stray capacitance and leakage.

6. PERSONNEL SAFETY

The jumper leads used for selecting the resistors and capacitors, and the connectors, will be at high voltage at least some of the time during calibration work. Operators therefore need to avoid contact with leads, connectors and the test plate when high voltages are, or may be, present. It is recommended that it is positively confirmed that the test plate voltage has dropped to near zero (using the surface voltage indicated on the “Home” screen of the JCI 155v6) before changing any jumpers.

The operator is protected against direct contact with high voltages on the test plate by the automatic earthing of the plate when the JCI 155v6 Charge decay Analyser is lifted from the JCI 255 Calibrator Unit.

7. REFERENCES

1. BS 7506-Part 2:1996, “M*ethods for measurements in electrostatics”*, BSI, 1996.

2. Chubb, J. N.: *“Methods for the Calibration of Electrostatic Measuring Instruments”,* http://www.jci.co.uk/Calibration/Calibration.pdf.

SPECIFICATION

Nominal values of capacitance (nF)	1, 10, 100, 1000
Nominal values of resistors (MΩ)	10, 100, 1000
Nominal values of decay times (s)	0.01, 0.1, 1, 10, 100, 1000
Maximum operating voltage (V)	1000

The specific values for the resistors and capacitors in individual units are determined by formal calibration at an approved test laboratory with traceability of measured values and their accuracy to National Standards. The values are listed in the calibration certificate. Decay time values are obtained by multiplication between the various combination of resistance and capacitance values.

JCI Chilworth *manufactures a wide range of high quality, state of the art electrostatic instrumentation. We also carry out servicing and repairs for JCI instruments, and where appropriate calibration traceable to national and international standards.* ***JCI Chilworth*** *is part of* ***Chilworth Global****.*

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Contact Information

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