



# Integrated Motor + Drive

## Selection Guide





## Aircore EC Integrated Motor + Drive

Motor and Variable  
Frequency drive -  
all in one



Sprecher + Schuh is proud to bring you the Infinitum Integrated Motor Plus Drive.

- Integrated variable frequency drive (VFD) facilitates variable speed applications, reducing overall energy usage.
- Power more with less. 50% lighter, 30% quieter and 10% more efficient than traditional AC induction motors.

### Powerful intelligence

State-of-the-art VFD allows precise speed control, reduces energy usage, and operates at a frequency to minimize audible noise.

I-con (motor control software) enables users to fine tune operational parameters to their specific applications. Maximum power density in a 50% smaller and lighter package.

### Optimized efficiency

Meets highest efficiency standards at a wide range of load conditions.

Increased operational efficiency by eliminating torque ripple, cogging, stator hysteresis and eddy current losses.

Compact form factor reduces wiring and facilitates direct mounting to fan applications, increasing efficiency by 10-15%.



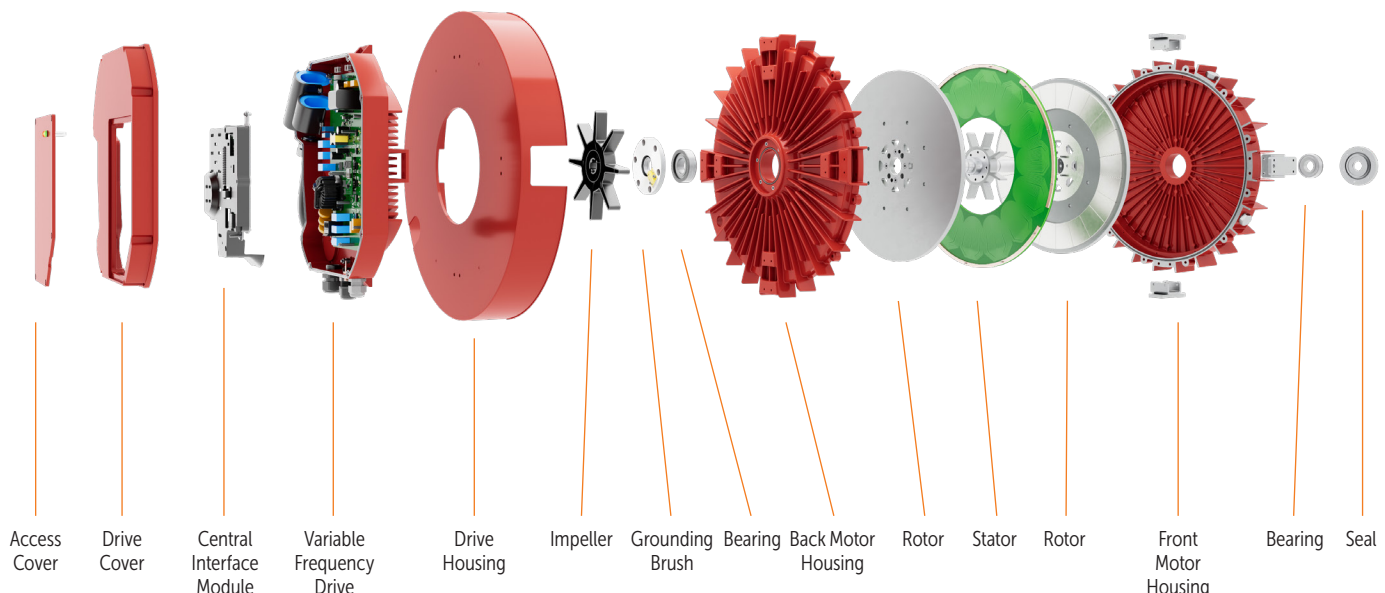
### Sustainable solution

PCB stator uses 66% less copper and has proven to be 10x more reliable than traditional iron-core, copper-wound stators. Smaller and lighter housing reduces transportation emissions by 30%.

Easy serviceability through our modular design enables the reuse and extended lifespan of components, keeping them out of the landfill.

### Applications

- Commercial HVAC
- Pumps
- Material handling



### Driving efficient fans

Aircore EC motors offer a remarkable advantage over traditional iron core motors as they are smaller, lighter, and enable direct mounting on the fan. This advancement allows original equipment manufacturers (OEMs) to create more compact systems that boast enhanced efficiency. By utilizing our motors, applications like fan arrays become much simpler to ship, install, and maintain.

Our motors come equipped with a VFD, granting you optimal operational control. Through this feature, you can effectively curtail energy costs by over 50 percent, a significant benefit that adds to the overall efficiency and eco-friendliness of the system.

### Efficient, sustainable data center solutions designed with flexibility in mind

Infinitum's high efficiency motors and environmentally-forward technology support lower carbon emissions through modular design. Our circular design strategy is centered around reliability, serviceability, and remanufacturing.

### Maximize pump performance

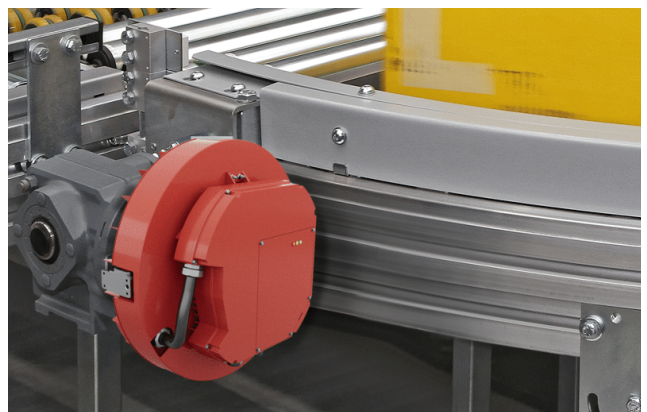
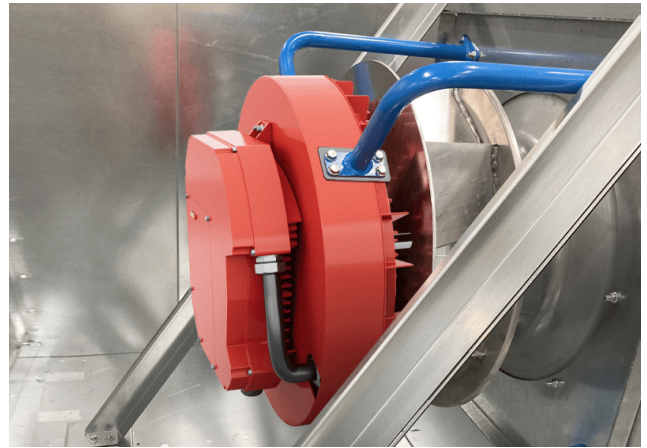
In industrial and commercial settings, robust and reliable pumps are essential for tasks ranging from HVAC systems to water treatment facilities. Aircore EC motors are purposefully designed to meet the demands of these challenging environments, by providing exceptional durability and power. Our motors are equipped to resist dust ingress and water splashing, ensuring continuous operation even in harsh conditions.

Additionally, the Aircore EC motors boast a compact and disc-like design, making them the ideal choice for applications with limited space, allowing for more flexible and versatile installation options.

### Revolutionizing material handling

Offering exceptional performance and efficiency across a broad spectrum of operating speeds, Aircore EC motors are the ideal choice for industrial conveyor and materials handling applications requiring substantial torque and power at lower RPMs. With a remarkable ability to maintain reliability, our motors can operate seamlessly within a temperature range of -25°C to 40°C and under 95 percent relative humidity.

Designed to endure the demanding conditions often encountered in industrial settings, Infinitum motors are engineered to withstand rigorous operating conditions. Their robust construction guarantees long-lasting performance while significantly reducing the risk of mechanical failures.



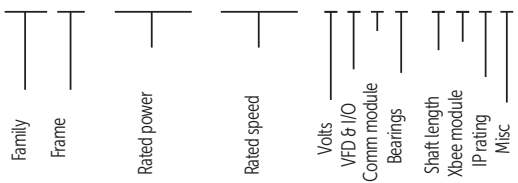
### Catalog number decoder

Family	Frame	Rated power	Rated speed	Volts	VFD & I/O	Comm module	Bearings	Shaft length	Xbee module	IP rating	Misc
XX	XX	XXXX	XXXX	X	X	X	X	X	X	X	X
AE	20	1500	3600	A*: 460 V / 60 Hz	A*: Modbus, analog input	A*: none	S*: steel H: hybrid	A*: 3.3" B: 4.0	A*: none	4*: IP54 6*: IP65	0: EPL

\*Standard

#### Example catalog number

AE20-1500-3600-AAAS-AA40



#### Example decoded

AE20 = Aircore EC, 20 frame  
 1500 = 15 HP  
 3600 = 3600 RPM  
 AAAS = 460 V / Modbus / Analog Input / No communication module / Steel bearings  
 AA40 = 3.3" shaft length / No IoT module / IP54 rating / Electronically Protected-L

Catalog number	Power (HP/kW)	Speed (RPM)	Torque (Nm)	Diameter (in/cm)	Motor + drive length (in/cm)	Motor + drive weight (lb/kg)	NEMA Frame	Bearing DE, NDE
<b>AE Series (Standard), 460VAC, IP54</b>								
AE20-1500-3600-AAA*-AA40	15 / 11.19	3600	30	21.1in / 53.7cm	8.9in / 22.5cm	128.1lb / 58.1kg		
AE20-1500-2400-AAA*-AA40	15 / 11.19	2400	45	21.1in / 53.7cm	8.9in / 22.5cm	128.1lb / 58.1kg		
AE20-1500-1800-AAA*-AA40	15 / 11.19	1800	60	21.1in / 53.7cm	8.9in / 22.5cm	128.1lb / 58.1kg		
AE20-1000-1800-AAA*-AA40	10 / 7.46	1800	40	21.1in / 53.7cm	8.9in / 22.5cm	128.1lb / 58.1kg		
AE18-1000-3600-AAA*-AA40	10 / 7.46	3600	20	18.6in / 47.2cm	8.7in / 22.1cm	96.1lb / 43.6kg		
AE18-1000-2400-AAA*-AA40	10 / 7.46	2400	30	18.6in / 47.2cm	8.7in / 22.1cm	96.1lb / 43.6kg		
AE18-0750-1800-AAA*-AA40	7.5 / 5.59	1800	30	18.6in / 47.2cm	8.7in / 22.1cm	96.1lb / 43.6kg		
AE15-0750-3600-AAA*-AA40	7.5 / 5.59	3600	15	16.4in / 41.7cm	8.7in / 22.1cm	81.4lb / 36.9kg		
AE15-0750-2400-AAA*-AA40	7.5 / 5.59	2400	22.5	16.4in / 41.7cm	8.7in / 22.1cm	81.4lb / 36.9kg		
AE15-0500-2400-AAA*-AA40	5 / 3.73	2400	25	16.4in / 41.7cm	8.7in / 22.1cm	81.4lb / 36.9kg		
AE15-0500-1800-AAA*-AA40	5 / 3.73	1800	20	16.4in / 41.7cm	8.7in / 22.1cm	81.4lb / 36.9kg		
AE13-0500-4200-AAA*-AA40	5 / 3.73	4200	8.5	14.5in / 36.7cm	9.1in / 23.1cm	62.8lb / 28.5kg		
AE13-0500-3600-AAA*-AA40	5 / 3.73	3600	10	14.5in / 36.7cm	9.1in / 23.1cm	62.8lb / 28.5kg		

#### AH Series (Heavy Duty), 460 VAC, IP65

AH18-1000-3600-AAAS-AA60	10 / 7.46	3600	20	18.6in / 47.2cm	8.7in / 22.1cm	96.1lb / 43.6kg	213/5TC	6308ZZ
AH18-0750-1800-AAAS-AA60	7.5 / 5.59	1800	30	18.6in / 47.2cm	8.7in / 22.1cm	96.1lb / 43.6kg	213/5TC	6308ZZ
AH15-0750-3600-AAAS-AA60	7.5 / 5.59	3600	15	16.4in / 41.7cm	8.7in / 22.1cm	81.4lb / 36.9kg	213/5TC	6308ZZ
AH15-0500-1800-AAAS-AA60	5 / 3.73	1800	20	16.4in / 41.7cm	8.7in / 22.1cm	81.4lb / 36.9kg	213/5TC	6308ZZ
AH13-0500-3600-AAAS-AA60	5 / 3.73	3600	10	14.5in / 36.7cm	9.1in / 23.1cm	62.8lb / 28.5kg	182/4TC	6206ZZ

Replace \* with desired bearing types. S = Steel Bearings, H = Hybrid Bearings



## Motor technology

### Who developed this technology? How was it invented?

Ben Schuler, Infinitum's CEO & Founder, is the original inventor of this technology.

Ben's previous company was focused on capturing waste energy from HVAC systems. While working to reduce the size and cost of the generator in that system, Ben invented the PCB stator technology at the heart of Infinitum's innovation.

### What is a printed circuit board stator?

A PCB (printed circuit board) stator is a unique technology that allows the copper winding core of the motor to be integrated into a thin, disc-shaped PCB. The PCB stator greatly reduces the size and weight of the motor. This PCB stator uses two thirds less copper compared to a conventional iron-core stator. This is the primary differentiator of Infinitum's technology vs. a conventional electric motor. This PCB stator can be manufactured worldwide in any printed circuit board design/manufacturing facility.

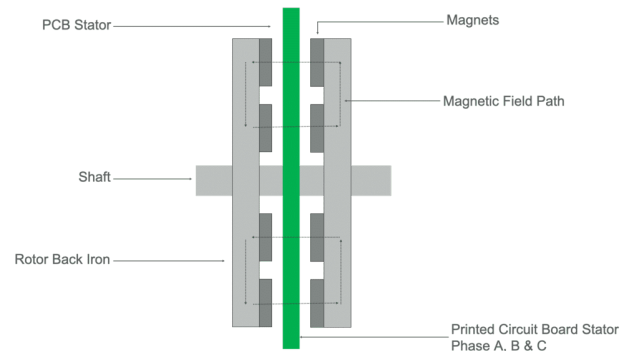
### Why is it more efficient?

A traditional motor features a laminated steel core with copper windings, and up to a third of the motor losses are caused by eddy currents in that steel core. When the core and copper windings are replaced by copper traces etched into the Printed Circuit Board (PCB) stator of Infinitum motors, the core losses are eliminated, which provides a higher efficiency motor.

### How does the the Infinitum motor compare to conventional EC motors? What are the size and weight differences?

Infinitum's motors have a geometry commonly referred to as "pancake" or "disc" motors. Infinitum's motors are less than half the volume and weight of conventional AC induction motors and approximately 30% smaller than electrically commutated (EC) motors. With these size and weight advantages, Infinitum motors achieve higher efficiency and boast a broader, flatter efficiency curve while being scalable to higher HP.

Another advantage of the Infinitum motor is the superior serviceability of components, including bearings and VFD modules. The control options of the Infinitum motor are similar to conventional motors; unlike traditional motors, Infinitum motors can capture and transmit rich monitoring data through enhanced communication options including Modbus TCP, RS485 e.g. Modbus RTU, with additional options are in development.



### What is an axial flux motor and how does it work?

In an axial flux motor, the magnetic flux travels parallel to the motor shaft, in the axial direction. Traditional AC induction motors are radial flux machines, where the flux travels perpendicular to the motor shaft in the radial direction.

The Infinitum motor is arranged so that the stator and rotor discs are all parallel to each other, and the stator is sandwiched between the rotor discs. As current passes through the coils on the stator PCB, they generate an electromagnetic field which interacts with the magnetic fields from the rotor magnets to generate torque and rotation.

### What type of magnets do you use?

The Infinitum technology allows the motor to be tailored to the application requirements. They can design your motor with both rare earth and ferrite permanent magnets.

### How does the reliability compare to conventional motors?

Third-party reliability tests have shown that the PCB stator is up to 9x more reliable than a conventional copper wire wound stator. Three common failure points in conventional motors are the copper wire windings, insulation between the copper wire and laminated core, and the bearings. In conventional motors, as the stator heats up and cools down, the copper wire windings rub against each other resulting in insulation failure. Additionally, the windings experience increased stress at the end turns which leads to eventual failure.

In contrast, the PCB stator is produced on fully automated equipment without any of the inconsistencies seen on traditional motor windings. The coefficient of thermal expansion of the PCB substrate and the copper is very similar resulting in almost perfect heat dissipation across the entire stator. Thus the design eliminates both the end-turn and insulation failure modes.

#### What is the efficiency of the motor?

Infinitum technology can be tailored to the application. Infinitum motors with integrated VFDs exceed AMCA 207 efficiencies. Want to learn more about drastically improved motor efficiency with Infinitum Aircore EC motor?

[Download the white paper, "High Efficiency Motors".](#)

## Drive technology

#### What is a Variable Frequency Drive (VFD) and why do I need one?

For most applications, supply line power is typically at a fixed voltage. In order to vary the speed and torque of most motors, you need to be able to control the frequency and voltage going into your motor. A Variable Frequency Drive or VFD allows you to control the power going into your motor and more precisely control the performance.

See our YouTube video "[What is a VFD?](#)" for more.

#### How is the motor controlled? What input/output (I/O) and communications are available?

Our Aircore EC motor is controlled via our integrated electronic drive. The drive is a standard 6-pulse drive topology utilizing extremely reliable and ultra efficient Silicon Carbide (SiC) MOSFET switching devices.

The Aircore EC offers the same control options as market-leading HVAC variable frequency drives (VFD) and EC motors, making the transition to the Aircore EC easy for installers and operators.

Control options include:

- Modbus TCP Primary interface for lab evaluations and configuration
- Modbus RTU: RS485 over serial connection provides read and write (control and configuration) functionality
- Configurable analog input (1 in @  $\pm 10$ VDC, 1 out @  $\pm 10$ VDC, 1 in @ 4-20mA, 1 out @ 4-20mA)
- $\pm 10$ VDC reference source (for analog control input e.g., a potentiometer)
- Configurable digital, 4 in (pull down), 4 out (open collector)
- 24V, 1A auxiliary power for both internal and external (equipment) use
- Fault relay

#### What data does the Infinitum motor collect? Are Infinitum motors IoT-enabled?

Unlike traditional AC Induction motors, the Aircore EC has sensors integrated into our PCB stator allowing us to measure the health of the motor and the equipment it's driving. The product provides rich data including vibration, motor and drive temperatures, speed, voltage, and current. This information is made available through advanced communication options including a cellular IoT connection, Ethernet (Modbus TCP), and RS-485 (Modbus RTU) with other communication options currently in development.

Our OPTIONAL integrated cellular IoT modem also uniquely allows users to transfer this data to our FluxVision IoT cloud dashboard and update firmware more easily.

#### Can you use the Infinitum motor without a drive?

No, our motor requires a drive to operate. The drive is integrated into the motor on our Aircore EC products, however, for larger applications or mobility systems, we would most likely keep it separate.

#### Can commercial variable frequency drives (VFD) drive this motor?

Infinitum develops its own proprietary inverters to optimize the performance of the motor. All Infinitum motors feature an integrated inverter with optional industry-leading communication and control options. Third party commercial VFDs are not supported by Infinitum.

How do your harmonics compare to conventional VFDs? We use a standard 6-pulse drive topology, and the total harmonic distortion (THD) is similar to competitive commercial and industrial VFDs. Depending on the application requirements, we can implement a variety of harmonic mitigation techniques including AC line reactor/DC link choke, multi-pulse rectifiers, or an active front-end (AFE).

## Aircore EC integrated motor and drive

### How does the efficiency compare to conventional AC Induction motors and drives?

Conventional AC induction motors operate at their highest efficiency at the rated speed (i.e., 1800 RPM) then have a steep drop-off in efficiency at partial load/partial speed. The Infinitum motor maintains a flat efficiency curve across a wider speed range. [Download the white paper, "High Efficiency Motors"](#), to learn more.

### How does the Aircore EC compare to EC Fans?

Unlike EC Fans, the Aircore EC motor allows fan and HVAC OEMs to perfectly match the best fan and motor combination for the application. By decoupling the two components, end-users can also more easily service either component including motor bearings.

Infinitum's thin profile allows fan and HVAC manufacturers to save space and reduce weight, making shipping, installation, and service easier.

### What kind of bearings does the Aircore EC motor use?

Our products utilize permanently sealed, industry standard steel 6206 bearings. L10 bearing life is a minimum of 50k hours for horizontal and shaft-down orientations. Hybrid ceramic bearings are also available.

### What is the mean time between failure (MTBF)?

(i.e., What is the motor lifetime? What is the lifetime of the drive and electronics?)

The bearing L10 life is 50,000 hours. The drive or VFD utilizes standard topology and industrial-grade power electronics, which have a lifetime comparable to other industrial grade VFDs on the market.

### What is your motor's operating environment range?

The operating temperature range is -25C to 40C. 95% relative humidity, non-condensing. Derated at altitudes over 1000m.

### How is the motor cooled?

The motor is actively cooled with an internal shaft-mounted impeller and heat sinks for the electronic components are arranged on the periphery of the motor housing. The integrated motor and drive protection rating is Totally Enclosed Fan Cooled (TEFC) and IP54.

### Where is the motor manufactured?

We're assembling our motors at a contract manufacturer in Mexico and in Round Rock, Texas. All motors are final tested at our Texas facility.

### What is your warranty?

We offer a standard 12-month warranty from date of delivery.

### What other applications are there for this technology?

We're currently working with a range of global OEMs in a variety of applications and industries including:

- HVAC and industrial fans, pumps, and compressors
- Electric mobility including passenger vehicles, commercial vehicles and aerospace
- Consumer appliances

### What is your product roadmap?

We're focusing on HVAC and pumps as our initial market focus. Our commercially available products range from 3 hp to 15 hp (2.2 kW to 11.2 kW). The motor may be applicable as-is for many other applications. Our design process is driven by customer input, and we would love to learn about your needs and requirement.

### Can you develop a custom design?

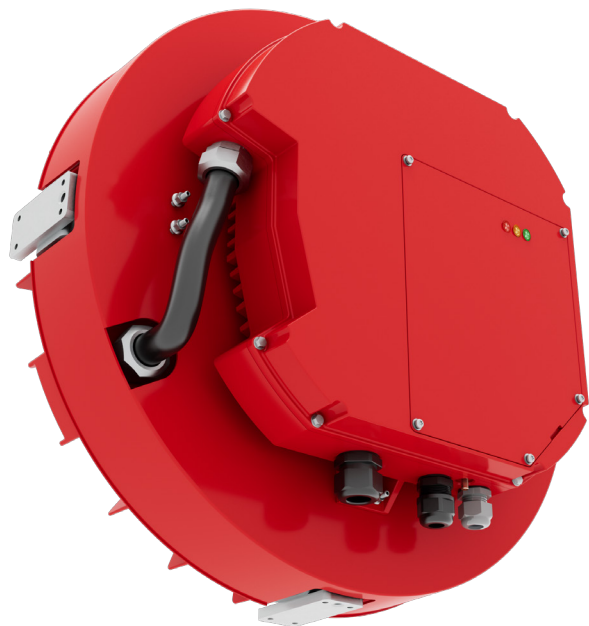
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Sprecher + Schuh has provided reliable control and protection solutions for its customers since 1903.

Today, Sprecher + Schuh offers a wide range of low-voltage industrial control products, including contactors, a variety of relays, starters, push buttons, switches, terminals and controllers, to name a few. All of our products are crafted with precision and tested rigorously for performance — far exceeding industry standards. Moving forward, we continue along the path of constantly seeking innovative ways to provide solutions for our customers. It is by this philosophy that Sprecher + Schuh has come to be the industrial control manufacturer of choice for many customers around the globe seeking quality, reliability, and a name they can trust.



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