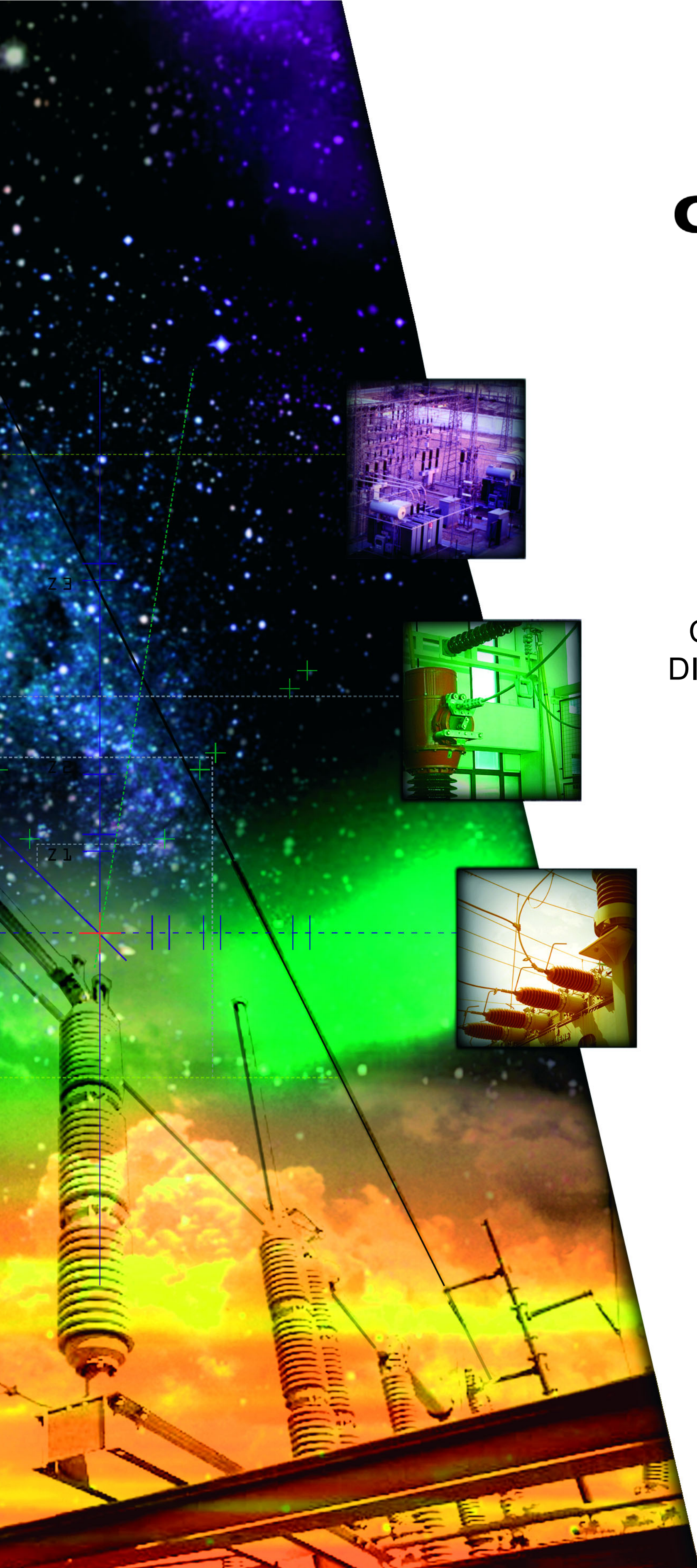


OMICRON

CP CR500

User Manual

COMPENSATING REACTOR FOR DISSIPATION FACTOR / TANGENT DELTA MEASUREMENTS AT LARGE GENERATORS AND MOTORS

in combination with CP TD1

Article Number VESD0608 - Manual Version: CP CR500.AE.4

The product information, specifications, and technical data embodied in this manual represent the technical status at the time of writing and are subject to change without prior notice.

We have done our best to ensure that the information given in this manual is useful, accurate and entirely reliable. However, OMICRON electronics does not assume responsibility for any inaccuracies which may be present.

The user is responsible for every application that makes use of an OMICRON product.

OMICRON electronics translates this manual from the source language English into a number of other languages. Any translation of this manual is done for local requirements, and in the event of a dispute between the English and a non-English version, the English version of this manual shall govern.

Contents

1 Using this Manual

The purpose of this user manual is to get you quickly started with the *CP CR500*. The user manual guides you through the process of measuring Dissipation Factor / Tangent Delta at large generators and motors with the test system *CP TD1*.

Reading the *CP CR500* User Manual alone does not release you from the duty of complying with all national and international safety regulations relevant to working with *CPC 100*, *CP TD1* and *CP CR500*. The regulation EN 50191 "The Erection and Operation of Electrical Test Equipment" as well as the applicable regulations for accident prevention in the country and at the site of operation has to be met.

1.1 Related Documents

The following documents complete the information covered by the *CP CR500* User Manual:

Title	Desciption
CPC 100 User Manual	Contains information on how to use *CPC 100* + *CP TD1*.
CP TD1 Reference Manual	Contains detailed information on the underlying measurements methods.

1.2 Designated Use

The *CP CR500* is designated for compensating large capacities to enable measurements at large generators and motors with the test system *CP TD1*. It must only be used for applications described in this user manual.

2 Safety Instructions

Before operating the *CP CR500*, please carefully read the following safety instructions.

It is not recommended that the *CP CR500* be used (or even turned on) without understanding the information in this manual.

The *CP CR500* should only be operated by trained personnel.

2.1 General

Application of high voltage tests is only allowed for operators who are particularly skilled and experienced in high voltage testing!

The operator is responsible for the safety requirements during the whole test.

Before performing tests using high voltage, please read the following :

– Do not perform any test without having carefully read the *CPC 100*, *CP TD1* and *CP CR500* user manuals!
– Read in particular all safety instructions and follow them!
– Do not use the test equipment without a good connection to substation ground!
– Pay attention to the national and the international standards for the safe operation of high voltage test equipment (EN 50191, IEEE 510 and others).
– Always follow the five safety rules:

FOR YOUR OWN SAFETY

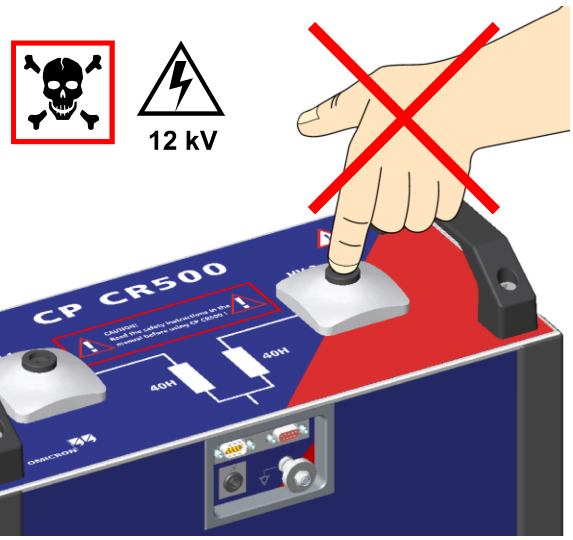
Always follow the 5 safety rules:

1. Insulate
2. Secure to prevent reconnecting
3. Check isolation
4. Earth and short-circuit
5. Cover or shield neighboring live parts

– Never touch any terminal without a visible earth connection!
– Do not open the *CP CR500* housing.

– Properly ground *CP CR500*, *CP TD1* and *CPC 100* by connecting them to the common equipotential ground. Use earth connection cables of at least 6 mm² cross-section. Never operate the *CP CR500* without solid grounding.

– Never touch the high-voltage sockets of the *CP CR500* during operation. Consider these sockets as live, and due to the high voltage life-hazardous.



– The plugs of the high-voltage cables and the cables themselves are not shielded and therefore not safe. While operating the *CP CR500*, consider these cables as live, and due to the high voltage life-hazardous.

2.2 Handling the High-Voltage Cables and the CP CR500

Before handling the high-voltage cables or the *CP CR500* proceed as follows:

1. Press the emergency stop button on the *CPC 100*'s front panel or disconnect *CPC 100* from the mains.
2. While working in the dangerous zone, turn the safety key on the *CPC 100*'s front panel to "lock" (vertical) and remove the key to prevent anyone from accidentally turning on the high voltage.
3. Check the operational condition, in particular:
   – that only the green light "0" on the *CPC 100*'s front panel is lit and
   – *that CP TD1* does not give an acoustic warning sound.
4. Now the high-voltage cables and the *CP CR500* can be handled safely.

2.3 Operating the CP CR500

For safe *CP CR500* operation:

1. Make sure that only the green light "0" on the *CPC 100*'s front panel is lit. *CP TD1* may not give any acoustic warning sound.
2. Secure the *CP CR500* unit with a chain or a barrier tape at a distance of at least 1 m / 3 ft to prevent an accidental entering of the dangerous zone during operation.
3. Connect *CP CR500*, *CPC 100* and *CP TD1* as described in this user manual.
4. Do not operate the *CP CR500* without connecting the safety circuit!
5. Make sure that the connectors are tighlty fit before turning on the high voltage.
6. Turn on the high voltage only for the short time that the measurement requires.
7. Do not touch cables while operating.
8. Do not leave the test set during operation.
9. Once the measurement is finished, press the emergency stop button on the *CPC 100*'s front panel.
10. After you have finished working with the *CP CR500*, turn the safety key on the *CPC 100*'s front panel to "lock" (vertical) and remove the key to avoid anyone turning on the high voltage accidentally.

3 Description

The *CP CR500* is a compensating reactor to enable Dissipation Factor / Tangent Delta measurements of large generators and motors in combination with *CP TD1*. *CP TD1* is able to deliver up to 300 mA at 12 kV. With this power, capacities up to 80 nF can be compensated at 50 Hz. For larger capacities more current is required.

The *CP CR500* contains two inductors. In parallel to the test object it forms a resonant circuit, which is able to compensate reactive power. By tuning the frequency via *CPC 100* and *CP TD1*, the circuit can be brought into resonance. At that time, the *CP TD1* is forced to deliver only the effective power while the current within the resonant circuit can be much higher. Thus, with a single *CP CR500*, capacities up to 500 nF at 50 Hz can be compensated.

3.1 Inductors inside the CP CR500

Essential parts of the *CP CR500* compensation reactor are two high power inductors with an inductive reactance of 40 H each. Both are capable to compensate 1 A. Connected in parallel, 2 A can be compensated by an inductive reactance of 20 H.

Each of the two inductors is protected by an overcurrent relay that interrupts or reconnects the safety circuit. The following time table shows the approximate "ON" and "OFF" times of the overcurrent relay at different currents:

Current in A	**0.3**	**0.6**	**0.8**	**1.0**
ON time in seconds	continuous	30	15	10
OFF time in seconds	-	60	60	80

3.2 High-Voltage Sockets

The *CP CR500* provides two high-voltage sockets for connecting with the test object. Two high-voltage cables are also included.

Caution:

– Never touch the high-voltage sockets of the *CP CR500* during operation. Consider these sockets as live, and due to the high voltage life-hazardous.

– The plugs of the high-voltage cables and the cables themselves are not shielded and therefore not safe. While operating the *CP CR500*, consider these cables as live, and due to the high voltage life-hazardous.

3.3 Low-Voltage Connector (LV)

The *CP CR500* provides one low-voltage connector LV for connecting with *CP TD1* and, if necessary, to another *CP CR500* (Figure 3-1: ”CP CR500’s Interface Panel” on page 12).

3.4 Safety Connection

On the interface panel of the *CP CR500*, there are two D-Sub 9 connectors (male and female) named Safety A (male) and Safety B (female).

These connectors are used for the safety circuit.

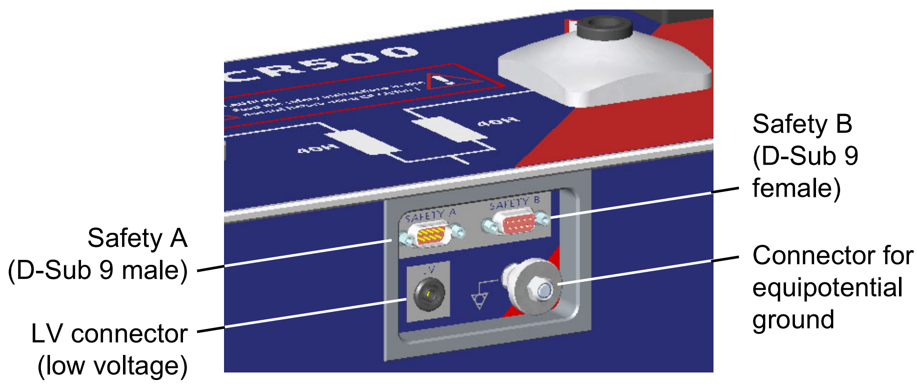
3.5 Equipotential Ground

The connector EG is connected with the *CP CR500*'s equipotential ground (functional earth, protective earth).

Caution:

For a safe operation make sure that all units involved and the trolley, if used, are connected to the common equipotential ground. Use earth connection cables of at least 6 mm² cross-section. Never operate the test setup without solid grounding.

Figure 3-1:
CP CR500’s Interface Panel



4 Setting Up the Test

The test setup consists of the *CPC 100* and *CP TD1* test system, the *CP CR500* compensating reactor(s) and the test object itself.

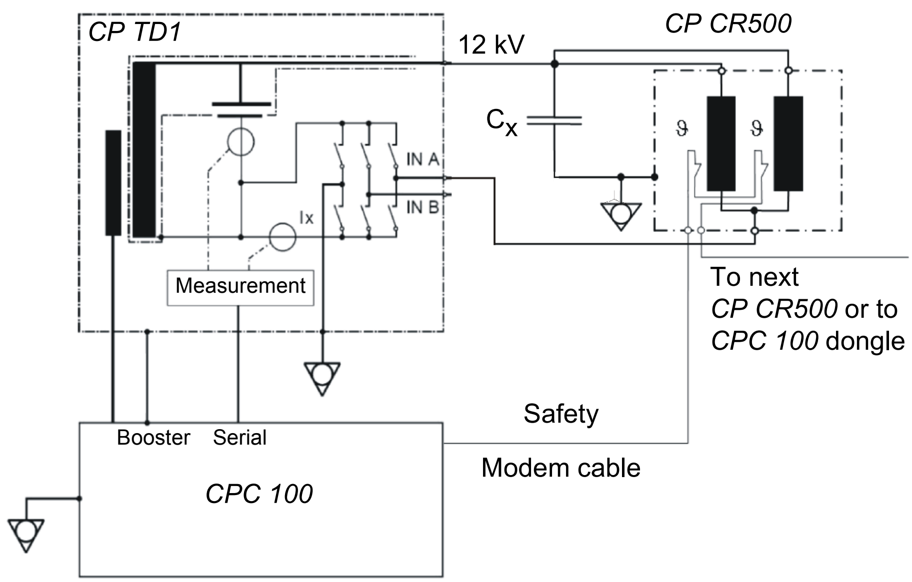
4.1 First Step: Grounding

Caution:

For a safe operation make sure that all units involved and the trolley, if used, are connected to the common equipotential ground. Use earth connection cables of at least 6 mm² cross-section. Never operate the test setup without solid grounding.

Connect *CPC 100*, *CP TD1*, the *CP CR500* compensating reactor(s) and the test object as described below.

Figure 4-1:
Principle diagram of test setup



4.2 Connecting CPC 100 to CP TD1

First, connect *CPC 100* with *CP TD1* as follows:

1. Switch off *CPC 100* at the main power switch.
2. Properly connect the *CPC 100*'s and *CP TD1*'s grounding terminals to earth. Use cables of at least 6 mm² cross-section.
3. Connect *CP TD1*'s "BOOSTER IN" to *CPC 100*'s "EXT. BOOSTER". Use only the booster cable supplied by OMICRON.
4. Connect *CP TD1*'s "SERIAL" to *CPC 100*'s "SERIAL". Use only the data cable supplied by OMICRON.

   The data cable also provides the power supply for *CP TD1*.

4.3 Connecting the CP CR500 to a CPC 100 (Safety Circuit)

1. Remove the dongle from *CPC 100's "*connector for external safety functions" (at the right side of *CPC 100).*
2. Connect the Safety A connector at the *CP CR500* interface panel to *CPC 100's* connector for external safety functions using the modem cable (length 9 meter).
3. Terminate the Safety B connector at the *CP CR500* interface panel with the *CPC 100* dongle that is normally plugged in at the *CPC 100's* connector for external safety functions.

If you use two *CP CR500*, please refer to 4.6 ”Connecting Two CP CR500 Units in Parallel” on page 16.

4.4 Connecting the CP CR500 to the Test Object

Caution:

– Never touch the high-voltage sockets of the *CP CR500* during operation. Consider these sockets as live, and due to the high voltage life-hazardous.

– The plugs of the high-voltage cables and the cables themselves are not shielded and therefore not safe. While operating the *CP CR500*, consider these cables as live, and due to the high voltage life-hazardous.

1. Connect the *CP CR500*'s high-voltage cable to the test object (e.g., a transformer) using the clamp provided with the *CP CR500*.
2. Connect low side of the test object to equipotential gound.
3. Connect the *CP CR500*'s high-voltage cable to the high-voltage socket HV1 or HV2.
4. Connect the *CP CR500*'s LV connector to *CP TD1*'s connector IN A (red plug) using the the low-voltage cable for measuring inputs.
5. Secure the *CP CR500* unit with a chain or a barrier tape at a distance of at least 1 m / 3 ft to prevent an accidental entering of the dangerous zone during operation.

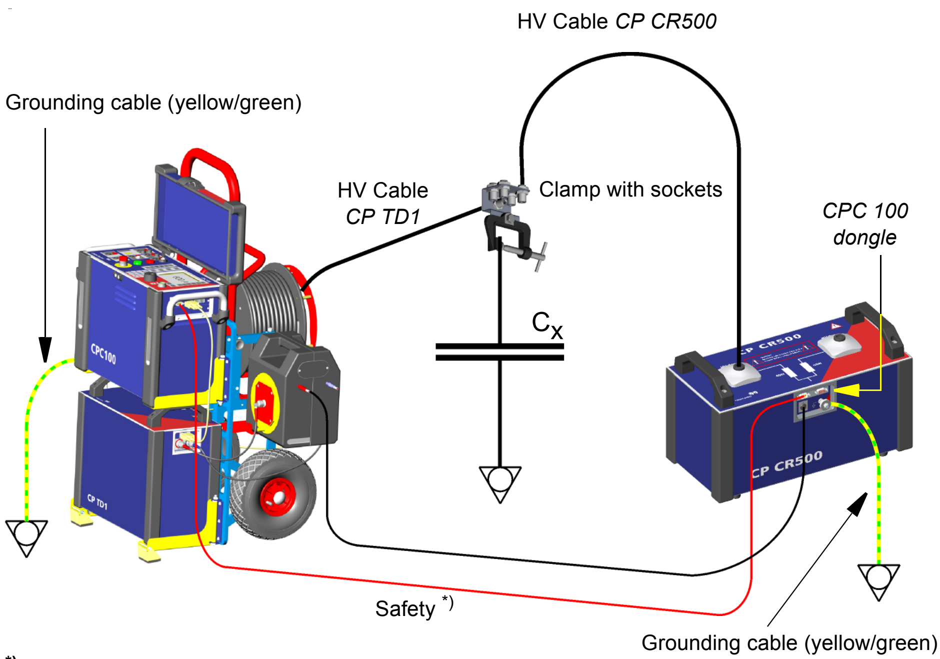


Figure 4-2: Connecting the *CP CR500* to the test object

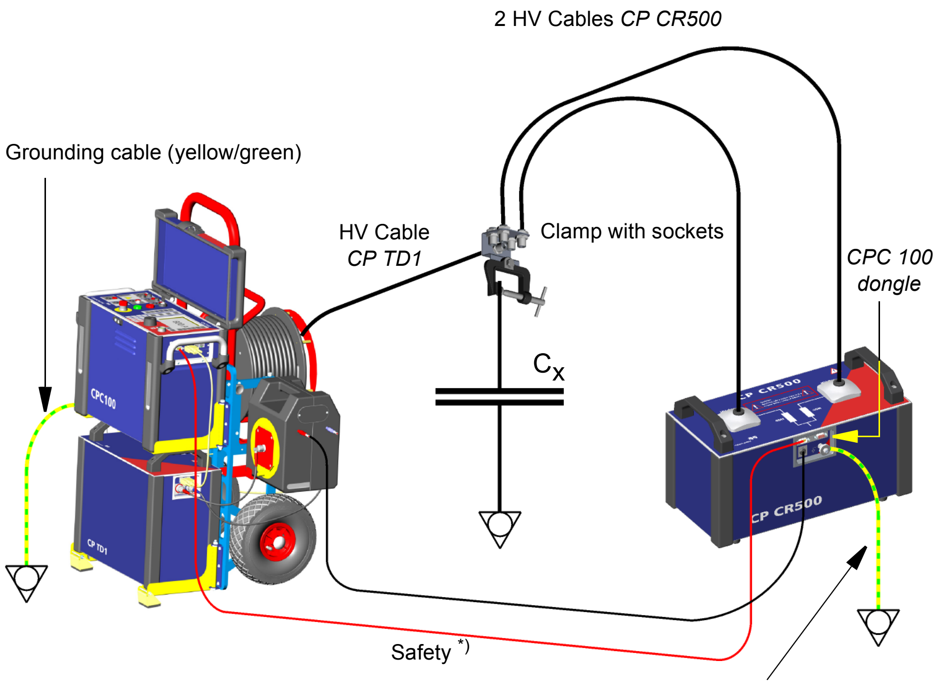
***) Note:** This is not the OMICRON-supplied red connecting cable. It is diplayed red here to denote its importance for operational safety!

4.5 Connecting Both Inductors of a CP CR500

The *CP CR500* contains two inductors with 40 H each. If one inductor alone cannot compensate the designated capacity, a second inductor can be connected in parallel.

Connection Configuration			C-values [µF] and V_{max}-values [kV] at different resonance frequencies [Hz]						
inductor	L [H]	I_{max} [A]	35	42	50	60	71	85	Hz
one	40.0	1.0	0.52/8.4	0.36/10	0.25/12	0.18/12	0.13/12	0.09/12	µF/kV
both	20.0	2.0	1.03/8.4	0.72/10	0.51/12	0.35/12	0.25/12	0.18/12	µF/kV

Figure 4-3:
Using both *CP CR500* inductors



*) **Note:** This is not the OMICRON-supplied red connecting cable. It is diplayed red here to denote its importance for operational safety!

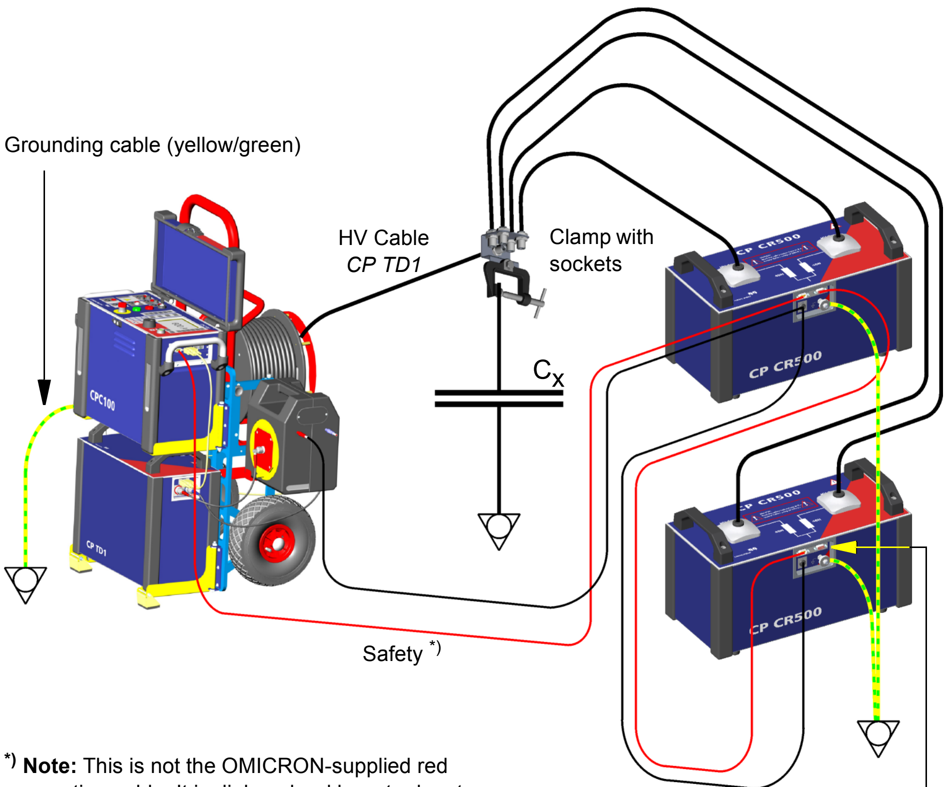
4.6 Connecting Two CP CR500 Units in Parallel

To compensate larger capacities (> 500 nF) two *CP CR500* units can be connected in parallel. The following table shows all possible capacities to compensate with different numbers of *CP CR500*.

Connection Configuration				C-values [µF] and V_{max}-values [kV] at different resonance frequencies [Hz]						
# units	# parll.	L [H]	I_{max}[A]	35	42	50	60	71	85	Hz
1	1	40.0	1.0	0.52/8.4	0.36/10	0.25/12	0.18/12	0.13/12	0.09/12	µF/kV
	2	20.0	2.0	1.03/8.4	0.72/10	0.51/12	0.35/12	0.25/12	0.18/12	µF/kV
2	3	13.3	3.0	1.55/7.7	1.08/9.3	0.76/11	0.53/11	0.38/11	0.26/11	µF/kV
	4	10.0	4.0	2.07/7.7	1.44/9.3	1.01/11	0.70/11	0.50/11	0.35/11	µF/kV

1. If you apply a second *CP CR500* unit, connect it to the Safety B connector of the first *CP CR500* unit using the second modem-cable (length 9 m). Close the Safety B connector on the second unit with the *CPC 100* dongle.
2. Connect both *CP CR500* units to the test object using the high-voltage cables (4-4 ”Connecting two CP CR500 units in parallel”).
3. Connect both low-voltage LV connectors to each other using the delivered standard connection leads 1 x 2 m x 2.5 mm² (black).

Figure 4-4: Connecting two *CP CR500* units in parallel



*) **Note:** This is not the OMICRON-supplied red connecting cable. It is diplayed red here to denote its importance for operational safety!

5 Testing

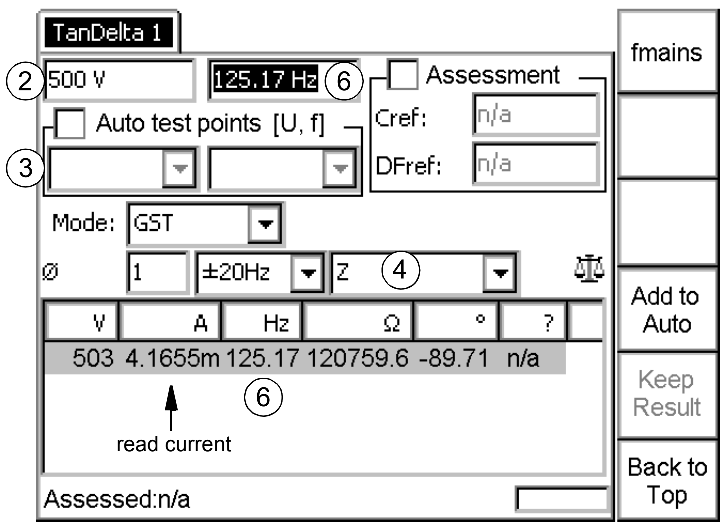
5.1 Find Resonance Frequency

1. After everything is properly connected, open a **TanDelta** test card at the *CPC 100*.
2. Set test voltage to 500 V.
3. At the "Mode" list box on the **TanDelta** test card (main page), select the "GST" mode.
4. It is recommended to select "Z" in the compound measurement setting list box to get results for the impedance measurement.
5. Push the *CPC 100* I/O button (Test Start/Stop).
6. Adjust the test frequency until the minimum current is displayed:
   - if the angle value is negative, decrease the frequency
   - if the angle value is positive, increase the frequency.

☞ Avoid to set the test frequency to the same value as the nominal frequency (e.g., 50.00 / 60.00 Hz) in order to suppress mains frequency interferences.

To increase the maximum voltage, set the frequency higher (up to 5 Hz) than the resonance frequency.

Figure 5-1: Finding the resonance frequency



5.2 Carry Out the Test

5.2.1 Grounded Specimen Test

Take the GSTgA+B mode acc. to sections 4.4 until section 4.6.

6 Diagnostic of Rotating Machines Insulation

For motors and generators, the expected life of a stator winding depends on the ability of the electrical insulation to prevent winding faults. High temperatures, and high rates of temperature changes, can generate inner micro-voids particularly at the interface between Mica and resin, and between semiconductive layers and the resin. Partial discharges in these voids can cause a growing of the voids by erosion and complete breakdowns are only a matter of time.

6.1 Tan Delta Measurements

Capacitance (C) and Dissipation Factor (DF) - often also called "Tan delta" or power factor (PF) - measurement is an established and important insulation diagnosis method. It can detect:

- insulation failures
- aging of insulation
- contamination of insulation liquids with particles
- water in solid and liquid insulation
- partial discharges, e.g., in voids and cracks.

Definition

In an ideal capacitor without any dielectric losses, the insulation current is exactly 90 ° leading according to the applied voltage. For a real insulation with dielectric losses this angle is less than 90 °. The angle δ = 90 °- φ is called loss angle. In a simplified diagram of the insulation, C_p represents the loss-free capacitance and R_p the losses (figure 6-1). The definition of the dissipation factor and the vector diagram are shown in figure 6-2.

Figure 6-1:
Simplified circuit diagram of a capacitor

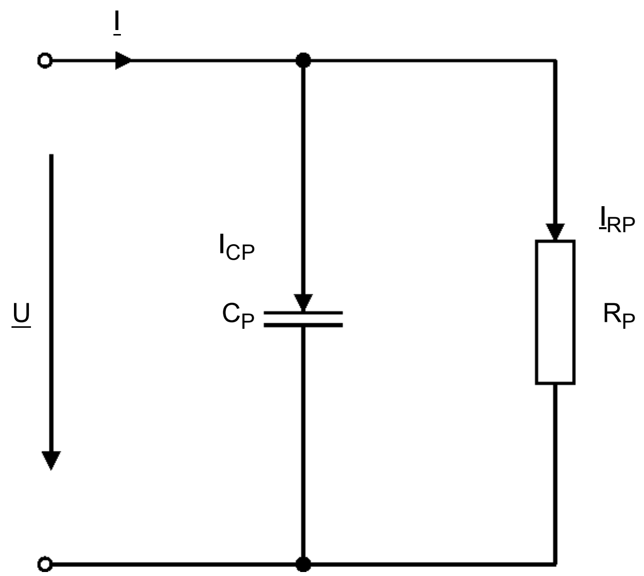
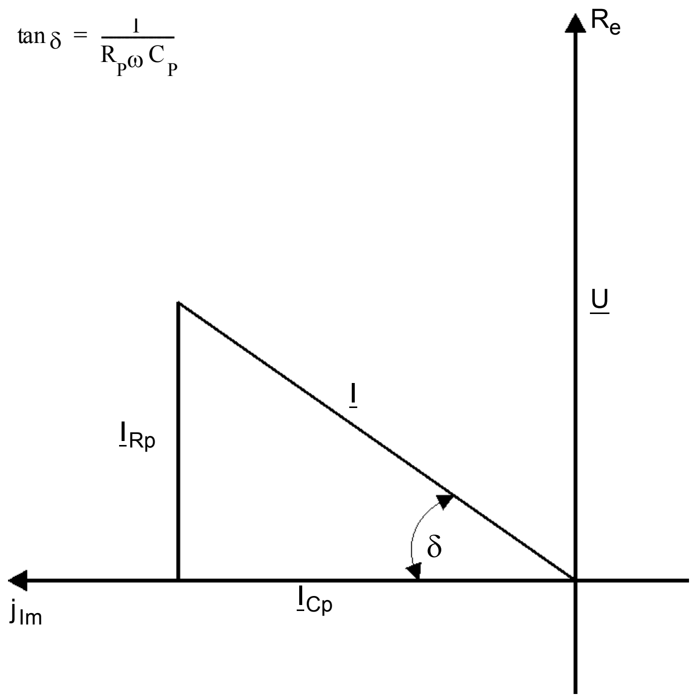


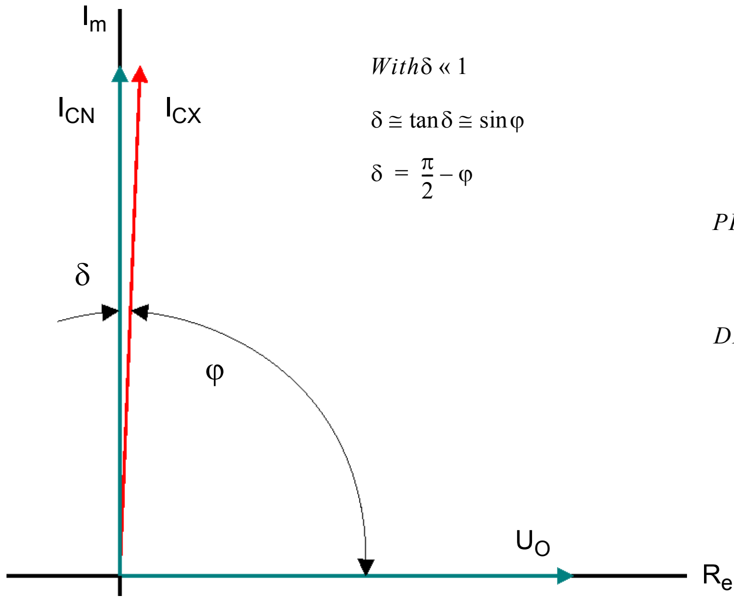
Figure 6-2:
Definition of dissipation factor (tan δ) and the vector diagram

$$\tan\delta = \frac{1}{R_P \omega C_P}$$



The correlation between the Dissipation Factor and Power Factor (PF = cos φ) and the vector diagram are shown in figure 6-3.

Figure 6-3:
Correlation between DF and PF



$$With\ \delta \ll 1$$

$$\delta \cong \tan\delta \cong \sin\varphi$$

$$\delta = \frac{\pi}{2} - \varphi$$

$$PF = \frac{DF}{\sqrt{1 + DF^2}}$$

$$DF = \frac{PF}{\sqrt{1 - PF^2}}$$

6.2 The ∆ Tan Delta" or "TIP-UP" Test

In IEC 60894 the "∆ Tan Delta" test and in IEEE 286 the "Tip-up" are described. Both ∆ Tan-Delta and Tip-up are an indirect way of determining if partial discharges (PD) are occurring in a high voltage stator winding. Since PD is a symptom of many winding insulation deterioration mechanisms, the described tests can indicate if many failure processes are occurring. In addition to its use as an off-line maintenance test, the tests are widely used by stator coil and bar manufacturers as a quality control test to ensure proper impregnation by epoxy and polyester, during coil manufacture.

6.2.1 Purpose and Theory

At low voltages, the PF and DF are not dependent on voltage. However, as the AC voltage is increased across the insulation in a form wound coil, and if voids are present within the insulation, then at some voltage partial discharges will occur. These discharges produce heat, light and sound, all of which consume energy. This energy must be provided from the power supply.

Consequently, in a coil with delaminated insulation (perhaps due to long term overheating), as the voltage increases and PD starts to occur, the DF and PF will increase above the normal level due to dielectric loss, since the PD constitutes an additional loss component in the insulation. The greater the increase in PF and DF, the more energy that is being consumed by the partial discharge.

In the tip-up test, the PF or DF is measured at a minimum of two voltage levels. The low voltage DF, DF_lv, is an indicator of the normal dielectric losses in the insulation. This is usually measured at about 20 % of the rated line-to-ground voltage of the stator. The voltage is then raised to the rated line-to-ground voltage, and DF_hv is measured. The tip-up is then:

Tip-up = DF_lhv - DF_lv

The higher the tip-up, the greater is the energy consumed by PD. Sometimes the PF or DF are recorded at several different voltage levels, and several different tip-ups are calculated between different levels. By plotting the tip-up as a function of voltage, the voltage at which PD starts is sometimes measurable. If the PF or DF is measured in percent, then the tip-up is in percent.

Figure 6-4:
Power Factor "Tip-Up" according to IEEE 286

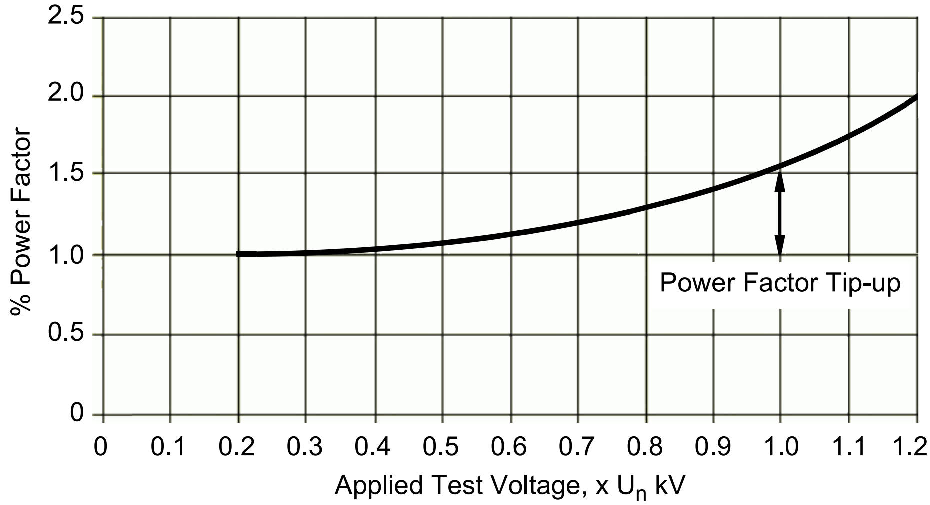
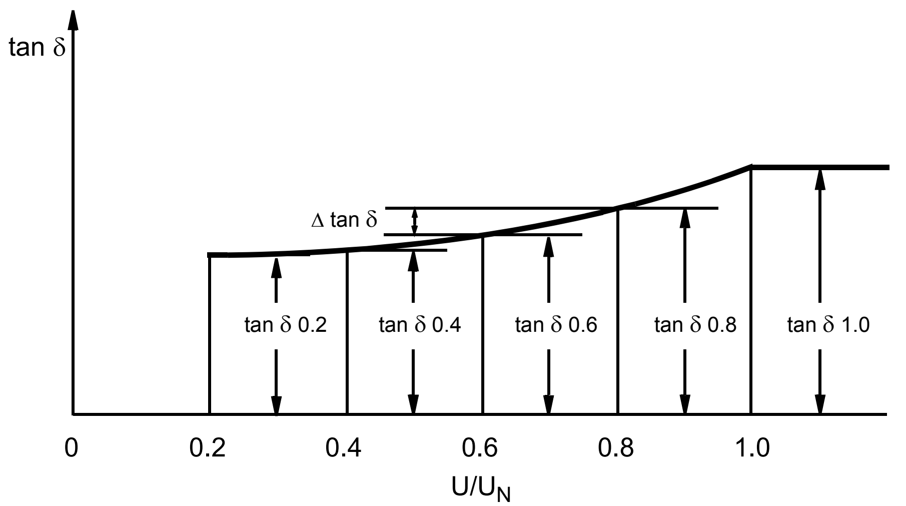


Figure 6-5:
"Δ tan δ" as a function of the test voltage according to IEC 60894



Historically, the DF test was first applied to high voltage stator bars and coils, to ensure that the insulation was completely impregnated. However, since the late 1950s, some motor and generator operators have applied the test to complete windings to detect various aging mechanisms that produce PD.

Measurement of the tip-up is complicated by the presence of silicon carbide stress control coatings on coils rated 6 kV or above. At low voltage, the silicon carbide is essentially a very high resistance coating, and no current flows through it. Thus, there is no power loss in the coating. However, when tested at rated voltage, by design the silicon carbide coating will have a relativity low resistance.

Capacitive charging currents flow through the insulation and then through the coating. The charging currents flowing through the resistance of the coating produce an I^2R loss in the coating.

The DF or PF measuring device measures this loss. Since the loss is nearly zero at low voltage, and non-zero at operating voltage, the coating yields its own contribution to tip -up. It is not uncommon for the tip-up due to the stress relief coating to be 2 or 3 %. This coating tip-up creates a minimum tip-up level. Very significant PD must be occurring in most windings for the PD loss to be seen above the silicon carbide tip-up. When manufacturers test individual coils and bars in the factory as a quality assurance test, the tip-up contribution - due to the stress relief coating - can be negated by guarding.

Unfortunately, it is not practical to guard out the coating tip-up in complete windings. It makes sense to do Tan-Delta and Δ-Tan-Delta tests upwards and downwards. The area between upwards and downwards curves is a measure for the PD activity, because ignition and extinguishing of PD will occur at different voltage levels.

6.2.2 Interpretation

As maintenance tools for complete windings, Δ-Tan-Delta and tip-up tests are used for trending. If the tip-up is measured every few years and the tip-up starts increasing from the normal level, then it is likely that the winding has significant PD activity. To increase the tip-up above the normal level requires widespread PD. The most likely causes of this PD are:

- thermal deterioration
- load cycling
- improper impregnation during manufacture.

An acceptable power factor offers assurance that the coil or the bar was properly fabricated with inherently low-loss materials and was properly processed. A low power factor tip-up reflects the quality of the construction and compactness (lack of gaseous inclusions or voids) of a coil or bar, the composition of the impregnating material and quality of the impregnating process, and the quality and condition of the semiconductive surface treatment in the slot area. Differences in the tip-up measured for coils or bars of similar composition and fabrication are generally attributed to a variation in the incidental void content.

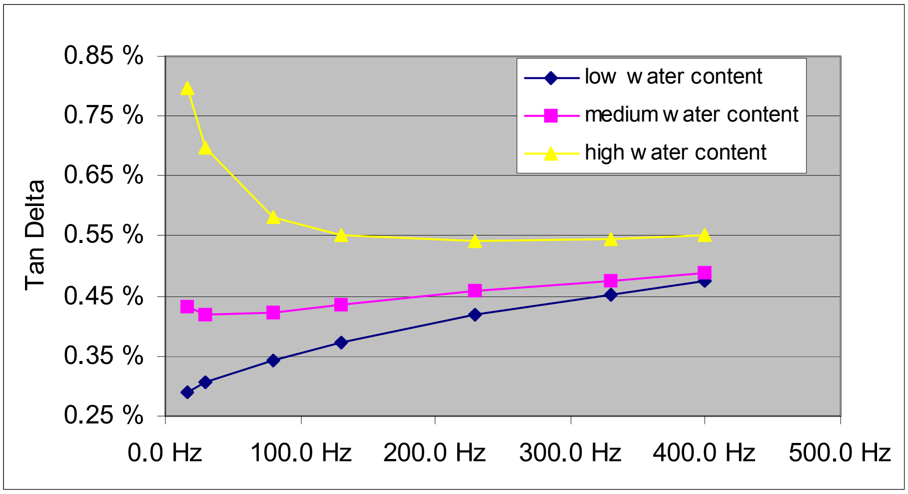
The power factor measured at a low voltage, e.g., 2 kV rms, is, for the most part, unaffected by partial discharge and is an indication of:

- the inherent dielectric losses of the insulation and its general condition
- the quality of the contact of the semi-conductive surface with the core
- the moisture content and degree of cleanliness
- the degree of curing of materials.

6.3 The Dielectric Response of Winding Insulation

With the dielectric response measurement at low test voltages, the general insulation aging and the water content in the insulation can be checked.

Figure 6-6:
Dielectric response of the winding insulation



The test is made at low test voltages of about 100 V to 200 V from 15 Hz to 400 Hz. In this case also high capacitance can be tested without compensating reactors. The value at rated frequency (50 / 60 Hz) can be compared to the value at test frequency of e.g. 55 Hz, which is used to get resonance with the compensating reactor coil.

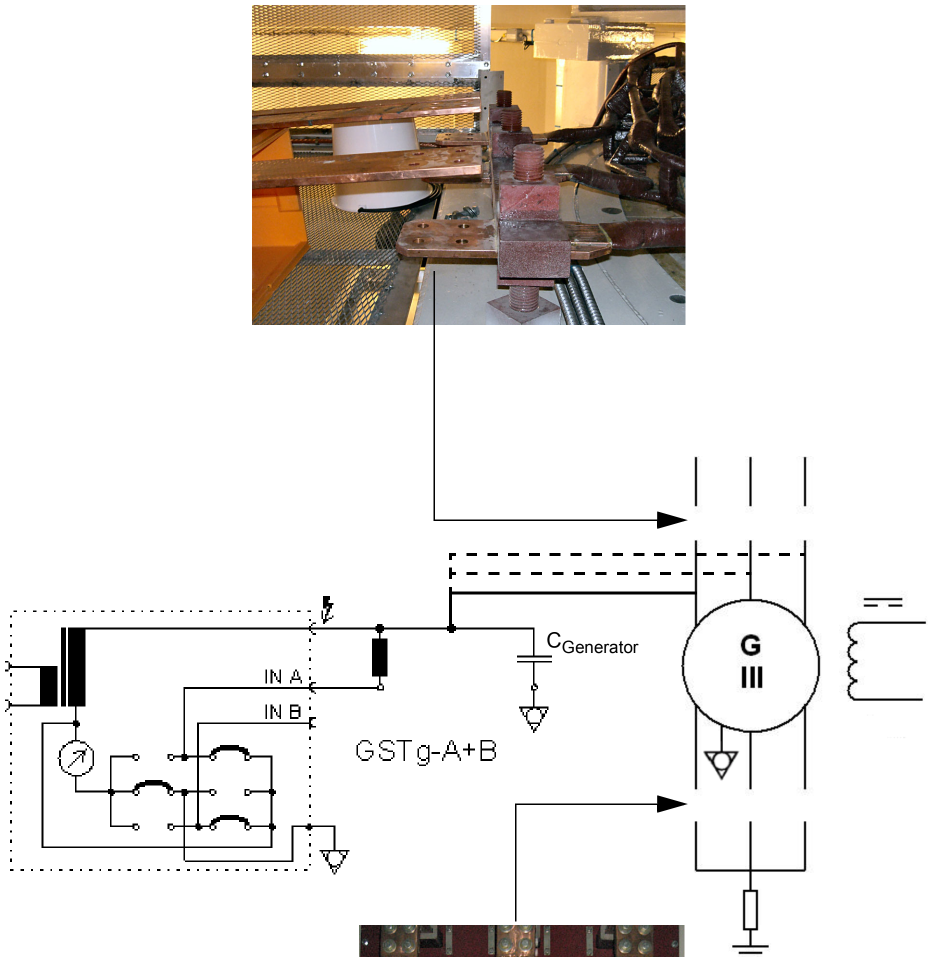
6.4 Example: C - Tan Delta Measurements on a Generator

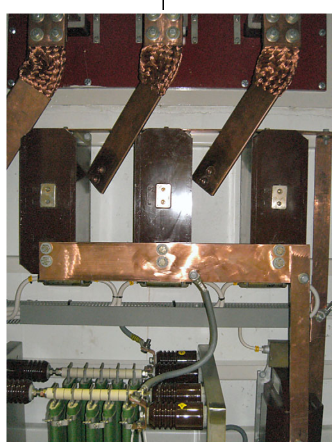
Step 1: Follow all safety rules for switching off the generator and grounding it!

Figure 6-7:
11 MVA generator

Step 2: Isolation of the busbars and connection

Figure 6-8:
Circuit diagram





If possible, all generator busbars should be isolated. Then the phases can be measured separately and can be compared to each other.

Step 3: Input of the name plate data

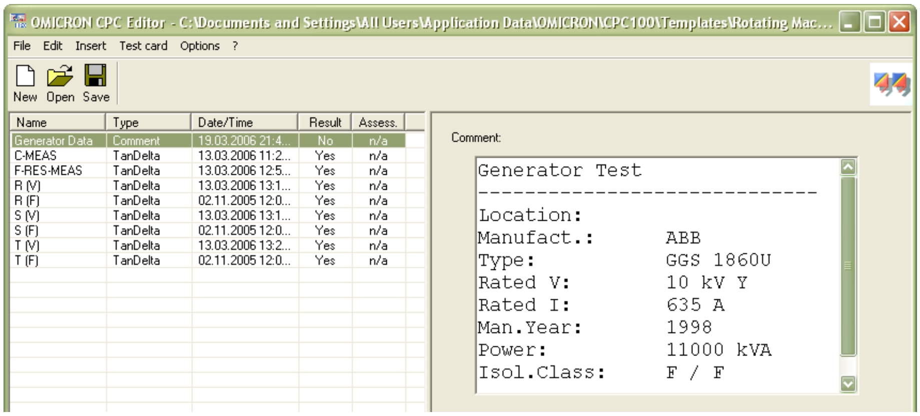


Figure 6-9:
Input of name plate data

Step 4: Measurement of the capacitance (GSTgA+B mode)

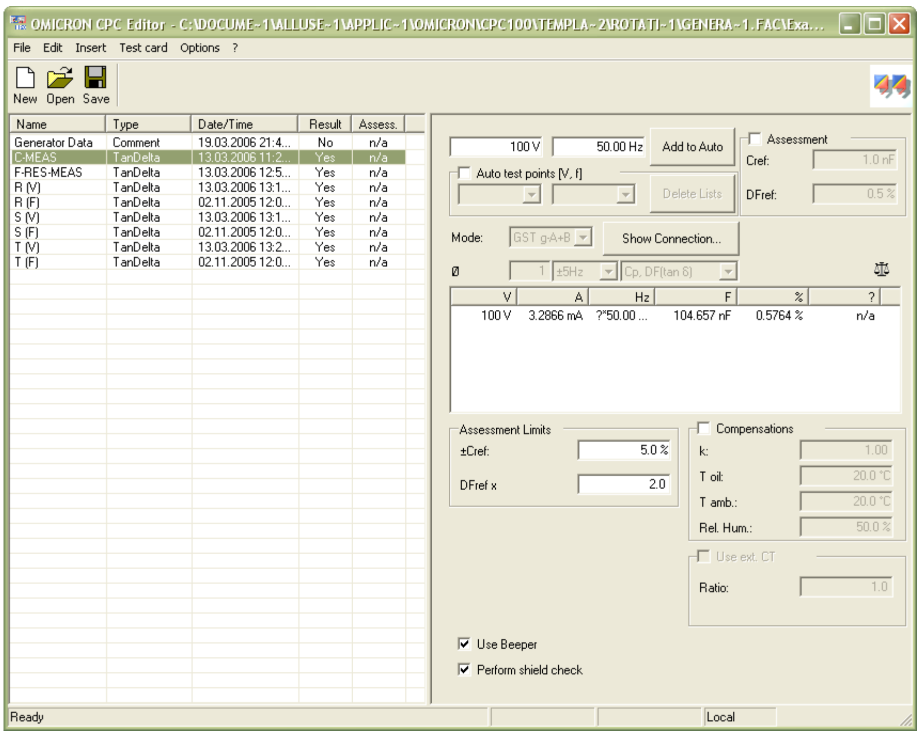


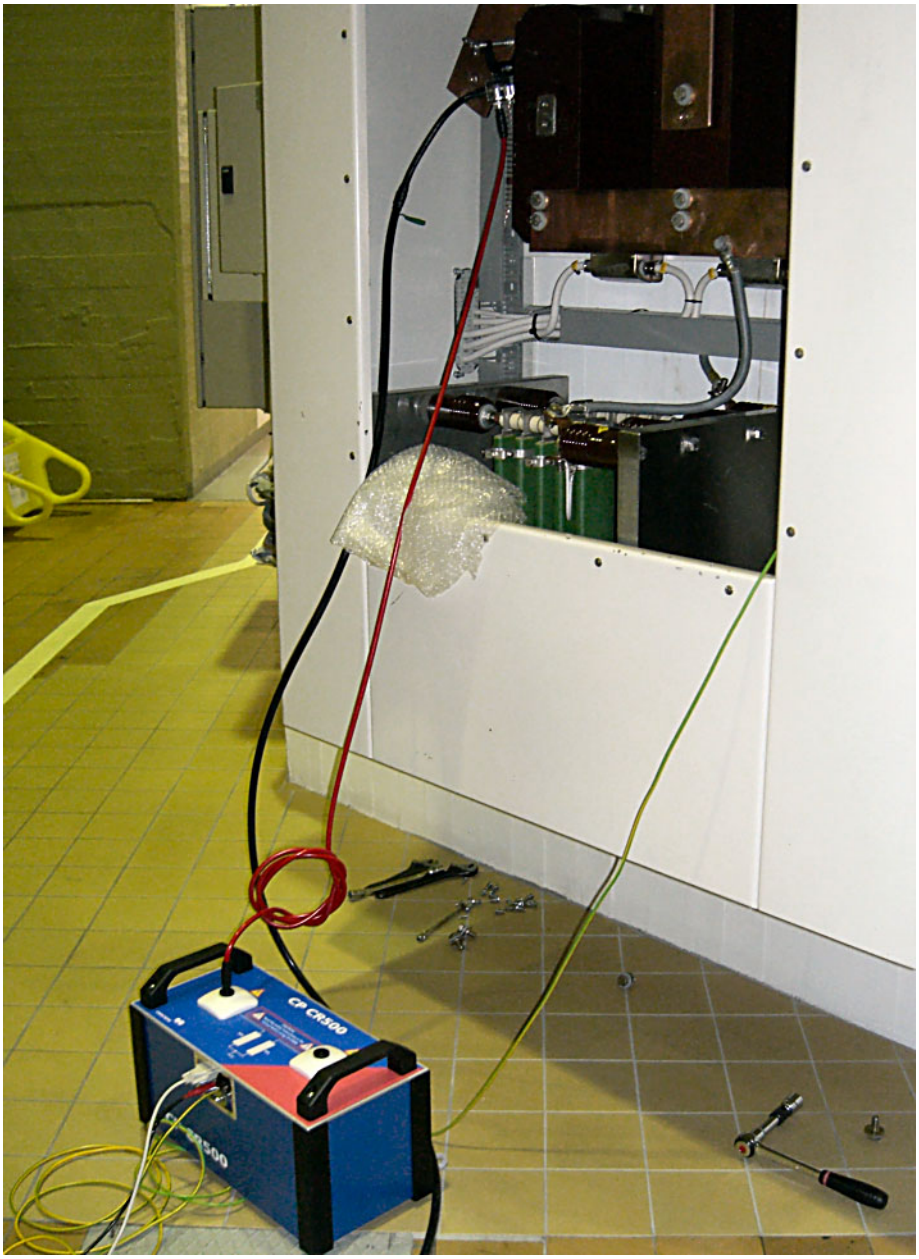
Figure 6-10:
Measurement of the capacitance (Phase A)

The capacitance per phase is 104.6 nF.

With one coil (40 H) the resonance frequency is: $f_{res} = \frac{1}{2 \cdot \pi \cdot \sqrt{L \cdot C}} = 78.8$ Hz.

This result can also be determined using the graph in picture "Resonance frequencies = function of capacity" on page 36 in section 6.6 ”Appendix”.

Figure 6-11: Connecting the *CP CR500*



Step 5: Measurement of the resonance frequency (GST mode)

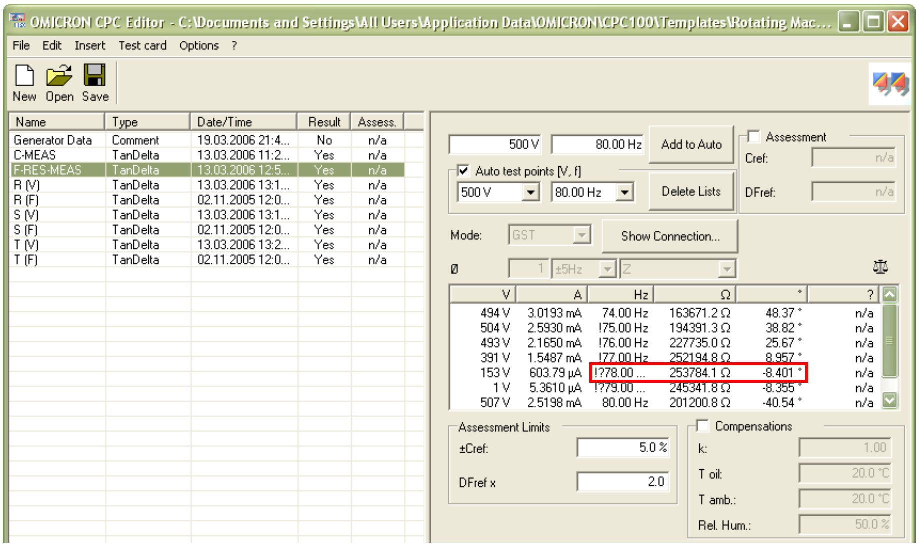


Figure 6-12:
Measurement of the resonance frequency

Step 6: Measurement of the "TIP-UP" and "TIP-DOWN" (GSTgA+B mode)

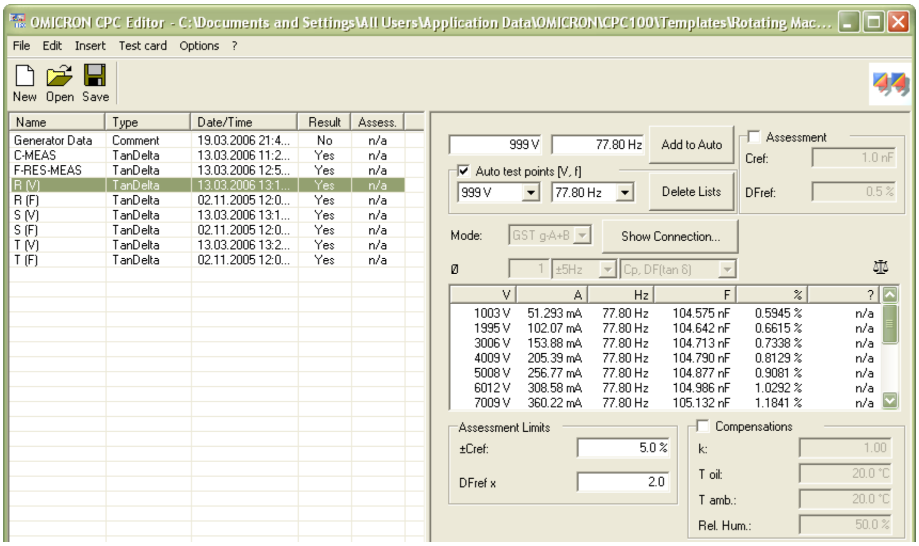
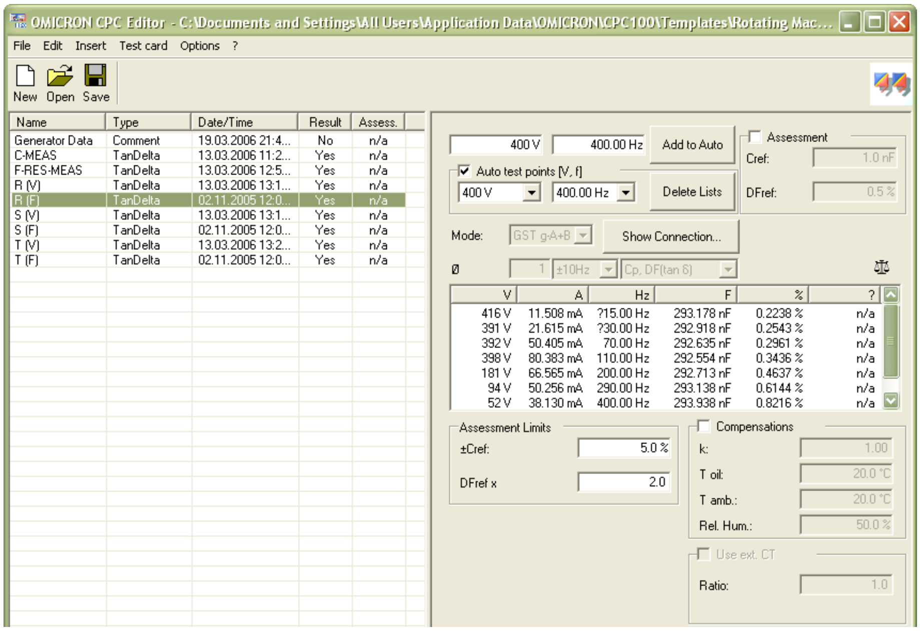


Figure 6-13:
"TIP-UP & TIP-DOWN" measurement

"Up" and "Down" tests can be programmed by entering a series of test voltages like: 1000-2000-3000-4000-5000-6000-4999-3999-2999-1999-999 V.

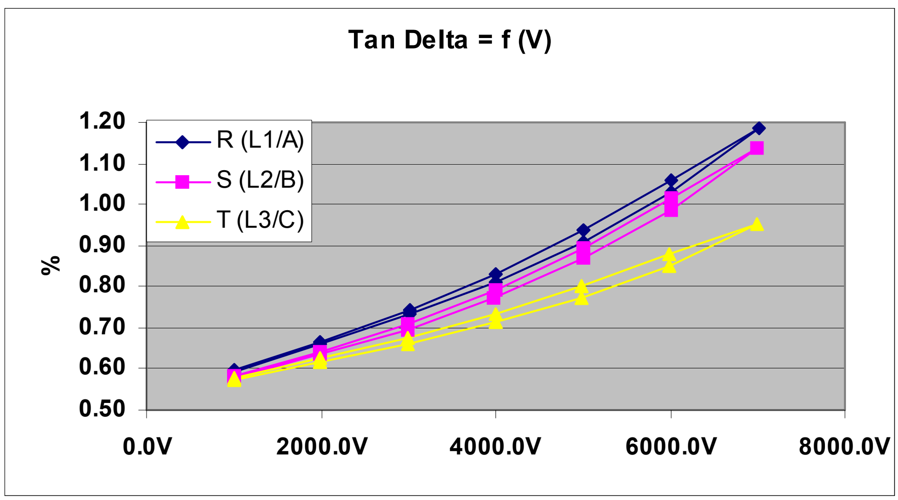
Step 7: Measurement of the dielectric response (GSTgA+B mode)

Figure 6-14:
Measurement the dielectric response



Step 8: Results

Figure 6-15:
Tan Delta = f (V)



Note: The results displayed in figures 6-15, 6-16 and 6-17 show curves of a "good" generator isolation.

Figure 6-16:
∆ Tan Delta = f (V)

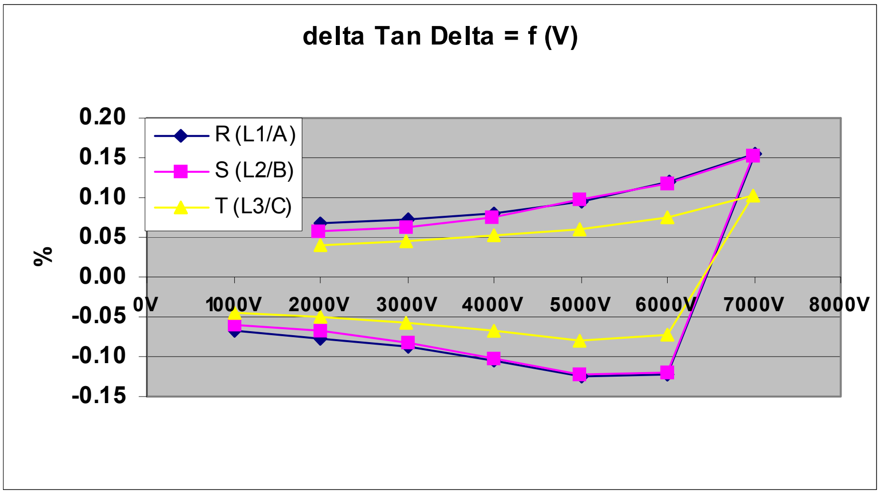
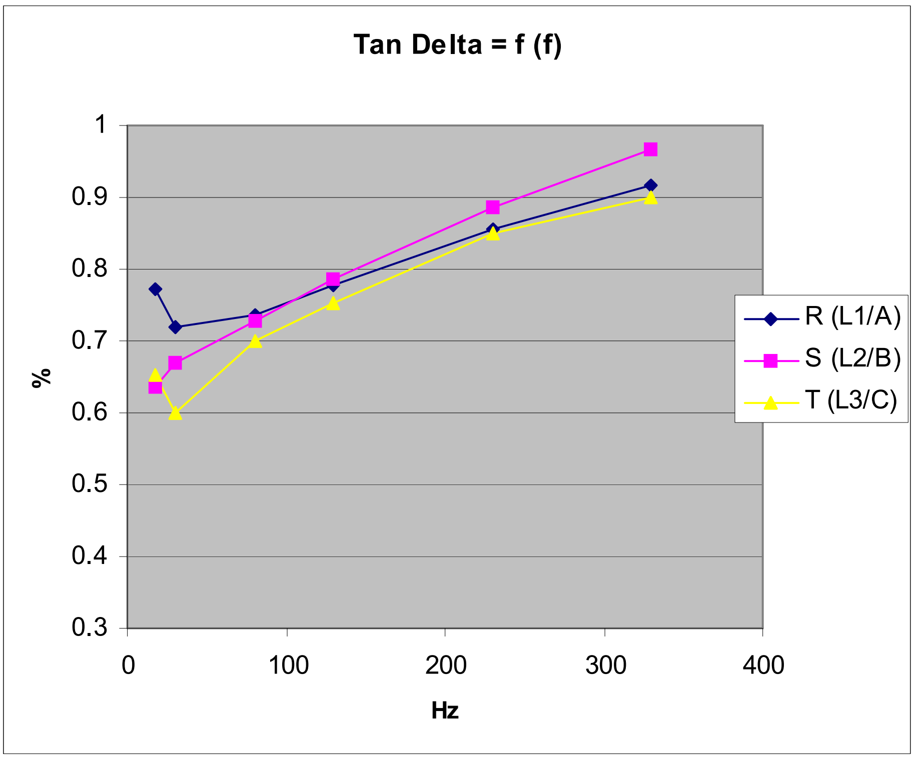


Figure 6-17:
Dielectric response
Tan Delta = f (f) at 200 V



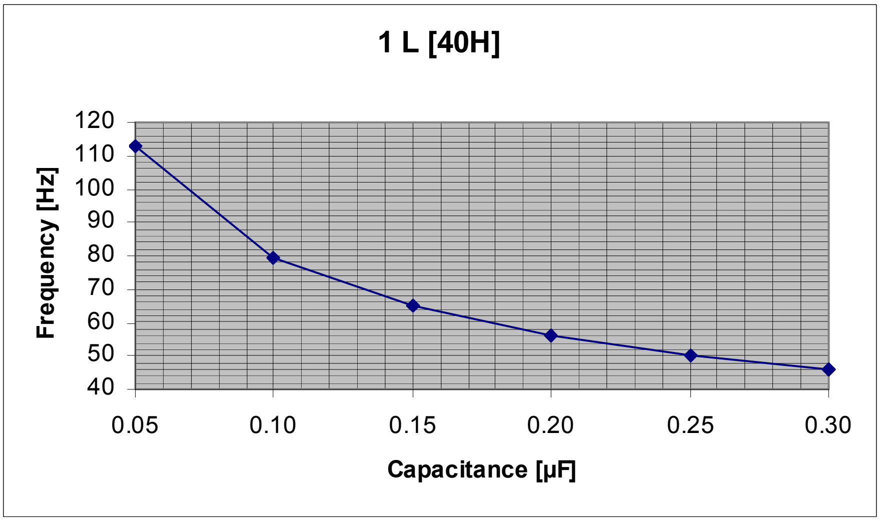
6.5 Literature

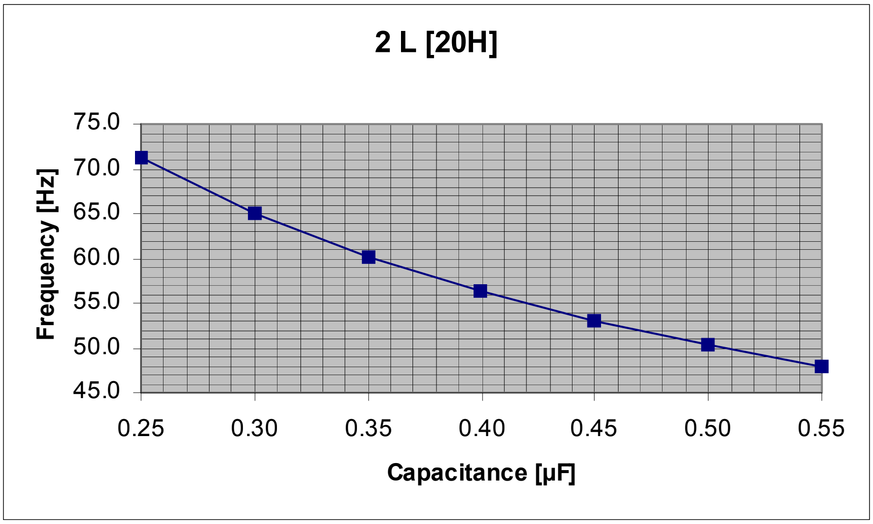
IEEE 286 - 2000, "Recommended Practice for Measurement of Power Factor Tip-Up of Electric Machinery Stator Coil Insulation".

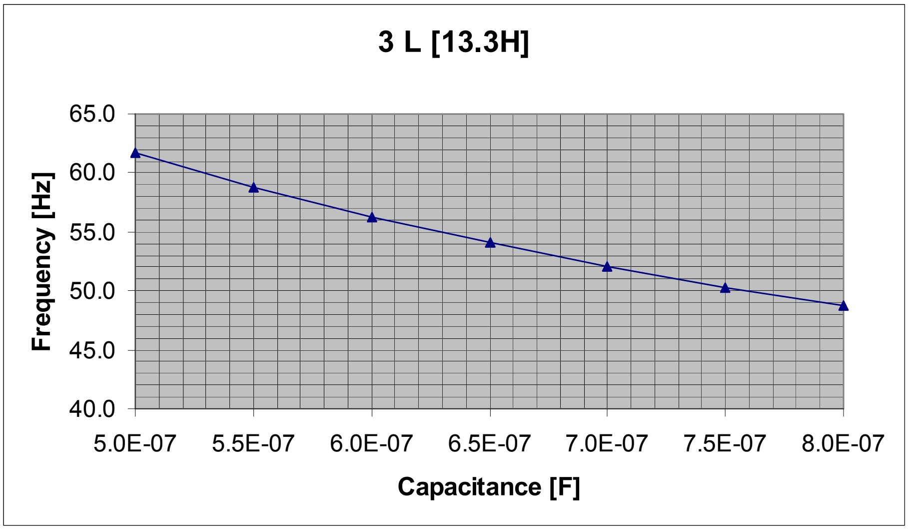
IEC 60894 -1987, "Guide for a test procedure for the measurement of loss tangent of coils and bars for machine windings".

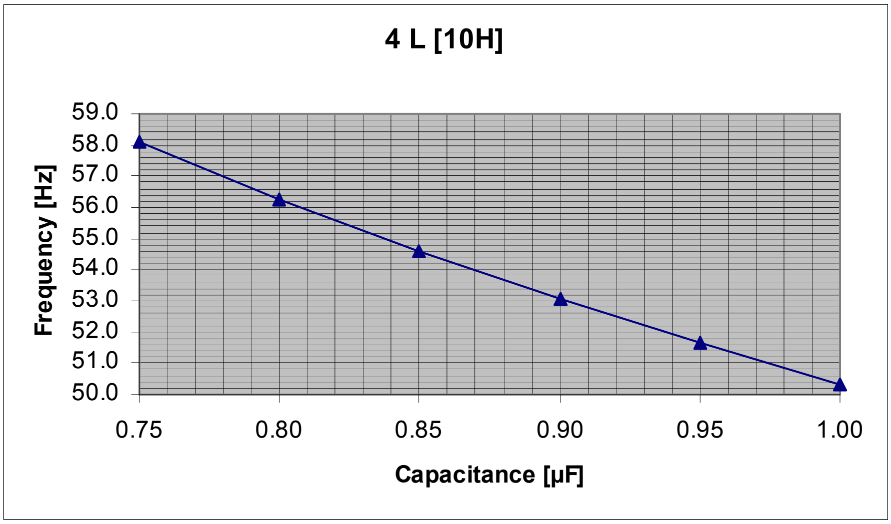
6.6 Appendix

Resonance frequencies = function of capacity at different numbers of compensation inductors.






3 L [13.3H]
Frequency [Hz]
65.0
60.0
55.0
50.0
45.0
40.0
5.0E-07
5.5E-07
6.0E-07
6.5E-07
7.0E-07
7.5E-07
8.0E-07
Capacitance [F]


4 L [10H]
Frequency [Hz]
59.0
58.0
57.0
56.0
55.0
54.0
53.0
52.0
51.0
50.0
0.75
0.80
0.85
0.90
0.95
1.00
Capacitance [μF]

7 Declaration of Conformity

OMICRON electronics GmbH, Oberes Ried 1, 6833 Klaus / Austria

herewith declares conformity of the *CP CR500* unit with the following normative documents of the EU:

- 73/23/EEC concerning electrical devices for use of certain voltage limits with changes due to the CE designation standard 93/68/EEC
- 89/336/EEC about electromagnetic compatibility changed by the standard of the Council from the 29th of April 1991 (91/263/EEC), the standard of the Council from the 28th of April 1992 (92/31/EEC), the standard of the Council from the 22nd of July 1993 (93/68/EEC)

and full compliance to the following standards:

- EN61010-1/A2:1995*
- EN61326-1:1997, EN61000-3-2/3

The following technical documentation is ready to be looked at:

TYPE TEST CERTIFICATE from OMICRON electronics GmbH This material can be seen at OMICRON electronics GmbH.

Name:	Dipl.-Ing. Dr. techn. Michael Krüger
Function:	Product Manager
Date:	xx. xxxx 2006

Signature: 

*The high-voltage (HV) components like HV sockets of *CP TD1* and *CP CR500*, the hot end of the HV cable and the HV clamps have some live parts during testing. These components in combination with *CPC 100* are designed to operate according the standards EN 50191 and VDE 104. The user has to take care of components that can have live wires by following the safety instructions. Understanding and fulfilling of all safety instructions mentioned in the *CPC 100* User Manual or in the *CP CR500* User Manual consequently have to be realized by the operator.

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