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Air conditioning solutions

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2212-SD-BR-1

HITACHI

SmoothDrive™

HITACHI ORIGINAL CAPACITY CONTROL TECHNOLOGY IN VARIABLE REFRIGERANT FLOW

Cooling & Heating

VRF air conditioners in buildings experience all kinds of changes during the day…

People coming and going…

Changes in outdoor weather conditions…

Variations in temperature preferences…

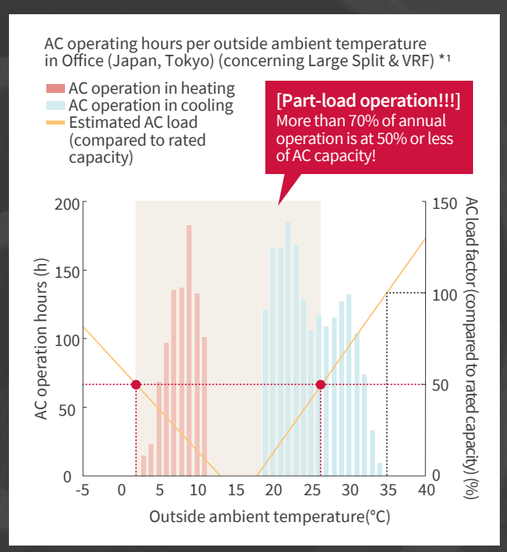
This causes VRF systems to operate at partial load

More than 70% of the time during a year, a VRF System will be running under part-load conditions, with most systems operating at 50% or less of their capacity*1.

These unpredictable part-load conditions cause real-world performance to deviate significantly from official published energy efficiency data.

It's a key reason why your customer may not fully experience all the energy savings they expected from new equipment.

*1. JIS B 8616:2015(Japanese packaged air conditioners standard) to arrange the performance test for the system.



The simplicity of SmoothDrive

We believe the key to energy efficiency at part load is how generating capacity is controlled.

In a normal VRF system this capacity control can be complex, combining both control of refrigerant evaporation temperatures and compressor operation.

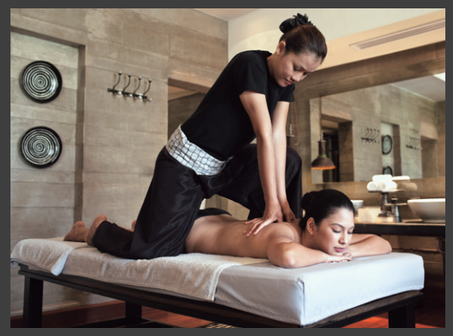
But at Hitachi Cooling & Heating we've developed a more simple approach called SmoothDrive.

Why SmoothDrive?

Part-load conditions cause real-world performance to deviate significantly from official published energy efficiency data. Which is why Hitachi's patented direct capacity control technology delivers…

real-world energy efficiency

Improved energy efficiency under part-load operation, which regulatory energy efficiency ratings do not account for.

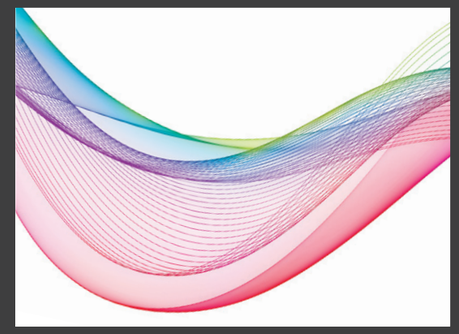


temperature stability

With continuous monitoring and adjustment of the capacity based on compressor speed, indoor temperatures can be maintained more accurately

smoother compressor operation

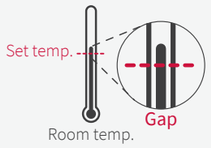
Compressor rotation frequency is more precise and stable. On/Off cycles are reduced, while peaks and drops are diminished, reducing wear on the compressor.



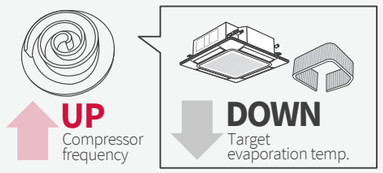
Conventional VRF systems control capacity indirectly…

1 In Cooling Mode* when the room temperature is higher than the set temperature, it must increase the cooling capacity to reach the set temperature.

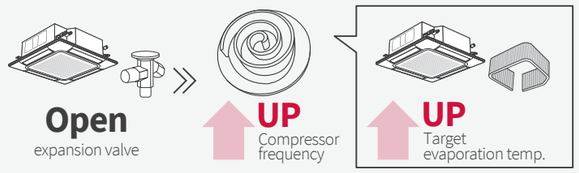
* For VRF systems with a Heating Mod, the reverse of this process is true under Heating operation



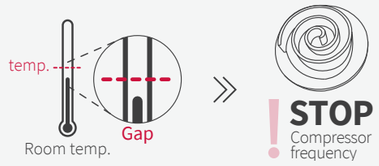
2 Therefore the target evaporation temperature is reduced and compressor frequency is increased.



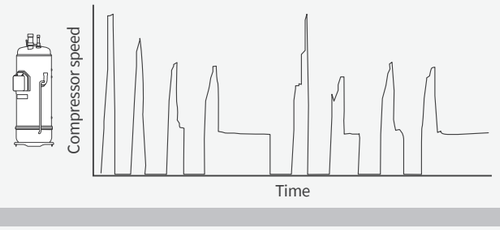
3 To maintain the degree of superheat within a safe margin, the indoor unit expansion valve will be opened slightly, but this has the effect of increasing the evaporation temperature. To mitigate this increase and avoid the room temperature increasing, the compressor frequency is increased even further.



4 Because of the increased generating capacity the room temperature will become lower than the set temperature, which will force the compressor to switch off (also known as thermos-off).

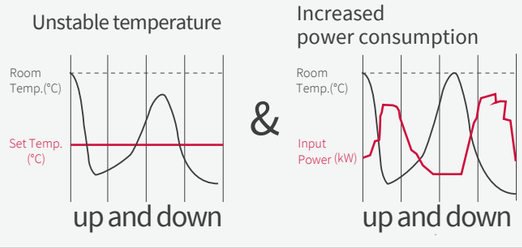


5 As the air conditioning is now switched off, the room temperature will eventually rise above the set temperature triggering the air conditioning to switch on again and repeating the cycle. This results in multiple on/off events, increasing energy consumption, wear and tear on the compressor, and unstable room temperatures.



End Result

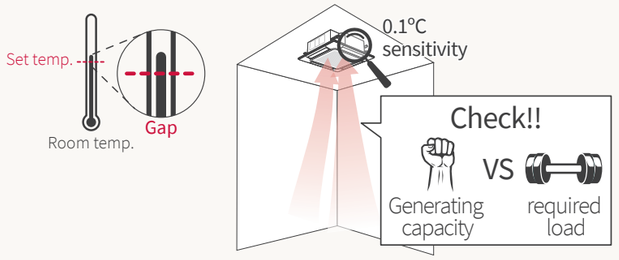
As the system is now switched off, the room temperature will eventually rise above the set temperature triggering it to switch on again and repeating the cycle. This results in multiple on/off events, increasing energy consumption, wear on the compressor, and unstable room temperatures.



SmoothDrive uses Direct Capacity Control…

1 Precise Demand analysis with up to 0.1°C temperature sensitivity

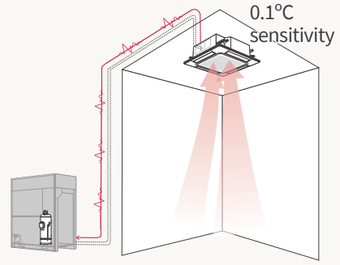
Every few minutes SmoothDrive calculates the right capacity to deliver in order to maintain the set temperature accurately.
It does this by analyzing the indoor temperature trend in each zone and any changes in demand, with a precision of up to 0.1°C sensitivity.



2 Direct Compressor Control

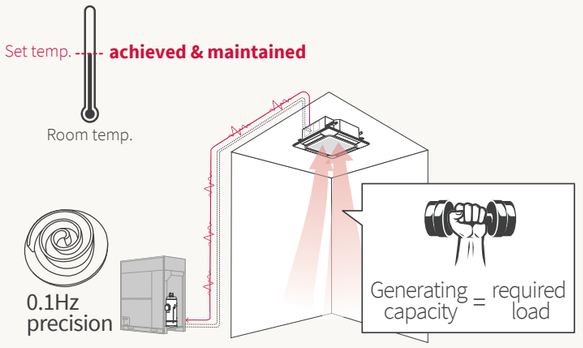
With this 0.1°C sensitivity
With this should say 0.1°C, information is sent from the IDUs to the ODU. As the set temperature is approached, only the compressor frequency is used to control the capacity, rather than the evaporation temperature.

Did you know?
Hitachi develop the world's first commercially available scroll compressor back in 1983 and to this day is a leading global supplier.



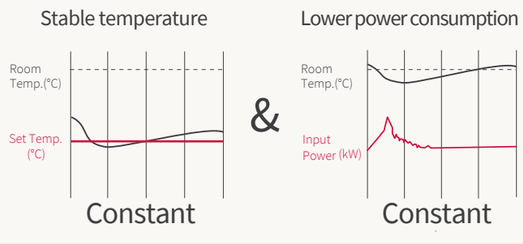
3 Superior Compressor Operation

By increasing or decreasing compressor speed with up to 0.1Hz (6rpm) precision, and where necessary being able to run at very low speed, the amount of refrigerant flowing from the ODU to the evaporator in each IDU is controlled precisely. The balance of load and capacity is monitored, and then controlled directly through the compressor speed, enabling room temperature to be close to the set temperature all the time without frequently stopping and starting the compressor.



End Result

Because compressor speed is calculated directly according to the gap between room and set temperature, it will more accurately balance the generating capacity and the load (demand) with less on/off cycles for the compressor. Just like a car that smoothly accelerates and gently brakes, it consumes less energy with less on/off operations.



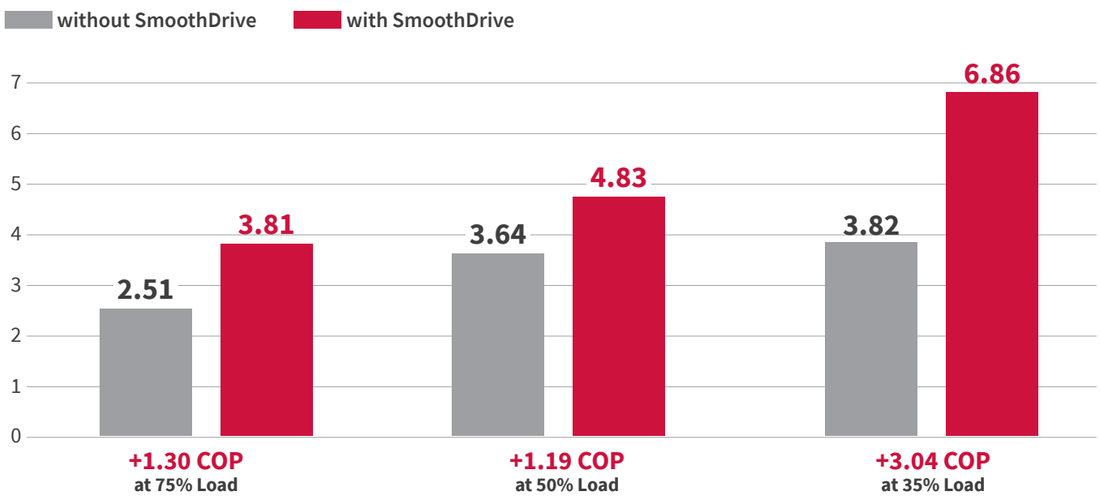
Simplicity that works

Real-world energy efficiency

Improved energy efficiency under part-load operation,
which regulatory energy efficiency ratings do not account for

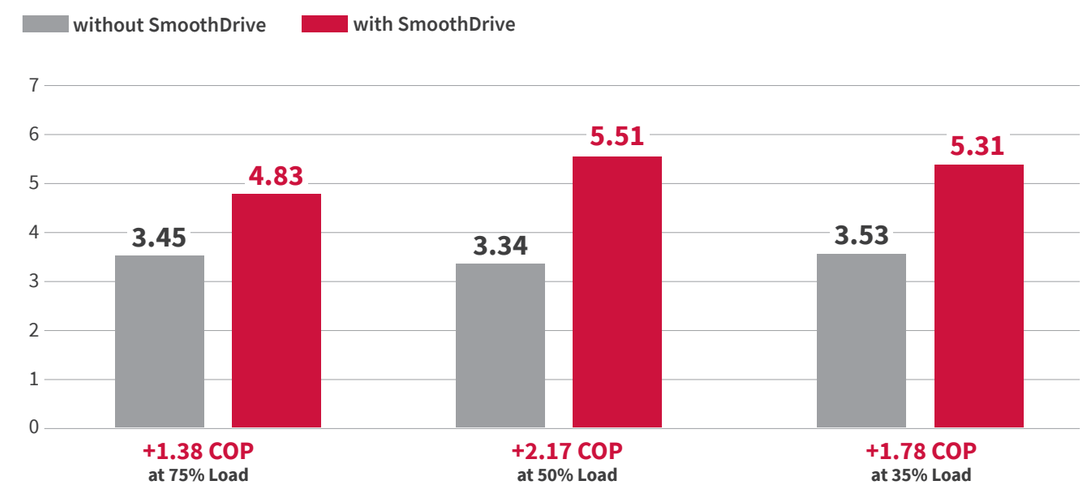
Cooling Mode

accumulated average COP at 35°C ambient



Heating Mode

accumulated average COP at 7°C ambient



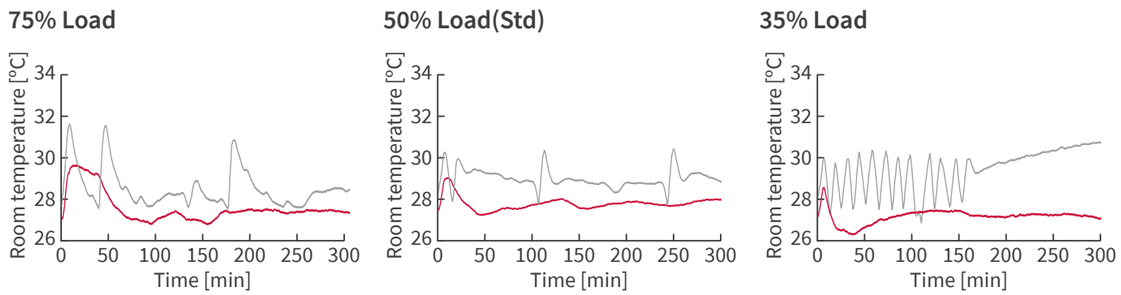
** Outdoor Unit; 10HP class. Indoor Unit: 5HP Class 4-way cassette unit * 2 pcs. In our own company's fixed-load testing facility(Dimension of the room per one indoor unit :5.6m×2.5m×3.1m).
Outdoor temp (DB / WB): 29°C / 19°C. Load per room (Sensible / Latent): 4.9kW / 0.0kW. Set temperature: 27°C. Initial Indoor unit temperature (DB / WB) : 27°C / 19°C. Indoor unit fan airflow rate: Hi-mode.

Averaged power/load are calculated for 5 hours from start. COP = Averaged load / Averaged power. Test Result Summary (Averaged load / Averaged power)
In Cooling: Without SmoothDrive (21.09/8.40 in 75%) (14.36/3.94 in 50%) (9.99/2.62 in 35%). With SmoothDrive (20.91/5.49 in 75%) (14.18/2.94 in 50%) (9.92/1.45 in 35%)
In Heating: Without SmoothDrive (24.00/6.95 in 75%) (15.86/4.75 in 50%) (11.02/3.13 in 35%). With SmoothDrive (23.79/4.93 in 75%) (15.86/2.88 in 50%) (11.10/2.09 in 35%)

Temperature stability

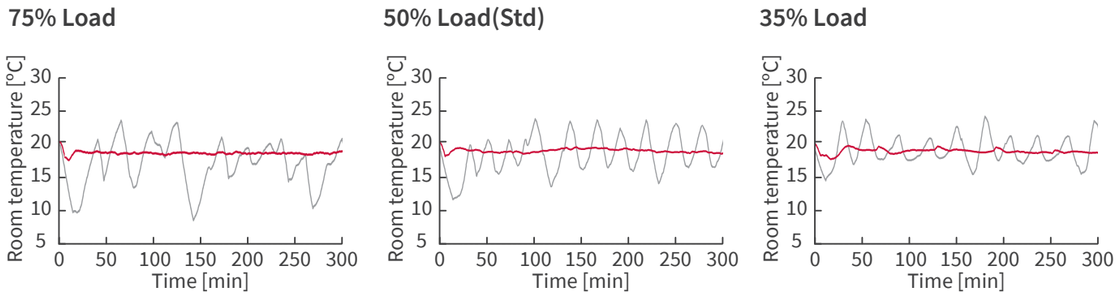
With continuous monitoring and adjustment of the capacity based on compressor speed,
indoor temperatures can be maintained more accurately

Cooling Mode



Set temp: 27°C
Initial IDU temp: 27°C / 19°C
Air Inlet temperature of IDUs (without SmoothDrive)
Air Inlet temperature of IDUs (with SmoothDrive)

Heating Mode



Set temp: 20°C
Initial IDU temp: 20°C / 14°C
Air Inlet temperature of IDUs (without SmoothDrive)
Air Inlet temperature of IDUs (with SmoothDrive)

** Outdoor Unit; 10HP class. Indoor Unit: 5HP Class 4-way cassette unit * 2 pcs. In our own company's fixed-load testing facility(Dimension of the room per one indoor unit :5.6m×2.5m×3.1m).
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For the simplicity of the SmoothDrive temperature stability, Only one temperature change is shown in this graph.
For more details, please consult our sales dealer.

SmoothDrive™

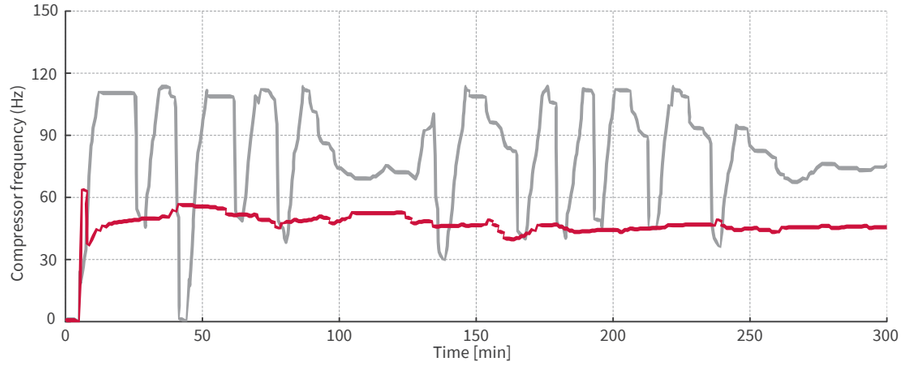
Simplicity that works

Smoother compressor operation

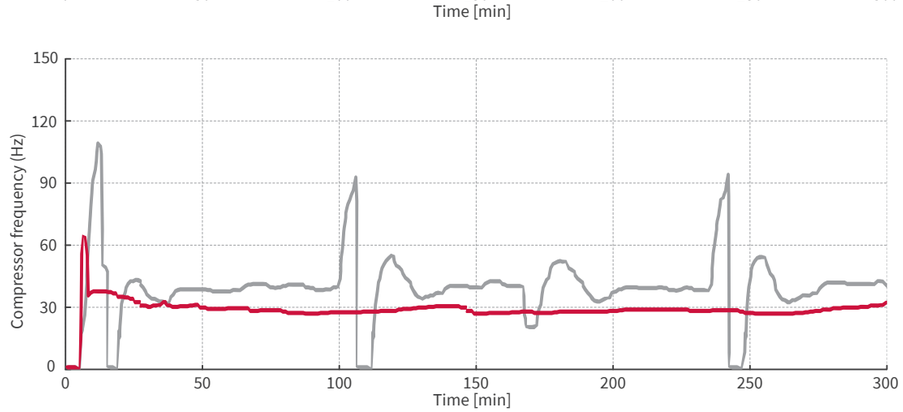
Compressor rotation frequency is more precise and stable. On/Off cycles are reduced, while peaks and drops are diminished, reducing wear on the compressor.

Cooling Mode

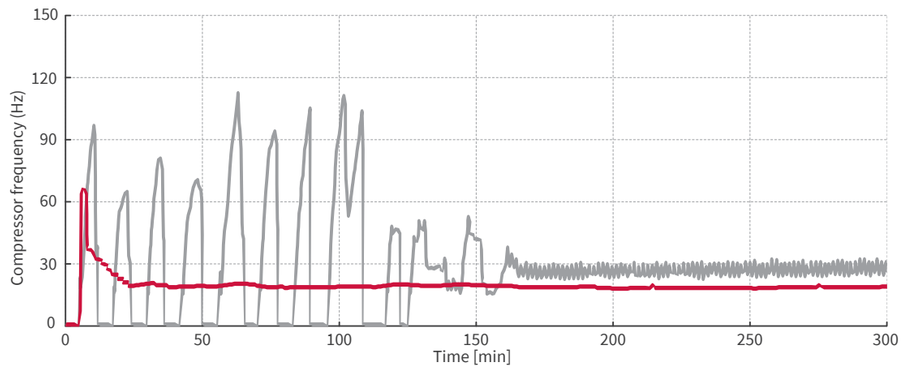
75% Load



50% Load(Std)



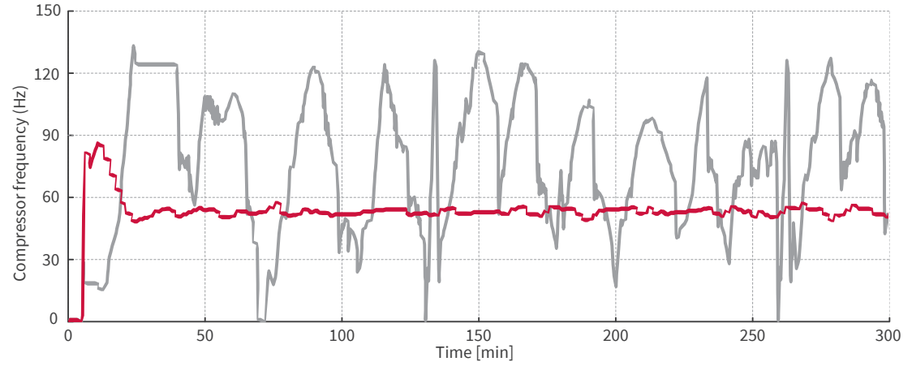
35% Load



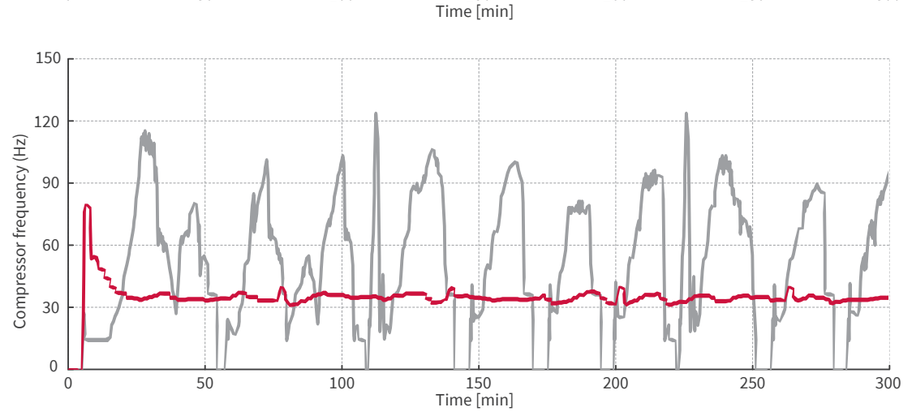
In Heating Mode the effects are even more dramatic…

Heating Mode

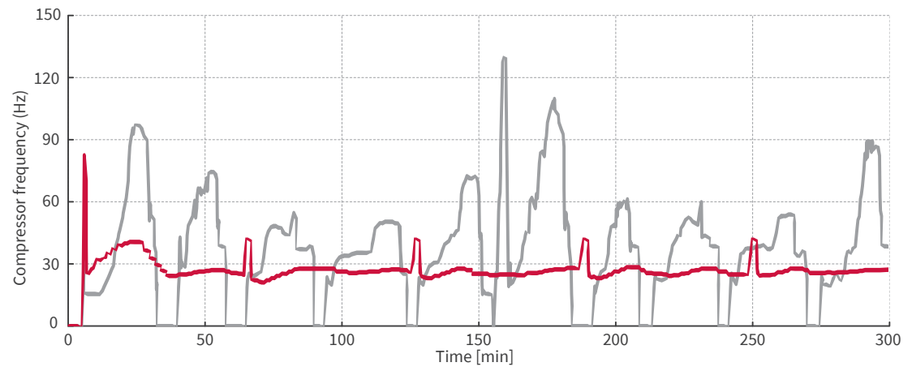
75% Load



50% Load(Std)



35% Load



without SmoothDrive with SmoothDrive

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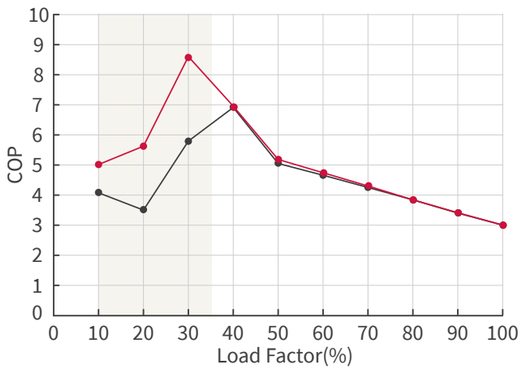
SmoothDrive 2.0

Our latest generation technology

Our latest VRF models are equipped with SmoothDrive 2.0 which further improves efficiency, particularly at 10-35% part load thanks to 0.1°C temperature monitoring sensitivity.

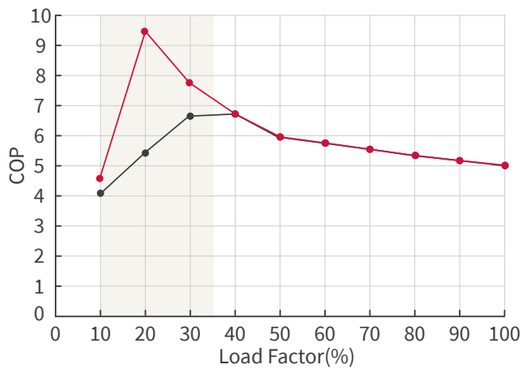
Cooling Mode

COP vs Load Factor



Heating Mode

COP vs Load Factor



SmoothDrive 1.0 SmoothDrive 2.0

Availability

	SmoothDrive 1.0	SmoothDrive 2.0
Temperature Resolution	1.0°C	0.1°C
Energy Efficiency	★★★★	★★★★★ improved performance at 10-35% load
Temperature Stability	★★★★	★★★★★
Smoother Compressor Operation	★★★★	★★★★★

Compatibility

		SmoothDrive 1.0	SmoothDrive 2.0
ODU		Set Free Sigma HNBQ, HNCQ Set Free Sigma CNCQ, JNBBQ Water-Source VRF	air365 Max Pro air365 Max Set Free Sigma FSNS, FSNP Set Free Sigma FSXNS, FSXNP SideSmart (all models)
IDU	4-way	-	RCI-1.0~6.0FSRP RCI-1.0~6.0FSKDN1Q
	4-way compact	-	RCIM-0.6~2.5FSRE
	2-way	-	RCD-0.8~6.0FSR
	1-way	RCIS-FSKDN1Q	RCS-0.8~3.0FSR
	Ducted	RPI-FSN2SQ RPI-8.0 & 10.0FSNQ RPI-8.0 & 10.0FSN3Q	RPI-2.0~6.0FSR / RPI-8 & 10FSR RPIM-0.8~6.0FSR RPIH-3.0~6.0HNAUN1Q RPIH-3.0~6.0HNAUB1Q RPIM-0.8~2.5HNAUN1Q RPIM-0.8~2.5HNAUB1Q RPIL-0.8~6.0HNAUN1Q RPIZ-0.8~2.5HNATN1Q RPIZ-0.8~2.5HNDTS1Q
	Wall Mounted	RPK-0.8~2.5HNBUSQ	RPK-0.4~4.0FSRM RPK-0.4~1.5FSRHM
	Ceiling Suspended		RPC-1.5~6.0FSR
	Floor Ceiling Convertible	RPFC-FSNQ	-
	Floor Standing	RPF-FSN2E	-
	Floor Concealed	RPFI-FSN2E	-
Others	Total Heat Exchanger	-	-
	Fresh Air Unit	RPI-KFNQ	-
	DX-Kit	DXF-A1	-
	Remote Sensor	THM-R21 (ARFG1)	-
Remote Controllers (in cases where Remote Control Thermistor is used for temperature control)		ARF1, AWR, HCWA10NEGQ, PC-LH7QE	ARFG1, ARC