



# Apexx™ VSH series variable speed scroll compressors for commercial air conditioning



## Apexx™ VSH: The first high-capacity R-410A variable speed scroll for air conditioning

While commercial air conditioning manufacturers strive to meet today's demands for increased energy efficiency, the cost of energy continues to escalate. At the same time, customers want to reduce noise, increase system reliability, and improve comfort, all at a minimum initial system cost.

Danfoss offers the means to meet these challenges.

VSH series compressors are the first high-capacity R-410A variable speed scroll compressors for air conditioning and heat pumps.

*More than half a century of world leadership in manufacturing high-performance compressors...40 years' experience in variable frequency drives*

This advanced design comes from Danfoss' unique competencies: more than half a century of world leadership in manufacturing high-performance compressors, including development of the Turbocor oil-free centrifugal

compressor. And 40 years' experience in variable frequency drives, including variable-speed control of reciprocating compressors. Today, these competencies come together in the VSH series.

The capacity of a VSH compressor varies continuously to match the load. Speed is controlled by the frequency output of its drive—from 30 to 90 Hz. Three VSH packages cover a 90 Hz design capacity range from 11 to 23 TR (R-410A). Delivered capacity is from 3.5 to 23 TR, depending on load.

*The drive for each VSH package is designed to match the compressor*

The drive for each VSH package is designed to match the compressor. Electromagnetic compatibility filters are built into each drive and comply with the stringent EN 55011 standard. Customized drive software protects the compressor and provides multiple control options supported by I/O capability for communication, control, and monitoring.

As a completely integrated package, a VSH solution delivers all the features necessary to make variable speed scroll systems a commercial reality.

**Improving energy efficiency... continuously**

Traditional commercial air conditioning systems are designed for efficient operation at peak load conditions, so systems are actually oversized about 85% of the time or more. Consequently at part load conditions, the systems deliver excess capacity, with significant and costly energy waste.

Traditional systems address part load conditions with unloading techniques—for example with hot gas bypass, or with multiple compressors, or with digital compressor technology—but these solutions are inefficient, either because high compressor efficiency cannot be maintained at part load or because load matching ability is limited. Hot gas bypass solutions are even less efficient.

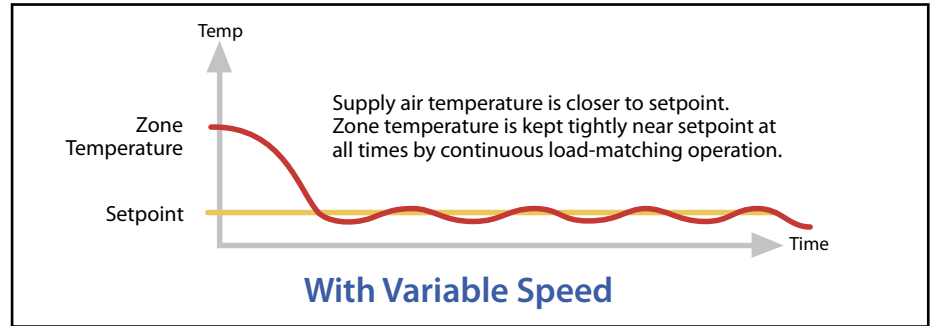
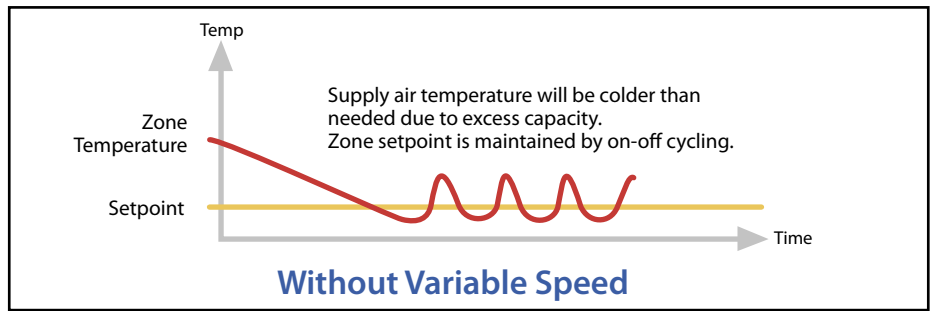
In contrast, the VSH compressor is designed to maintain high isentropic efficiency at part load and has the inherent benefit of precisely and continuously matching the load by operating from 30 Hz to 90 Hz.

With no excess evaporator and condenser capacity under part load, VSH system COP is higher, leading to significant energy savings. Another benefit is that continuous operation means less cycling and system stress, higher reliability, and longer lifetime.

VSH packages	Capacity at 30 Hz ARI condition (Ton)	Capacity at 90 Hz ARI condition (Ton)	EER at 30 Hz Part load condition	EER at 90 Hz ARI conditions
VSH088	3.5	11.7	20.01	9.84
VSH117	4.7	15.6	20.02	10.09
VSH170	7.0	23.0	20.97	10.23

**ARI:** Evaporating Temp.: +45°F, Condensing Temp.: +130°F, Superheat Temp.: +20°F, Subcooling: +15°F  
**Part load conditions:** Evaporating Temp.: +45°F, Condensing Temp.: +90°F, Superheat Temp.: +20°F, Subcooling: +15°F





Additional VSH utility savings can result because the power factor remains above 0.90 regardless of the load. Also, drive controller logic ensures a soft start that reduces inrush current.

Compared to conventional systems, energy savings with a VSH compressor can exceed 20%.

### Make a difference with more comfort

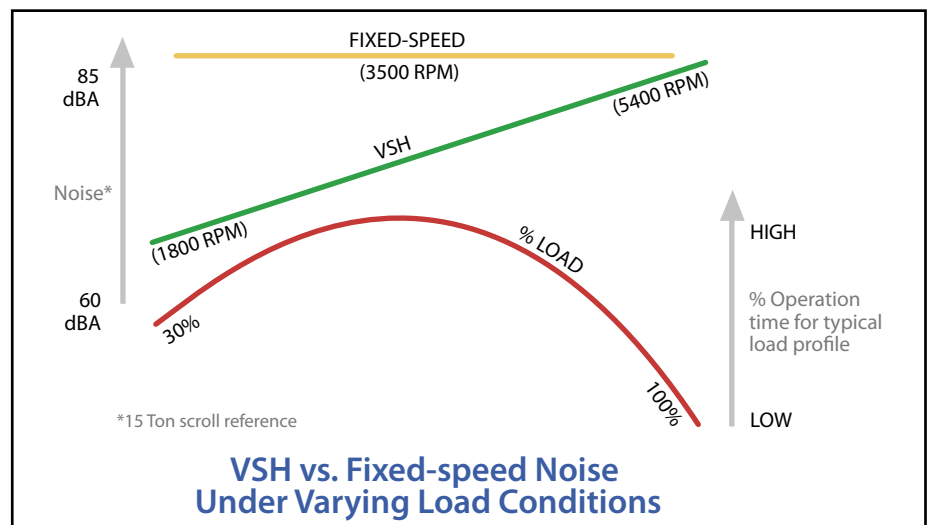
The new degree of control capability offered by a VSH compressor means manufacturers can create control strategies to differentiate their systems in the marketplace. Tight temperature control is easy and cost efficient. And VSH compressors can cool or heat rapidly on demand by increasing speed instantly.

## Creating a quieter environment is another competitive difference

Creating a quieter environment is another competitive difference. That's because sound level is an important comfort consideration, and noise abatement regulations are becoming more important, too. Noise reduction is especially critical at night and in densely populated areas. At night, when loads are typically lowest and a VSH compressor cycles, it does so at its lowest (and quietest) speed.

### Extending the benefits—and the competitive advantage

Where variable speed is applied to



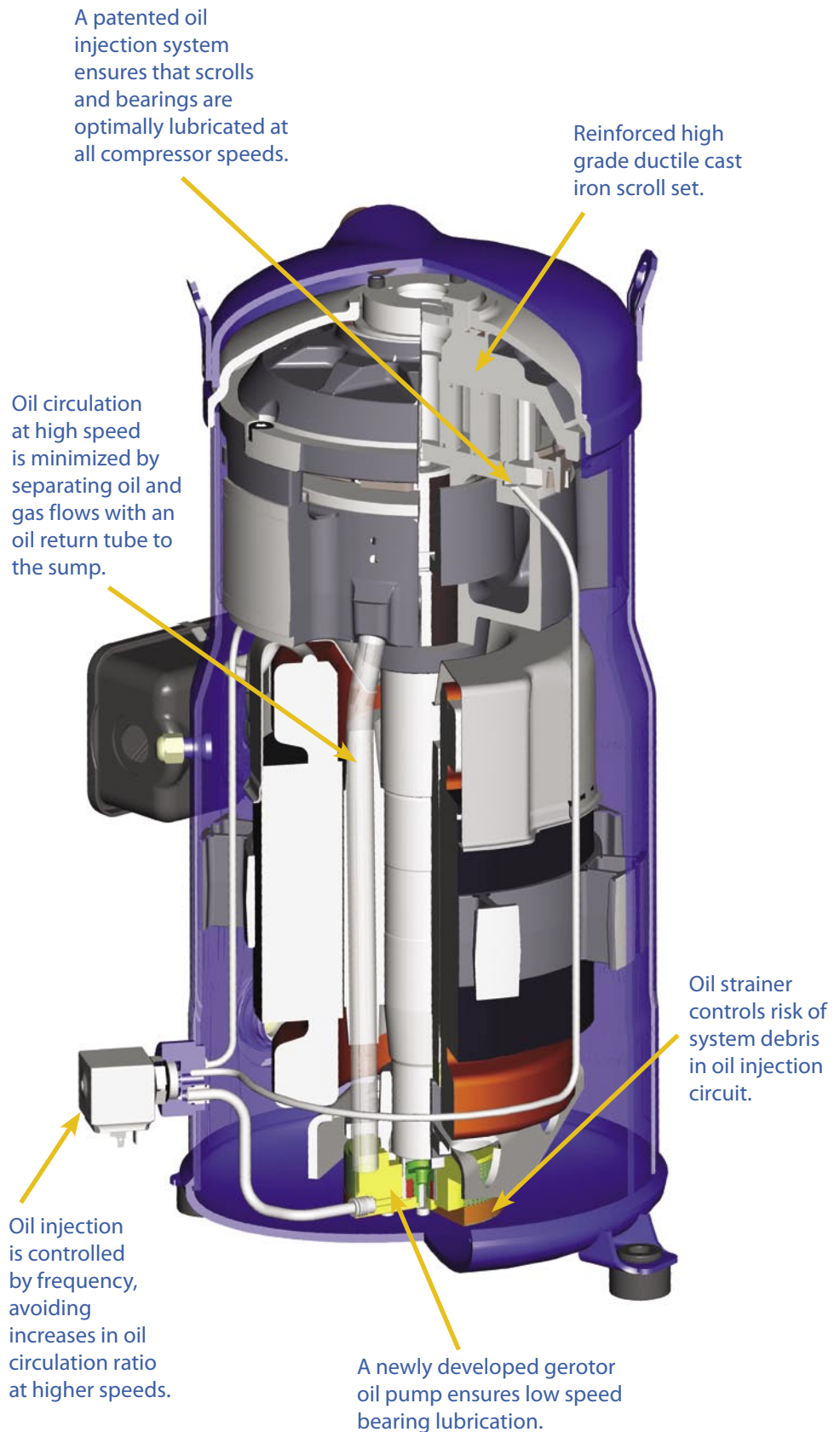
compressors, it makes sense from both efficiency and noise control standpoints to apply variable speed condenser fans, air blowers, and chiller pumps as well. A system built using multiple variable speed components will have much better noise performance throughout the year because fan, compressor, blower, and pump speeds will be lower most of the time.

### Compact design creates more opportunities

With a VSH scroll, system designers can create more compact designs, because a VSH compressor is physically smaller than a fixed-speed compressor of similar capacity. And designers can take advantage of new opportunities: eliminating hot gas bypass piping, avoiding manifolds, and reducing circuits.

### Advanced compressor protection enabled by the drive

- Short-cycling is limited by user-definable minimum run times.
- Speed is automatically reduced at motor current limits, avoiding compressor cut out.
- Advanced current monitoring of each phase ensures against motor overloads, and the need for internal motor protection is eliminated.
- Higher tolerance to mains voltage imbalance.
- High discharge temperature protection by automatic speed reduction at user-defined levels.
- Optimum oil management is ensured by a user-definable interval for boosting the compressor to high speed, forcing oil return from circuits when necessary.
- Reverse rotation protection and ramp-down function prevent stopping noise.
- Built-in crank case heater.
- Designed for 122°F (50°C) ambient with full current output.
- Protection against short circuits on motor terminals.
- No need for contactors.
- No periodic maintenance is required for the drive.



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15  
Orpm 3.45A 2.1

34.6 Hz

Remote Ramping

Quick  
Menu

Main  
Menu

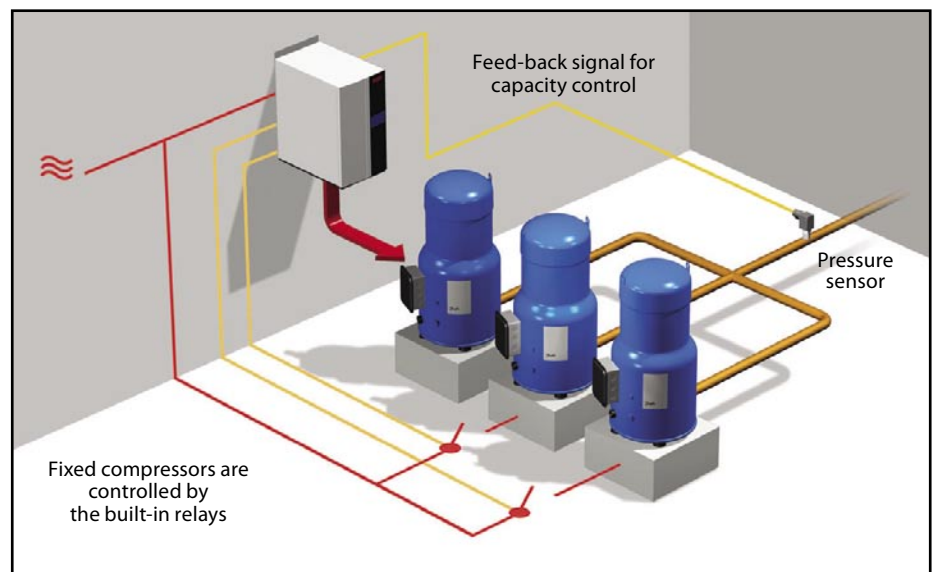
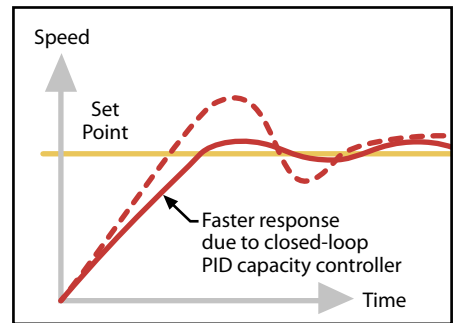
OK

Off

Auto  
On

#### Added values

- Capacity can be controlled by an external signal using the drive's user-definable closed-loop PID capacity controller. There are also alternative options for open-loop capacity control by means of an external signal.
- In hybrid VSH units, an innovative pack controller allows staging of up to two fixed-speed compressors.



- Optional graphic display and keypad – with on-board memory – gives access to the menu structure and can be used to make parameter changes on other VSH drives. It's a great tool for easy commissioning and service.
- For control via communication from a master unit while locking out local control, a version without display is available.
- Comprehensive I/O provides RS-485, analog, digital, and USB interfaces to support diagnostics, load monitoring, and communications.
- MCT10 software allows interrogation and programming from a Windows PC.
- VSH flux vector motor control, optimized for each compressor type, ensures the lowest possible drive size for each model, plus greater control accuracy and response.

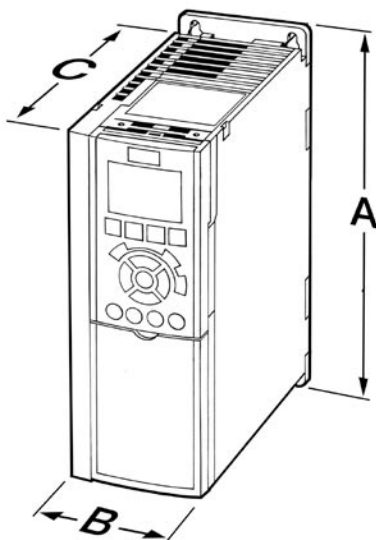
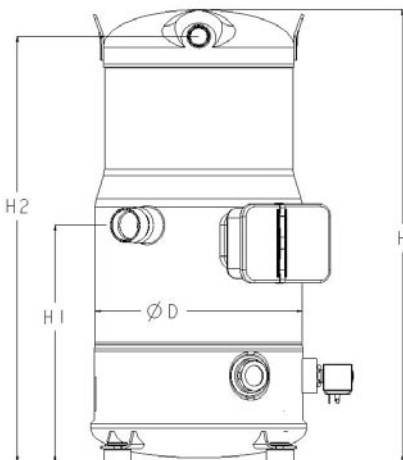


# General Specifications

## Single-source supplier

Danfoss is a single-source supplier for every system component, including electronic expansion valves, 4-way reversing valves, controllers, sensors, and microchannel and brazed plate heat exchangers, together with a complete offering of drives for fans and pumps.

**For more information on how VSH series compressors can advance your system design, call your Danfoss sales engineer today.**



Models	IP20 Drive Frame	Power Sizes [kW]	Compressor Dimensions H x H1 x H2 x ØD (mm) H x H1 x H2 x ØD (inches)	Drive Dimensions A x B x C (mm) A x B x C (inches)
VSH088	B3	15	473 x 235 x 442 x 224 18.6 x 9.3 x 17.4 x 8.8	380 x 165 x 248 15.0 x 6.5 x 9.8
VSH117	B4	18.5	531 x 278 x 500 x 224 20.9 x 10.9 x 19.7 x 8.8	460 x 231 x 242 18.1 x 9.1 x 9.5
VSH170	B4	22	679 x 330.5 x 644 x 317.8 26.7 x 13.0 x 25.4 x 12.5	460 x 231 x 242 18.1 x 9.1 x 9.5

Mains supply (L1, L2, L3)	
Supply voltage	200–240 V
Supply voltage	380–480 V
Supply voltage	525–600 V
Supply frequency	50/60 Hz
Analog Input	
Analog input	2
Modes	Voltages or current
Analog Output	
Programmable analog outputs	1
Current range at analog output	0/4 – 20 mA
Digital Inputs / Outputs	
Digital inputs	3
Digital outputs	2 (also configurable as inputs)
Relay Outputs	
Programmable relay outputs	2
USB Port	
PC access to drive parameters via MCT software	USB port
Serial Communication	
Interface	RS-485
Built-in protocols	FC Protocol
Harmonic Protection	
Built-in dual DC-link reactors	Allow connection to network without interference on mains with voltages distortions



## Look to Danfoss Apexx™ for variable speed solutions

The growing trend in our industry, across every application, is to variable speed compressors. In Japan, the world's most demanding efficiency market, variable speed has been a proven technology for more than 30 years, and now has a tremendous market share. Well-established in Europe, the success of variable speed compressor technology is now growing in China and more recently in America.

Danfoss is the world's only independent source of variable speed compressor solutions.

We are providing variable speed compressors for household appliances, for refrigeration, and Danfoss Turbocor for large chillers. Danfoss drives are used with variable speed screw compressors. With the introduction of VSH R-410A variable speed scrolls for commercial and light commercial systems, Danfoss further extends a commitment to variable speed technology that will grow stronger as the best answer for increasing energy efficiency and providing greater comfort and control.



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