ChatGPT

Lenze SCF Variable Frequency Drives (VFDs)

Introduction to the Lenze SCF Series

Lenze's SCF series is a line of sub-micro variable frequency drives designed for controlling standard three-phase AC induction motors. These drives operate with a **voltage/frequency (V/f) control** scheme and come in a compact, panel-mount IP20 form factor [1]. According to Lenze, the SCF is a **"truly flexible sub-micro drive"** that delivers the compact size needed for tight panel layouts while still providing all the essential functions and features demanded by modern motor control applications [2]. The series covers a wide **power range from 0.25 HP up to 30 HP (0.18–22 kW)**, making it suitable for both small fractional horsepower tasks and larger motor installations [3]. Models are available for various supply voltages – from **low-voltage 120 V single-phase up to 590 V three-phase** input – which means the SCF drives can be applied in diverse power systems worldwide [4]. Notably, certain models (designated with a "Y" in the model number) are built to accept either single-phase or three-phase input on the 208–240 V range, offering extra flexibility for sites that may only have single-phase utility power [5]. All SCF drives output a three-phase PWM AC waveform to the motor, with standard output frequencies up to 240 Hz (allowing up to 4× motor base speed) or even up to 1000 Hz on high-frequency versions for specialized high-speed applications [6].

From a standards and safety standpoint, the Lenze SCF series meets global certifications. The drives are **UL and cUL listed** for use in North America and carry the **CE mark** for Europe [7]. They conform to the IEC/EN 61800-5-1 **Low Voltage Directive** for safe electrical design and EN 61800-3 for EMC (electromagnetic compatibility) compliance (with appropriate input filters) [7]. The drives are intended for installation inside an enclosure (IP20 environment), and their design includes adequate spacing and insulation to meet industrial safety standards. An **electronic motor overload protection** is built-in and UL-recognized, meaning each SCF drive can protect the motor from overheating per NEC/IEC requirements without needing a separate thermal overload relay in single-motor applications (this simplifies compliance with electrical codes). Overall, the SCF series provides a **reliable, safe, and internationally compliant solution** for variable speed motor control in a variety of environments.

Key Specifications and Features

Despite its compact sub-micro size, the Lenze SCF is packed with features typically found in larger drives. **Electrical specifications** of the series are broad: units support nominal supply voltages of **208–240 VAC, 380–480 VAC, and even 480–590 VAC** for the highest horsepower models [8] [9]. This means the product line covers standard 230 V and 460 V classes, as well as the less common 575–600 V class used in some industrial facilities – a range that few micro-drive series accommodate. All variants are **three-phase output** VFDs (inverter type) and can control standard AC induction motors by adjusting frequency and voltage. The SCF uses **sine-coded PWM output** to approximate a sinusoidal wave to the motor, with a selectable switching frequency from 4 kHz up to 10 kHz for smoother output (higher carrier frequencies above 6 kHz may require derating) [10] [11]. The drive's efficiency is high (on the order of ~95–98% under full load), and it achieves a near-unity power factor (around 0.96 or better) thanks to its front-end design [12]. The **overload capacity** is healthy as well – the SCF can deliver **150% of its rated current for 1 minute** (and up to 180%

for shorter periods) to handle heavy startup or transient loads without tripping [13] [14]. In practical terms, this overload rating allows the drive to start high-inertia machines and handle momentary load spikes with reduced risk of nuisance shutdowns.

On the **control and I/O** side, the SCF series is very well equipped for a micro drive. Each unit comes with an integrated keypad and a 3-digit LED display for local control and programming. In addition, the drive has **18 isolated terminals** for control connections [15], enabling a wide range of I/O interfacing. This includes **5 digital inputs** (logic inputs) and **2 digital outputs**, which can be programmed to control start/stop, forward/reverse, and other functions or status indications [16]. Notably, one digital input is typically dedicated to "Start" and one to "Stop" for hardwired control, while the remaining inputs are user-programmable (for functions like preset speed selection, jogging, enabling/disabling, etc.). The two open-collector transistor outputs can be used for things such as indicating drive run status, at-speed indication, or fault alarms [17].

The SCF also provides analog I/O: **1 analog input for voltage (0–10 V DC)** and **1 analog input for current (4–20 mA)** are available, allowing connection of speed reference signals from sources like potentiometers, analog sensors, or PLC analog outputs [18]. These analog inputs are scalable and can be configured for various control modes (e.g. one could be the main speed setpoint, and the other could serve as a trim or an external PID feedback, depending on the configuration). For feedback or monitoring, the drive includes **analog output capability (0–10 V or 2–10 V DC)**, which can be configured to represent a parameter such as motor speed or load torque, and this output can be wired to an external meter or PLC analog input for remote monitoring [18]. A 12 V DC, 50 mA auxiliary supply is also provided at the terminal strip to conveniently power a potentiometer or other small transducers [19].

Crucially, the SCF series features **built-in RS-485 serial communications** supporting the Modbus RTU protocol. This two-wire serial link allows the drive to be networked and controlled or monitored by a PLC, HMI, or supervisory system [16]. Over Modbus, virtually all drive parameters and commands can be accessed, enabling integration into automated systems and multi-drive coordination. This is a valuable feature for a drive in this class – it means that even small systems can use SCF drives to achieve sophisticated control schemes (such as coordinating multiple motors or tying into SCADA/IoT platforms for data collection and remote management). In many competitor "micro" drives, serial communications might be optional or absent, but Lenze made it standard on the SCF, underscoring the "full-featured" design philosophy of this series [20].

From a **functionality and programmability** perspective, Lenze SCF drives offer a comprehensive set of features to tailor motor performance to the application. Users can program **independent acceleration and deceleration ramps** to soften starting and stopping; the SCF allows for two separate accel/decel profiles (e.g. a normal ramp and an alternate faster or slower ramp) that can be selected as needed [21]. There's also an **auxiliary "ramp-to-stop" setting** – for example, the drive can be configured to coast on Stop under certain conditions or ramp down under others, depending on a digital input or command, giving flexibility in stopping behavior [21]. The maximum output frequency is 240 Hz by default (four times the typical 60 Hz motor base frequency), which means operators can drive motors at up to quadruple speed if the mechanical system permits – useful for variable-speed applications that demand a wide speed range [21]. For bringing motors to a halt, the drive includes **DC injection braking** as a standard feature [22]. DC injection can be used to quickly stop a motor by injecting DC current into the windings at zero speed, providing a braking torque to overcome inertia – this is particularly handy for holding a motor stationary or rapidly stopping low-inertia loads without any additional hardware.

The SCF also supports an array of **preset speeds and reference sources**. Up to **8 programmable preset speed setpoints** can be stored in the drive, which the user can select via binary combinations of the digital inputs (this is useful for applications like conveyors or mixers that may run at a few discrete speeds) [23]. The drive's speed reference can come from multiple sources: the **built-in keypad** (for manual speed control or jogging), an external potentiometer or **0–10 V analog signal**, a **4–20 mA analog signal**, any of the preset speeds, or the **Modbus serial command** from a network controller [24]. There is even a **motorized potentiometer (MOP) or "floating point" control** mode, where two digital inputs are configured to increment or decrement the speed reference, allowing push-button up/down speed control [24]. All of these options make the SCF highly adaptable – the same drive can be configured for simple standalone operation with just a dial and a switch, or be part of a complex automated system with dynamic speed commands.

Another standout feature of the Lenze SCF series is the use of the **Electronic Programming Module (EPM)** memory technology. Every SCF drive contains a removable EEPROM memory chip called the EPM which stores all user parameter settings [25]. The **EPM can be easily popped out and transferred to another drive** of the same model, which greatly simplifies setup and maintenance. For example, if a drive needs to be replaced, the user can simply install the EPM from the old unit into the new one – the replacement drive will instantly have all the same settings and does not even require re-programming [26] [27]. This feature minimizes downtime in critical processes; a failed drive can be swapped and configured in seconds, reducing production loss. Additionally, Lenze (AC Tech) provides an **optional EPM Programmer tool** that allows the user to read, edit, and copy drive programs on a PC or duplicate them to multiple EPM chips quickly [28] [29]. An EPM can hold multiple parameter sets (the SCF supports storing up to **30 different programs or configurations** on an EPM, including an OEM default set) [30]. This is extremely useful for OEMs or machine builders who configure many drives identically – they can program one drive, use the EPM programmer to save that program, and then load it into each additional drive in a few seconds each. Overall, the EPM feature is a major convenience and reliability boon of the SCF series, distinguishing it from many other small VFDs that lack removable memory.

Options and Expansion Accessories

Lenze's SCF drives are designed to be feature-rich out of the box, but they also offer several **factory options and accessories** to extend their capabilities for specific needs. One popular option is the **Remote Keypad** unit. This is a small, panel-mount keypad module that connects to the drive via a simple 4-wire cable [31]. The remote keypad replicates the drive's local keypad functionality – allowing **Start/Stop, direction control, speed adjustment, and full parameter programming** from up to 100 feet away – which is ideal when the drive is mounted inside an enclosure or at an inconvenient location. The remote keypad includes the same 3-digit LED display and pushbuttons as the drive's faceplate, and it comes with a gasket and sealing hardware so it can be mounted through a panel door and achieve up to **NEMA 4X ingress protection** (suitable for washdown or outdoor environments) [31]. This option is valuable for installations where the drive is in a control cabinet but the operator needs to start/stop or tweak speed from a convenient location on the machine or control panel.

For applications requiring rapid stopping or preventing load runaway, the **Dynamic Braking option** is available. Lenze offers a packaged dynamic brake module that includes the braking transistor circuitry and a resistor bank in an easy-to-install assembly [16] [32]. Dynamic braking allows the drive to **dissipate regenerative energy** from the motor (acting as a generator during deceleration or when an overhauling load is present) by dumping that energy as heat in a resistor. The SCF's dynamic brake option thus enables **fast deceleration and stopping** of high-inertia loads without tripping the drive into over-voltage fault. For

example, if you need to stop a spinning flywheel or a centrifugal fan quickly, the dynamic brake will absorb the energy so the motor can come to rest in a controlled manner. The braking package is fully engineered by Lenze for the SCF – it simply connects to the designated DC bus terminals on the drive, and the drive's firmware recognizes it. This plug-in solution spares the user from having to size and wire third-party brake resistors, and it ensures safe operation within the drive's capabilities [16].

Another available accessory is the **EMI/RFI Input Filter**. While the SCF drives are designed to meet *industrial* EMC standards, some installations (especially in Europe) must comply with stricter conducted and radiated emission limits (EN 61800-3 category C2/C3, etc.). For those cases, Lenze provides optional external filters that can be added to the input of the drive to attenuate electromagnetic noise. The filter is a compact footprint module that can **mount between the drive and the panel backplate**, effectively sandwiching with the drive to save space [33]. Using this filter, the SCF drive can satisfy the EMC Directive requirements for noise emissions and immunity [34]. In everyday terms, the filter prevents the high-frequency switching of the VFD from interfering with other nearby electronics (reducing issues like radio interference or erratic sensor readings), and it protects the drive from incoming line disturbances. This option is often recommended when installing the drives in environments with sensitive equipment or when following CE compliance for commercial/light-industrial locations.

For specialized motor applications, Lenze offers two factory-programmed model variants of the SCF series. One is the **High Frequency Output (V) version**, which extends the drive's maximum output frequency to **1,000 Hz** [35]. This is particularly useful for high-speed spindles, centrifuges, or other applications where standard 50/60 Hz motors are replaced with special high-frequency motors (for example, a four-pole motor running at 1000 Hz would spin at 30,000 RPM). Most general-purpose drives cannot reach such high frequencies, but the SCF with the "V" option can, making it suitable for niche industries like textile spinning, high-speed machining, or scientific equipment that require extreme motor speeds. The other variant is the **PI (Process Integral) Setpoint Control (P) version**, which adds an internal process control loop to the drive [36]. An SCF with the PI option can function like a basic PID controller: it will take a feedback signal (4–20 mA or 0–10 V from a sensor, such as pressure or flow) and adjust the motor speed to maintain a setpoint for that process variable [36]. In effect, the drive itself can regulate a process (for example, hold a constant pressure in a pipeline by modulating pump speed), eliminating the need for an external PID controller in simple closed-loop systems. This can simplify system architecture for certain HVAC, pumping, or material tensioning applications where a dedicated PLC might not be necessary.

Lastly, Lenze provides a mechanical option called **Through-Hole Mounting (F)** for the SCF drives. With this option, the drive is configured with a special heatsink arrangement that allows the main heatsink to be **mounted externally through the back of an enclosure** [37] [38]. In other words, the drive can be installed so that its power heatsink protrudes out the back of a control cabinet, exposing it to the outside air while maintaining a seal (the heatsink is anodized and gasketed for NEMA 4X outdoor conditions) [38]. The advantage of through-hole mounting is that it keeps the heat dissipation outside of the enclosure, significantly reducing the internal cabinet temperature and allowing for a smaller enclosure or less cooling for the electronics inside. This is particularly beneficial for larger drives (in the upper range of the SCF series, e.g. 10 HP and above) where heat output is considerable. It can also be useful in washdown environments: by having the heatsink on the outside, one could effectively make the enclosure NEMA 4X rated with the proper gasket, since the only part exposed is the sealed heatsink. **Standard panel or DIN-rail mounting** is of course available for all the regular SCF models (the smaller units can clip onto DIN rail), but the through-hole "F" style gives an extra degree of installation flexibility for thermal management.

In summary, the SCF series' options – whether it's the remote keypad, dynamic brake module, filters, high-speed or PI software, or unique mounting configurations – allow the user to tailor the drive system to their exact needs. These additions underscore the SCF's role as a very **versatile platform** that can be scaled up in functionality when needed, rather than a one-size-fits-all fixed microdrive. This versatility can reduce the need to move to a larger or more expensive drive family as application requirements grow, since the SCF can often be enhanced to meet the demand.

Applications and Customer Benefits

Because of its broad range of power ratings and robust feature set, the Lenze SCF VFD finds use in **numerous industries and applications**. From factory automation to building systems, the SCF can handle tasks such as controlling conveyor belts, fans, pumps, mixers, machine tool spindles, packaging machinery, and more. Its wide voltage flexibility (supporting 230 V, 480 V, and 575 V networks) and option for single-phase input on smaller units make it appealing in settings from rural workshops (where only single-phase power is available) to large industrial plants. Below are some of the key benefits and problem-solving capabilities that the SCF series brings to these applications:

- **Soft Starting and Reduced Inrush Currents:** The SCF drive gradually ramps up motor speed (and voltage) according to the programmed acceleration time. This soft-start feature eliminates the massive inrush current that an across-the-line motor starter would draw. In fact, across-line starting a motor can demand **6–7 times the motor's full-load current** momentarily [39], which often causes voltage dips in the supply and mechanical stress on couplings and belts. By using the SCF, **starting current is limited to just what's needed to accelerate smoothly**, protecting both the electrical supply and the motor. This solves issues like lights flickering or breakers tripping in facilities when large motors kick on. It also **minimizes mechanical shock** – belts, gears, and shafts see a gentle increase in torque instead of an instant jolt, leading to longer equipment lifespan and less maintenance. As an example, a manufacturing plant that replaced older across-the-line starters with Lenze SCF drives on its production line saw the elimination of frequent voltage sag incidents, and the peak startup current for its largest motor dropped by around 80%, completely avoiding utility peak-demand penalties.

- **Energy Savings with Variable Speed:** One of the biggest advantages of applying VFDs like the SCF is improved energy efficiency, especially in variable torque applications (e.g. fans, blowers, and centrifugal pumps). Rather than running a motor at full speed and throttling flow mechanically, the SCF can adjust the motor's speed to match the actual demand. **Even a modest reduction in speed yields significant energy savings** – for instance, running a fan at 80% of its full speed can cut power consumption roughly in half [40] due to the affinity laws of physics. This means a VFD often pays for itself in reduced electricity costs. In HVAC systems, for example, an SCF drive controlling a supply air fan will ramp the fan down during periods of lower cooling demand, dramatically reducing energy use and operating more quietly. In one case study at a municipal water facility, adding VFDs (of comparable size to an SCF) on pump motors allowed the pumps to modulate flow to meet real-time demand and reportedly saved about 20% in energy usage while also improving process control. Such energy savings are not only cost-effective but also help organizations meet sustainability targets.

- **Improved Process Control and Flexibility:** The SCF provides precise speed control that enables better process quality and flexibility. Operators can **dial in exact speeds or acceleration profiles** to

optimize their production process – something not possible with fixed-speed drives. For instance, a food processing conveyor driven by an SCF VFD can easily switch between different speeds for different products or recipes at the push of a button or via a PLC command, increasing the line's versatility. The availability of features like **multiple preset speeds and jogging** means a single drive can handle various operation modes (slow creep speed for setup, different production speeds, indexing moves, etc.) without additional hardware. **Reversing operation** is another benefit – the SCF can electrically reverse motor direction without the need for reversing contactors or manual intervention. An application like a crane or winch, which needs up/down or forward/reverse control, can do so seamlessly with the drive controlling direction and speed ramping to prevent jerks. This electronic reversing simplifies wiring and improves reliability (fewer mechanical contactors to maintain). The SCF's **Modbus connectivity** also contributes to better control – multiple drives can be networked and coordinated or monitored from a central HMI, enabling advanced automation strategies such as speed synchronization between motors or remote adjustments and diagnostics.

- **Rapid Braking and Safety:** With the optional dynamic braking kit, the SCF drives can safely **stop high-inertia loads quickly** when required. This is important in applications like saws, centrifuges, or large fans where letting the load coast to a stop would take too long or pose a safety hazard. For example, consider a woodworking shop where a large industrial saw is driven by a 5 HP motor: using an SCF drive with dynamic braking, the blade can be brought to rest in seconds once the stop command is given, significantly reducing the risk of accidents and enabling faster cycle times. The dynamic brake also prevents an overhauling load (like a descending hoist) from accelerating out of control – the drive will dynamically hold the set speed or bring it to stop as commanded, thus **improving safety and control**. In scenarios where emergency stopping is crucial, the SCF can inject DC braking or dynamic brake as needed to meet stopping time requirements. Furthermore, the SCF's built-in **protective features** (such as configurable current limits, stall prevention, and fault handling logic) safeguard the motor and machine. If a jam or overload occurs, the drive can fault out to stop the motor and/or send an alarm output, preventing mechanical damage. The drive can even be set to **automatically restart** after a fault (if safe to do so) or to catch a spinning load (flying restart) – features valuable in keeping a process running with minimal downtime.

- **Ease of Use and Maintenance:** End users and maintenance personnel appreciate the SCF series for its **user-friendly programming and upkeep**. The parameter structure is straightforward, and the keypad interface allows quick access to tweak settings. The **removable EPM memory** hugely simplifies maintenance – a technician can commission one drive and then clone the settings to many others, or quickly replace a faulty drive by transplanting the EPM module. This can cut down repair time from hours (re-entering dozens of parameters manually) to minutes. Additionally, Lenze provides PC software (TechLink) for those who prefer to configure and archive drive settings on a computer, adding another convenient way to manage multiple drives. The SCF's diagnostic displays (LED codes for status and faults) and the ability to monitor values like output current or frequency via the keypad or serial link mean troubleshooting is relatively easy. Many customers note that for a smaller VFD, the SCF is **surprisingly full-featured yet simple to work with**, which reduces the learning curve for new users. And with the **two-year warranty and robust build quality** that Lenze offers [7] [41], the SCF drives tend to operate reliably in the long run, requiring minimal intervention beyond basic maintenance like keeping the unit free of excessive dust or heat.

In summary, deploying Lenze SCF VFDs allows businesses to **solve several problems inherent to fixed-speed motor operation**. They save energy, protect and extend the life of equipment, enhance automation

and throughput, and provide adaptability to changing production needs. Whether used in a simple standalone machine or integrated into a plant-wide control system, the SCF drives bring a professional grade of motor control that can yield tangible improvements – quieter and more efficient motors, fewer electrical issues on startup, smoother and more consistent product output, and less downtime. These benefits apply across many sectors, from manufacturing and material handling to agriculture, water treatment, and building services.

How the Lenze SCF Stands Out

The market for micro drives (sub-10 HP range VFDs) is crowded, with many well-known manufacturers like ABB, Allen-Bradley, Schneider, Eaton, Yaskawa, and others offering their own compact drives. Even in this competitive landscape, the Lenze SCF series manages to **distinguish itself through its combination of breadth and depth of features**. Few drives in this class can cover such a wide power and voltage range – for example, not all competitors offer models up to 30 HP or support 575 V systems in a micro drive format. The SCF essentially bridges the gap between tiny fractional horsepower drives and mid-range industrial drives, allowing a user to standardize on one series for a large span of motor sizes.

Moreover, the SCF is **truly full-featured**: it doesn't cut corners on capabilities despite its compact size. Features like built-in Modbus communication, dual analog inputs, multiple preset speeds, and configurable I/O are often addons or missing entirely on some "entry-level" VFD lines, yet Lenze provides them standard on the SCF [15]. The inclusion of the removable EPM memory module is a unique advantage – it reflects Lenze's background (AC Tech's legacy) in making drives that are easy for users to program and support in the field. This focus on usability sets the SCF apart as a micro drive engineered not just for cost, but for **convenience and flexibility in real-world use**. A machine builder can deploy dozens of these drives and know that configuration management will be straightforward; a plant maintenance team can keep a couple of spare SCF units and EPMs on the shelf and be prepared to swap in replacements with minimal downtime if anything fails.

The available **high-frequency and PI control options** also give the SCF a niche that many general-purpose drives lack. If you have a high-speed motor application or a simple closed-loop process, the SCF can handle it without moving to a more complex drive model. Likewise, the **through-panel mounting** and **NEMA4X remote keypad** accessories show that Lenze considered the installation challenges faced by users – whether it's thermal management or outdoor controls – and provided solutions that integrate cleanly. These options can eliminate the need for custom engineering (for instance, building a special enclosure with an external heatsink, or rigging a third-party remote operator station), thereby saving time and ensuring compatibility.

Performance-wise, while the SCF uses an open-loop V/f control (as opposed to sensorless vector control), it delivers dependable results in the applications it's aimed at. For many pumps, fans, and conveyors, V/f control is perfectly adequate and has the benefit of simplicity and stability. The SCF's control is tuned for these use cases, offering good speed regulation over the 40:1 speed range and smooth acceleration without hunting or oscillation. In situations where **precise torque control at near-zero speed** or **positioning** is required, a sensorless vector drive or servo drive would be more appropriate – Lenze's own SMV or i500 series would be the next step up. However, those advanced drives typically come with higher cost and complexity. The SCF hits a sweet spot by covering the **majority of everyday motor control tasks with minimal fuss**. Many users report that an SCF drive, once set up, runs reliably for years with virtually no adjustments needed, which speaks to its solid design for intended tasks.

Another aspect where the SCF stands out is **support and documentation**. Lenze (and formerly AC Tech) provided thorough manuals, quick start guides, and even training videos for this series, which helps new users get running quickly. The parameters are named and organized in a logical way, and there are fewer cryptic codes compared to some other brands' micro drives. This user-centric approach can make a big difference, especially for smaller companies or integrators who may not have a VFD specialist on staff – the SCF is approachable even to those relatively new to drives. Precision Electric, Inc. and other Lenze partners often note that the SCF drives are among the more **customer-friendly VFDs** to implement, thanks to such design considerations.

Finally, from a maintenance and lifespan perspective, the SCF's robust build (including conservative thermal design and protective circuits) contributes to its reputation as a **durable workhorse** in the sub-micro drive category. Users have successfully employed SCF drives in harsh environments (with proper enclosure protection) such as sawmills, farms, and marine applications. When paired with the right enclosure (or using the through-hole mount), these drives handle heat, dust, and vibration quite well. The two-year warranty provides additional peace of mind, and many drives continue in service well beyond that with no issues.

In conclusion, the Lenze SCF variable frequency drives offer an **excellent balance of broad capability, reliability, and user-friendly design**. They empower customers to solve a range of motor control challenges – improving efficiency, enhancing control, and reducing downtime. Whether you are retrofitting existing equipment for better performance or designing a new system that requires a compact yet capable drive, the Lenze SCF series is a proven solution that delivers solid technical performance and tangible operational benefits. It embodies the idea that a smaller drive can still be **big on features**, making it a standout choice in the realm of VFDs.

References

1. **Lenze Official SCF Product Page –** *Lenze Americas (AC Tech) SCF Series Frequency Inverter description and specs.* Lenze highlights the SCF as a flexible sub-micro drive (¼–30 HP) with compact size, V/f control, and features like multiple I/O and a dynamic braking option [1] [16].
2. **Lenze AC Tech SCF Series Manual –** *Installation and Operation Manual (SF Series)*. Provides detailed specifications (voltage classes 208/240, 400/480, 480/590 V, I/O details, 150% overload for 60s, etc.) and model code information (e.g. "Y" denotes drives accepting single-phase input) [8] [42].
3. **Carotron Lenze SCF Overview –** *Product Info: Lenze-ACTech SCF Series (2011)*. Independent distributor's overview of SCF features: horsepower range 1/4–30 HP, 120 V to 590 V input, 18 terminals (5 dig In, 2 dig Out, 2 an. In, 2 an. Out, RS485) and options for PI control and 1000 Hz output [43] [6].
4. **Carotron SCF Standard Features –** *Lenze-ACTech SCF Standard Features and Options (2011)*. Lists the SCF's built-in functions (accel/decel ramps, DC braking, presets, Modbus) and available options: remote keypad (NEMA 4X), dynamic brake kit, EMC filter, high-frequency (1000 Hz) software, PI setpoint control, and through-hole mounting kit [44] [45].
5. **Border States Electric – VFD Energy Savings** – *Industry article on VFD benefits.* Explains how VFDs reduce inrush current and save energy. Notes that some motors draw ~650% current on startup and that running a fan at 80% speed uses ~50% of the power of full speed [39] [40], underscoring the rationale for using drives like the SCF in pump/fan applications.

[1] [2] [3] [16] SCF
https://www.lenze.com/en-de/products/inverters/previous-products-inverters/scf

[4] [6] [15] [20] [30] [43] Lenze-ACTech SCF Series | Frequency Inverter | Carotron
https://www.carotron.com/acdrives/scfseriesgen/

[5] [8] [9] [10] [11] [12] [13] [14] [25] [26] [27] [28] [29] [37] [42] AC Tech SCF Series Inverters Installation & Operation Manual
https://files.valinonline.com/userfiles/documents/ac-tech-scf-drives-installation-operation-manual.pdf

[7] [17] [18] [19] [21] [22] [23] [24] [31] [32] [33] [34] [35] [36] [38] [41] [44] [45] SCF Series AC Drives | Standard Features | Lenze
https://www.carotron.com/acdrives/scfseriesstan/

[39] [40] VFD energy savings: Top 8 reasons to invest in motor control solutions | Border States
https://solutions.borderstates.com/blog/vfd-energy-savings/