Success story

Efficiency and premium design for professional refrigeration

The iJF controller improves performance with VCC technology

For its latest range of professional refrigeration cabinets, Studio54, a manufacturer of stainless steel refrigerated units, opted for the CAREL iJF controller with VCC frequency inverter control, so as to offer the market a highly-efficient solution with a premium design.

Where
San Giorgio in Bosco (Padua), Italy

What
Freezer cabinet for professional refrigeration with VCC inverter technology.

Why
Need to offer a premium unit with high energy efficiency, and therefore with attention to both energy consumption and unit design.

Studio54: sustainable innovation, made in Italy

Studio54 is an Italian company founded in 1994. Based in San Giorgio in Bosco (Padua), it specialises in professional refrigeration equipment. Research, innovation and Italian design are all factors that distinguish their solutions for the HoReCa market (hotels, restaurants, catering).
With a strong focus on technological innovation, the company is committed to conceiving and designing cutting-edge professional refrigeration solutions, using the most innovative and sustainable processes.

Through constant commitment to research and testing, supported by vertical skills in the refrigeration market, the company has established a consolidated presence on domestic and international markets. Its approach - a perfect balance between experience and continuous growth - makes it highly appealing to customers looking for a sound yet at the same time visionary partner.

For Studio 54, the aim is to apply technology to a market where growth and the environment are equally important.

Indeed when designing their equipment, the company is committed to reducing environmental impact and energy consumption, through specific choices in every stage, from design to materials.

Market challenges and demands

Until recently, commercial refrigeration unit manufacturers (OEMs) were focused primarily on offering robust, high-capacity products with low noise. However, with the coming into force of new regulations on natural refrigerants (F-Gas) and energy efficiency (ESPR - Ecodesign for Sustainable Products Regulation), new technological challenges are arising that require manufacturers to adapt their offering.
In this context, more and more manufacturers are adopting VCC (variable-capacity compressor) inverter technology, due to its benefits in terms of energy efficiency and overall performance.
In the professional refrigeration sector, manufacturers need to be able to offer different lines of units (standard, premium, etc.) to satisfy the needs of different types of users. The electronic thermostat also plays a key role in this differentiation process, becoming an integral part of the solution offered.

The CAREL solution: smart control and premium design

CAREL's iJ platform comprises a wide range of electronic controllers for the management of VCC inverter compressors.
The iJF model, just like other devices in the same family, can directly control compressor speed via a frequency or serial signal, thus allowing the thermostat to determine the most suitable speed based on the unit's operating conditions.
This feature takes full advantage of VCC technology, improving energy efficiency and ensuring optimal food preservation.
However iJF is not just a controller for modulating compressors: with its unique design, advanced algorithms, and simple and intuitive user interface, it represents a complete solution that allows manufacturers to offer their customers a high-level user experience.

Lower energy costs

VCC compressor control via a frequency signal means iJF can directly adjust the compressor speed. It is therefore the electronic thermostat itself that, by always keeping unit operation under control at all times, can always implement the most suitable action to guarantee the highest energy savings.

Optimal food preservation

Stable temperature is synonymous with better food preservation. iJF can respond quickly to transients (door opening, defrost, etc.), ensuring a stable temperature around the set point. This responsiveness, however, is only possible when the thermostat itself controls the compressor speed based on the information available, ensuring a rapid return to stable conditions at all times.

Advanced aesthetics

It's also important to identify when a unit features premium performance! CAREL's new iJ XL also allows manufacturers to differentiate their units in terms of aesthetics. This is in line with the philosophy of the entire iJ range, which has always been focused on cutting-edge design and a wide range of HW and SW options and customisations, allowing manufacturers to stand out from the competition.

Everything at your fingertips

Users no longer need to know how to operate the electronic thermostat on the unit: all they need is a smartphone. With the Controlla and Applica apps for end users and maintenance personnel respectively, any action can be carried out intuitively and quickly. From changing the set point, to downloading HACCP reports and advanced diagnostics, everyhting is available in the app.

CONTROLLA

Energy performance comparison tests

Unit data

Unit type	Professional stainless steel
Set point	Low temperature
Capacity	465 l
Refrigerant	R-290
Charge	< 150 g

Fig. 1.a - Studio54: Piergiorgio Meneghetti, Laboratory Manager, and Marco Bruseghin, CEO

Objectives and test conditions

The aim of the tests conducted was to measure the energy savings achieved when using the iJF with frequency-controlled VCC inverter technology compared against the previous fixed-speed compressor control solution. The tests thus compared the two technologies:

- Fixed-speed compressor (ON/OFF);
- Modulating compressor (VCC) controlled by iJF via a frequency signal

The tests were carried out in accordance with ISO 22041/EN16825:2016, specifically:

- Package temperature class L1 (-15 to -18°C)
- Climate chamber with temperature= 30°C and humidity= 55%)
- 4 hours with door open + 4 hours with door closed + 4 hours with door open + 12 hours with door closed.

Graphic comparison: stability and energy savings

The following two graphs compare the thermal behaviour of the unit in real operating conditions, simulating door opening/closing cycles, with two different compressor control strategies:

Graph 1 – ON/OFF (fixed-speed compressor)

The temperature profile shows wider and less controlled swings around the set point. Every time the compressor switches on and off, the temperature measured by the

sensors located at different levels in the freezer (top, middle, bottom) shows significant peaks and troughs. Instability is particularly evident during transient stages, such as door openings or defrosting. Furthermore, the bottom diagram ("STATO COMPRESS.") shows a continuous compressor on/off cycle, which leads to greater mechanical stress and higher energy consumption.

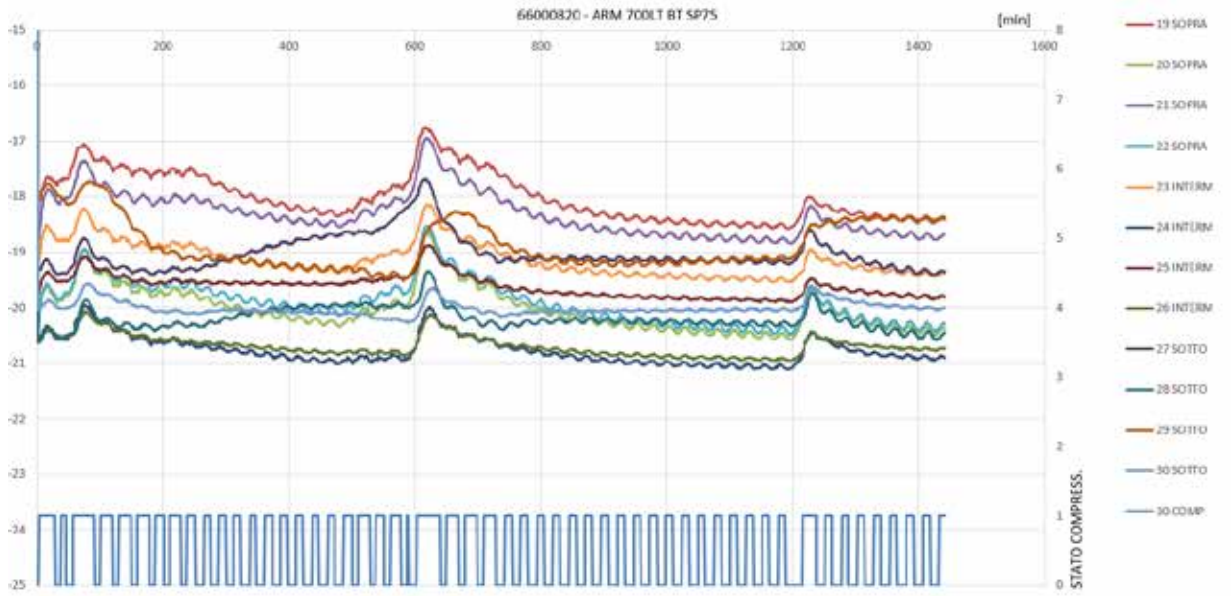


Fig. 1.b - Temperature trend in the different areas of the freezer and activation of the fixed speed compressor. Wide temperature fluctuations and frequent on/off cycles are evident.

Graph 2 – VCC (iJF speed-modulated compressor)

The temperature trend is clearly smoother and closer to the set point. Inverter control allows the compressor to modulate its operating frequency based on actual demand (orange dotted line), reducing the need for abrupt on-off cycles. Temperature swings are much more limited, ensuring more stable and uniform food preservation. Even in critical (transient) stages, the unit responds faster and in a more controlled way.

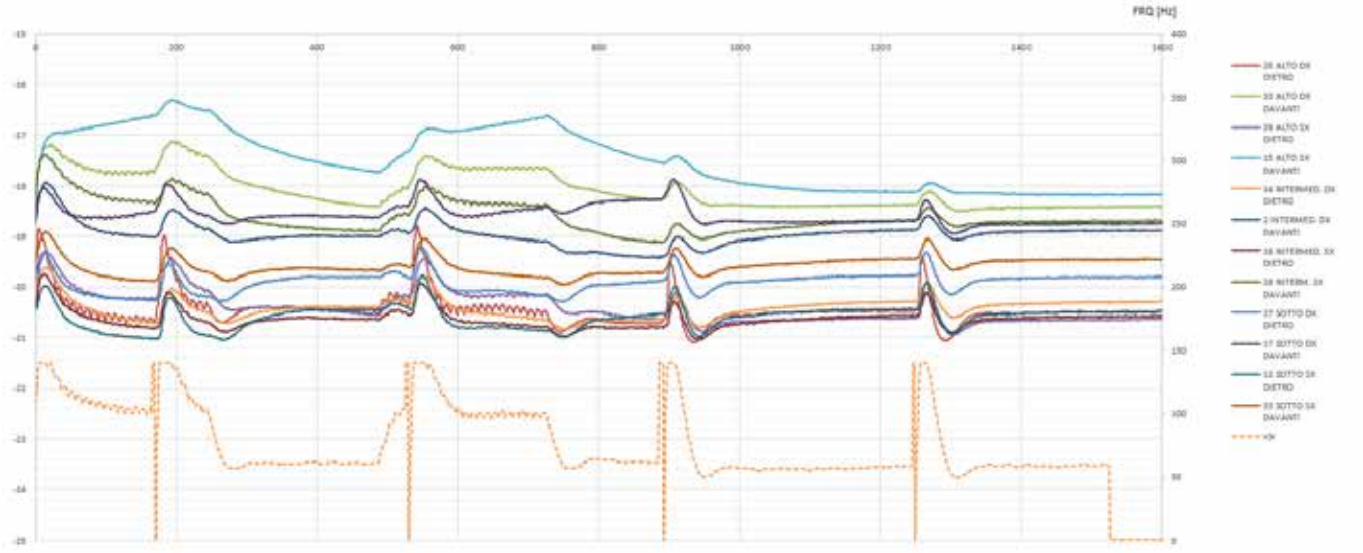


Fig. 1.c - Temperature trend with the compressor managed via CAREL iJF with frequency control. The graph shows smooth frequency modulation and increased temperature stability at different points in the unit.

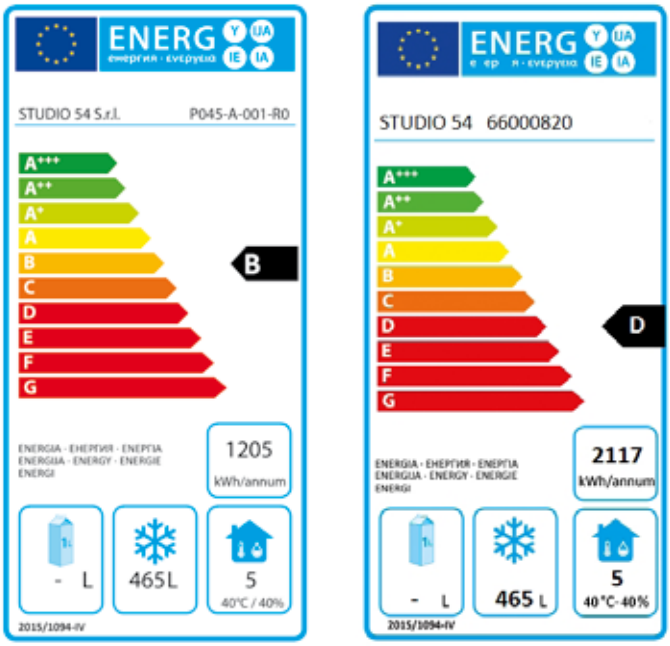
Results: higher performance and lower energy consumption

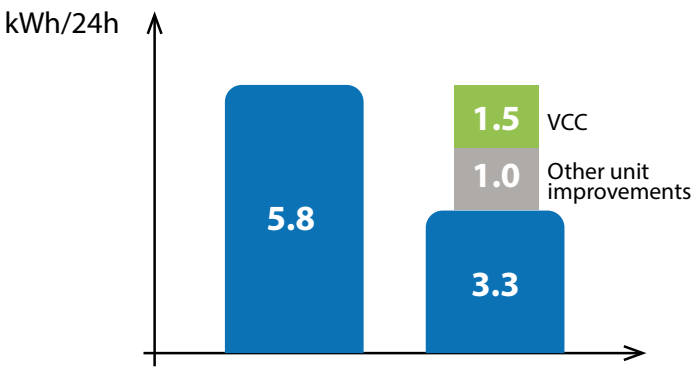
The test results show how managing VCC compressor speed directly via the CAREL iJF with frequency control ensures much more stable control and a faster response during transients. This reduces compressor on/off cycles, allowing the compressor to work constantly at the least energy-intensive frequency, thus ensuring greater temperature stability around the set point. And at the same time, being much more responsive to transients such as door openings and defrosting, the unit returns more quickly to the set point and ensuring optimal food preservation.

The graphic Fig.1.c shows how the tests were carried out in the climate chamber, with the various packages simulating the foods that will be contained in the freezer and their corresponding temperature trends.

Daily energy consumption fell from 5.8 kWh/24h to 3.3 kWh/24h, equivalent to a total energy saving of 43%.
As regards daily energy savings, this means 2.5 kWh/24h; of this total, iJF VCC frequency control accounts for 1.5 kWh/24h (the remaining kilowatts are due to other improvements implemented on the unit).

It is important to underline that, in addition to ensuring lower daily energy consumption, the energy class has improved by two ratings from class D to class B.





Conclusions

CAREL and Studio54 have exploited their extensive experience in implementing high-efficiency solutions.

In conclusion, we can state that VCC inverter technology, when managed directly by iJF with frequency control, reduces energy consumption by 26%, equal to 153 euros/year (calculation based on ENEA guidelines for Italy: 1 kWh = €0.28).

In addition to an improvement in energy performance, a reduction in temperature swings was also seen , reaching a maximum of 0.5°C around the set point, optimising food pre servation.

This also has a significant impact on the unit's energy rating, jumping two classes – from D to B – thus contributing to the overall sustainability of the product. The results also highlight a faster response by the unit to transients such as door openings and defrost cycles, ensuring smoother operation and food protection in real-world conditions.

26%
energy saving

-153 €
per year

0.5 °C
max fluctuation

"Thanks to the iJ CAREL solution with direct control of the variable speed compressor and other technical features, we have reduced energy consumption by over 40% and improved the efficiency of our freezer.
This allowed us to gain two energy classes and reduce the product's environmental impact.
We are proud to make a contribution to more sustainable refrigeration, together with a reliable technological partner such as CAREL."

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