Plasma Control Technologies

Service Bulletin-34

N-Cap Series

Technical Recommendations and General Information

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1 Document Summary

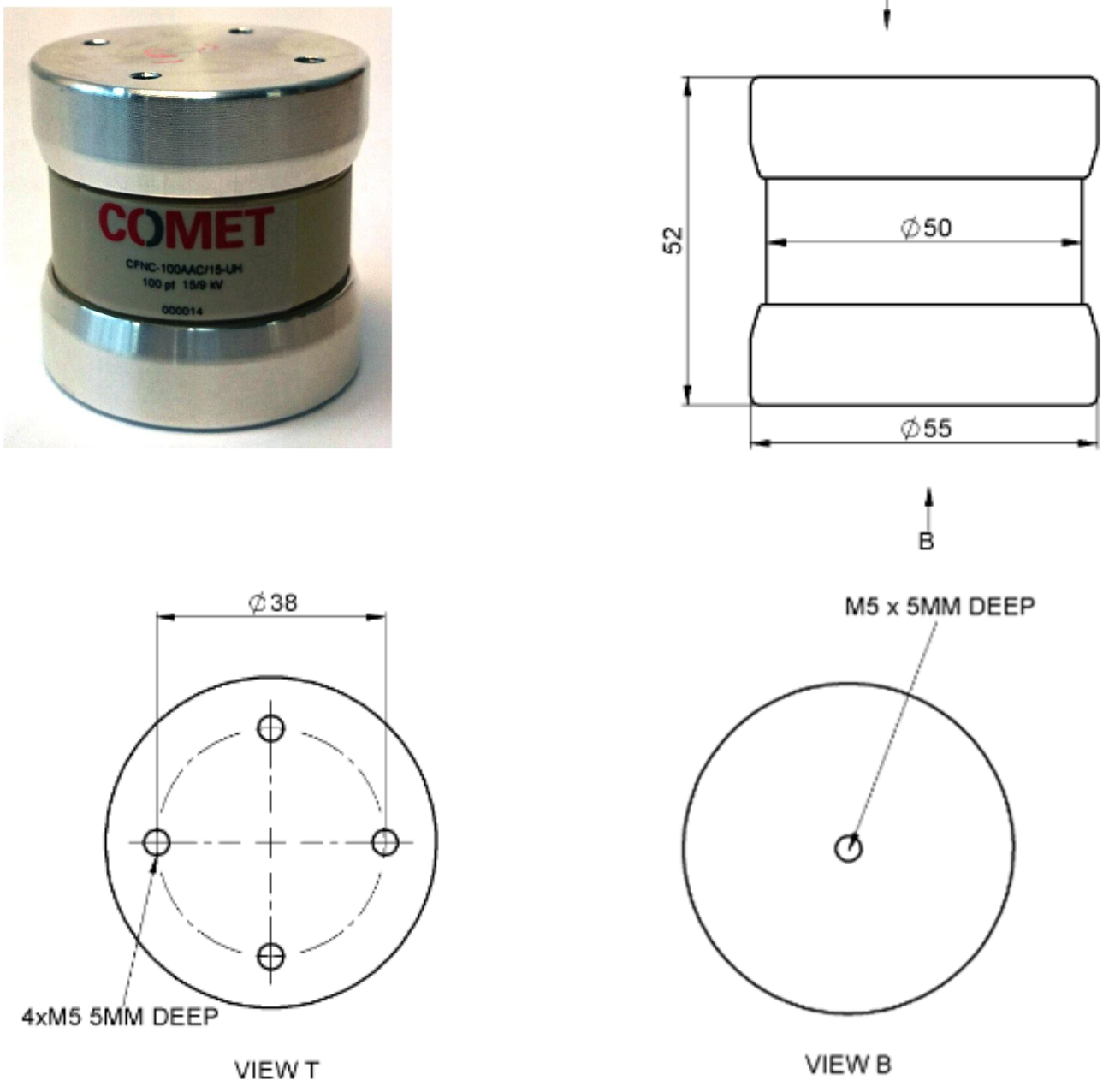
The N-Cap series are gas filled capacitors. This document contains info such as general information, a technical description, test information, and handling and storage information. Please see the contents for the full list of information.

2 General Technical Data

Description

N-Cap is a fixed high voltage capacitor made of plastic and metal. (See Figure 1) It is filled with pressurized inert gas and is for various applications with frequencies up to 100 MHz.

Figure 1: Photo and dimensional views



The N-Cap series contains the standard versions shown in Table 1.

Table 1: N-Cap Types Electrical Specifications

Type	Capacitance	Upt	Upw	I_{max} @13.56 MHz
CFNC-25AAC/15-UH	25 pF	15 kV	9kV	13 A_{rms}
CFNC-50AAC/15-UH	50 pF	15 kV	9kV	27 A_{rms}
CFNC-100AAC/15-UH	100 pF	15 kV	9kV	54 A_{rms}
CFNC-150AAC/15-UH	150 pF	15 kV	9kV	81 A_{rms}

Mechanical Data

Table 2: Mechanical Data

Net weight	~190 gr.
Maximum body temperature: Storage	-30 to + 125° C
Maximum body temperature: Operating	-10 to + 125° C
Mounting position	any

3 Peak Working Voltage

The peak working voltage depends mainly on 3 factors: The minimum distance between the internal electrodes, the properties of the dielectric between these electrodes and the distance between the external connections. All current varieties of N-Cap have the same working voltage equivalent to a Mini-cap. (See Table 3)

Table 3

N-Cap (CFNC)	Mini-cap (CFMN)	Upt
CFNC-AAC	CFMN-CAC	15
CFNC-BAC	CFMN-DAC	30
CFNC-CAC	CFMN-EAC	35

4 Electrical and Mechanical Quality Control

Every capacitor is subjected to extensive high voltage tests at 50 Hz prior to shipment. Furthermore a DC test at 60 % of the peak test voltage is performed to determine the leakage current characteristics of the capacitor in both directions. The dimensional data and capacitance curve are carefully verified.
COMET recommends that a 50/60 Hz AC hold-off voltage test be carried out by the customer prior to installation.

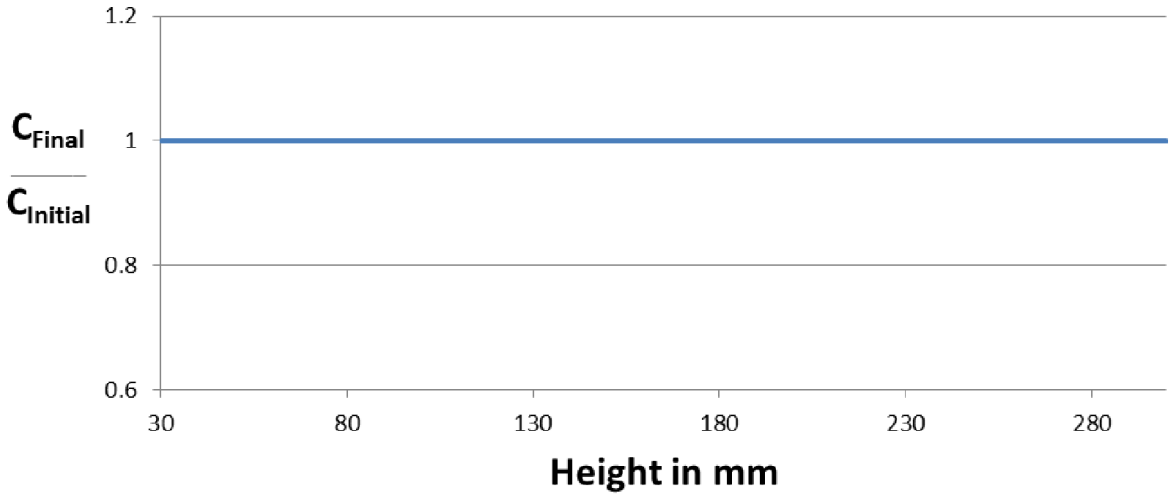
Caution: Whenever DC-testing is performed, particular care should be taken. Capacitors charged with DC may hold their charge for days and are dangerous. Verify that they are properly discharged before handling.

Warning: The applied DC test voltage should not exceed 60 % of the rated peak test voltage. Reconditioning of capacitors should only be done with 50/60 Hz voltage.

5 Mechanical Stability

N-Cap has been subjected to drop tests to verify the capacitance stability. N-Cap can withstand minor drops of up to 30 cm with no changes in the capacitance. For a chart showing the ratio of the C value after being dropped over the C value before being dropped see Figure 2. While the N-Cap is robust, care should be taken to avoid multiple drops and impacts.

Figure 2



6 Thermal Stability

N-cap has been tested at various thermal conditions. The coefficient for the change in capacitance as it heats up is -0.0044 pF/°C for the CFNC-100AAC/15-UH.

7 Gas as dielectric

N-Cap is not a vacuum capacitor. Instead of vacuum, it is filled with pressurized inert gas. Because of this, there are some physical effects that need to be considered.

Pressure Integrity

Permeation is the diffusion of molecules through a solid. A good example of this is a child's helium balloon. When it is first filled up with helium the balloon floats, however after a few days the balloon will end up on the ground. This is because the helium permeates through the balloon material over time. N-Cap has been designed to minimize this effect. However, over time some permeation will occur and the pressure inside will decrease.

The N-Cap housing is designed to keep the initial gas pressure at a level which guarantees the electrical specifications for years. The electrical design is based on Paschen's law. A series of tests have been performed in order to assure minimum pressure for safe operation. It has been validated, that even at $^2/_3$ of the initial pressure the capacitor performance is maintained and ensures a trouble free operation of more than 5 years under normal operation conditions.

Thermal Considerations

The effect of temperature on the gas pressure has also been considered. As the temperature increases so does the pressure inside of N-Cap due to the Ideal Gas Law. For a change from room temperature (20°C) to the maximum operating temperature (125°C) the pressure will increase 33%. Using modern simulation tools and laboratory testing, the safety of the capacitor has been verified.

Characteristics

- inert, non-corrosive gas
- nontoxic (inhalation of decomposition products should be avoided when high electrical sparking occurs) not flammable in air
- dielectric strength, dielectric constant ε_r independent of frequency
- thermal stability
- low electrical loss factor
- density is 1.25 kg/m^3
- thermal conductivity is 0.02583 W/(m·K)

8 Handling

When installing or removing gas filled capacitors, extreme care must be taken to avoid damage to the body of the capacitor which could displace the electrodes. Whereas this was quite obvious with the old glass capacitors, it is less so with the modern types that can take higher mechanical and electrical/thermal loads. For this reason, any rough handling like machining of the flanges must be avoided.
Note: Only use existing threads and holes for fixation.

9 Mounting

Convection capacitors can be mounted in any position. For all capacitors we recommend that one side be mounted non-rigid to prevent excessive thermo-mechanical and external forces from acting on the capacitor.

Note: It is important to use all provided mounting holes/threads of the end cap; this in order to make sure that the capacitor is connected to a well-defined electrical potential. If connection or mounting will not require the use of all mounting holes, at least one M5 screw should be inserted and tightened.

Screws should be tightened to 2 Nm maximum.

10 Packaging and Labeling of N-Cap Series

N-Cap is sealed in a robust transparent plastic air bag and then mechanically protected in an especially designed cardboard box. It guarantees a high degree of protection against environmental influences such as shock and dirt. The packing is convenient for shipping and storage purpose. See Comet SB-24 for further details on the airbag packaging. The COMET part number of the capacitor is printed on 3 sides of the box.

In addition a 30 mm x 40 mm label - identical to the one on the N-Cap - is placed to the front

side of each box to identify its contents and to provide the following information:

- manufacturer's name
- variant of N-Cap
- C/Upt/Upw
- Serial Number

Photo N-Cap Label

11 Recommendations for Storage of N-Cap Capacitors

N-Cap capacitors should be stored in a clean, dry place.

12 Maintenance

Under normal operating conditions the capacitors do not need much maintenance. They should be free from dust and dirt accumulation periodically.