CATALOG

A guide to selecting variable-speed drives for use in buildings

Checklist for building services consultants

Drive features for effective building control

Today's variable-speed drives (VSDs) bring enormous benefits to buildings, whether commercial, residential or industrial. Yet many of these benefits are not widely recognised.

As a result, end users could be missing out on significant cost and time savings through:

- **Improved energy efficiency,** leading to lower energy bills
- **Faster installation** and commissioning times
- **Reduced maintenance** routines
- **Greater adaptability** and flexibility when using drives in buildings
- **Greater connectivity** through automation networks

When specifying VSDs, consultants are urged to review their specification requirements and ensure that the selected drives – and the suppliers from which they are purchased – have, as a minimum, the features contained within these checklists.

Feature	Description	Benefit	Tick
Meets EN 61000-3-12; Harmonic Product Standard	EN 61000-3-12 is a European standard limiting current harmonic pollution of a single product. Mandatory for products connected to a 400 V network.	Swinging choke technology compliance to EN 61000-3-12. This gives product compliance to harmonic mitigation and prevents unnecessary site audits for harmonic content. A VSD supplier should be able to assist with site-wide harmonic surveys and offer ultra low harmonic solutions to solve potential problems.	☐
Swinging choke	Reduces drives' harmonic signature. Choke varies its impedance as motor load changes, thus optimising the harmonic signature at all loads. Traditional chokes have a fixed impedance and cannot adapt in this way. Patented by ABB.	With a drive providing adjustable motor speed for the lowest energy consumption, the swinging choke provides the optimum harmonic mitigation even at partial loads. With standard DC chokes the harmonic output of a drive increases more significantly when motor speed is reduced.	☐
ACH580-31 ultra low harmonic drive variant	The integrated active supply unit technology guarantees you a network free from harmonics.	The ultra low harmonic drive variant ensures a pollution-free electric supply and allows the motor to be run at full voltage even in situations where the network voltage is reduced.	☐
EMC compliance to IEC/EN 61800-3 (2004) and A1 (2012) (Manufacturer's certification DoC statement available)	IEC/EN 61800-3 (2004) and A1 (2012) is specific EMC standard for power drive systems (PDS) and requires a motor to be connected to VSD to achieve compliance. In Europe it takes precedence over other generic standards e. g. EN 55011 which do not require motor connection. Claiming EN 55011 to a PDS system is a mis-application of this standard.	EMC filters built into drive as standard save panel space, avoid additional wiring, earthing and assembly costs. C2 compliance up to 150 m, longer cables are possible with sine filter installation. (Note: C1 is not relevant as the drive requires skilled cable installation and placement of the drive inside an RF shielded enclosure to comply with radiated C1 emission limits. Therefore, full C1 compliance is not recommended for HVAC applications.)	☐
Circuit breakers	Protect drive input with installation of standard MCBs or MCCBs. Supplier should have extensively tested circuit breakers and be able to provide an approved list of tested devices.	Earlier generations of drives were often protected by larger and more expensive semiconductor fuses which were difficult to apply. MCBs or MCCBs are easier to install and use.	☐
Sinusoidal vibration compliance during operation	Drive is able to withstand following vibration levels: Vibration (IEC 60068-2) • max. 1 mm (0.04 in), 5 to 13.2 Hz • max. 7 m/s2 (23 ft/s2), 13.2 to 100 Hz sinusoidal	Drive will withstand conditions when mounted directly within AHU. It is useful to mount drive within AHU (utilising remote keypad kit) as an additional enclosure is not required.	☐

Feature	Description	Benefit	Tick
Tolerance to network dips (Manufacturer's statement available)	Verified tolerance to network interruptions in accordance with Semi F47. Drive is equipped with a suitably rated DC link capacitance and can be programmed to recover energy from load to extend ride-through time.	Reduced spurious trips due to supply interruptions and transients. Critical equipment can be kept operational during power dips, energy recovery from load can increase duration of ride-through.	☐
Flange mounting for cabinet and duct installation	Drive needs to be able to be mounted through a cabinet or to a duct to reduce cooling need inside the cabinet. Flange mounting needs the outside part of the drive to comply with IP55 UL type 12 requirements.	Reduce the cooling need and save money on the cooling equipment by putting drive losses to the cooler environment while maintaining protection class.	☐
50°C ambient temperature (Manufacturer's statement available)	Ensure drive can operate in ambient temperatures up to 50°C while still providing typical IEC motor current. Ensure higher currents at lower ambients can be provided.	The drive always has enough current to operate the motor in the application. The drive does not have lower available currents as ambient conditions increase from typical switch-room conditions, thus difficulties during commissioning or operation are avoided. If ambient conditions are accurately known, then more optimal, cost effective, selections can be made. If necessary the drive can limit the switching frequency and output current automatically.	☐
Coated boards as standard	Special varnish coated on all printed circuit boards for protection.	Improved resistance to environmental factors. The entire drive complies with the contamination levels in IEC 60721-3-3 class 3C2/3S2.	☐
Isolation/safety	The drive can be equipped with an input isolation device, to remove power from drive and can be locked in "off" position.	Motor isolation is possible without any external equipment and without inconvenience of requiring interlocked isolation in motor cable. Isolating drive internally also removes need to provide an EMC compliant enclosure for motor isolator.	☐
BACnet interface built into drive as standard	BACnet is an open serial communication protocol and is fast becoming HVAC industry standard, due to its "open" nature. BACnet does not tie system into a particular manufacturer's hardware. Communication can be via RS485 or Ethernet hardware medium, allowing different communication media.	BACnet over RS485 (BACnet MS/TP) and over Ethernet (BACnet/IP) are supported. Easy integration to BMS and building controllers, allowing large amounts of data or control signals to be exchanged with minimal cabling (compared to traditional I/O). BACnet allows complete access to drive parameter information, including all information surrounding energy saving and other operational parameters.	☐
Additional serial communications	HVAC protocols built in as standard. BACnet MS/TP, ModBus RTU, N2 Metasys. Additional fieldbus adapter allows connection of: LonWorks, Profibus-DP, DeviceNet, ModBus/TCP, ControlNet, Ethernet/IP, EtherCAT.	Ensure drive has such a wide range of protocols allowing it to connect easily to any BMS. Note: ABB is not aligned with any single protocol but support all, to allow maximum flexibility. If protocol is not known before of a project, an ABB drive could be best choice.	☐
Emergency override operation mode (Fireman's override) (Run to destruction) (Smoke extract mode)	Drive programmed to ignore most of its trips and warnings that would normally stop it if application was at fault. Override function is password protected for security and can be programmed to run at a predefined speed, keep a constant pressure or other reference value such as analog input. "Trigger" input can be programmed to come from a number of sources so fireman can initiate mode when required.	Feature is designed to allow fire department to use drives to assist with smoke extraction. Input is triggered with a special key and drives operate HVAC motors in forward or reverse to remove smoke from building, assisting with visibility and safety during fire fighting. Drive ignores functions that normally stop it operating, giving priority to its continued operation.	☐
Range of IP protection ratings	IP ratings define protection levels for ingress from dust and protection against water; they do not define ability of drive to be mounted outdoor.	Ensure IP21/NEMA1 and IP55/NEMA12 available as standard, allowing flexible mounting within control rooms or within AHU fan sections without need for additional backplate for cooling purposes.	☐
Outdoor installation	Outdoor mounting requires control of heating and UV effects of direct sunlight and effects of temperature variations across year which will cause condensation to form. These effects cause premature drive failure. High IP ratings do not guarantee successful outdoor mounting.	Outdoor mounting requires design to control effects of sunlight, UV and condensation. The drive does not require a closed enclosure for being installed outside as long as it is placed in some shade. This saves cost as not a complete electrical cabinet is required for rooftop installations.	☐
Real-time clock/automated building control	Drive should contain a real time clock (RTC) with time and date functionality. Clock can be used in conjunction with extensive timer functionality to automate fan or pump control depending on time of day. As standard RTC battery backup. Timers can be used to change speed or automatically stop and start motor, thus operating like a simple BMS.	Drive should be able to operate standalone, without need for BMS input. Ensure preprogrammed times and "boosted" times can be employed. No extra hardware options needed for backed up RTC function. Ensure energy can be saved by tailoring drive operating time to occupancy levels and opening times of building or facility. RTC time stamps event, faults and warnings, making diagnostics easier.	☐

Feature	Description	Benefit	Tick
Drive control panel (keypad)	Among control panel features to consider are: • multilingual alphanumeric display for easy drive programming • various assistants and a built-in help function to guide user • real-time clock for fault logging and for controlling drive, such as start/stop • ability to copy parameters for backup or for downloading to another drive • large graphical display and softkeys for easy navigation • IP55, and ability to mount keypad remotely to drive, on outside of an AHU or cabinet • ability to be removed without tools • keypad display that is easily customised to display user-specific values • Drive does automatically backup to the keypad 1 hour after the last configuration change has been made.	Ease of use means set-up times are reduced and reliable installations are produced, thus reducing cost of the overall installation. Ability to copy parameters between drives reduces set up times for a large system. Context sensitive help available at press of "?" key, so user has no reliance on manual. Several remote mounting options so keypad can be mounted anywhere. User can edit multiple homeview screens to quickly display many signals from the keypad which are appropriate for applications to aid diagnostics and running conditions. Prevents the user error of forgetting to take backup after changing configuration. Easy to replace failed unit by restoring the backup from the old unit keypad.	☐
Smart modes of operation	HVAC control panel (operator keypad) should have several different modes for configuring, operating and diagnosing drive: • homeview – shows drive status information and operates drive • primary settings – allow quick and effortless way to editing settings • diagnostics – a single place where you can troubleshoot potential issues • parameter mode – edits parameter values individually • assistants mode – guides startup and configuration • changed parameter mode – shows changed parameters • drive parameter backup mode – uploads or downloads parameters between drive and control panel • time and date mode – sets time and date for drive • I/O settings mode – checks and edits I/O settings	Modes presented to user as menu choices on keypad, which can easily be selected using navigation keys. Some modes give further diagnostic help, like changed parameter mode which just presents parameters that have been edited, making it simple to spot programming mistakes. Other modes report status of I/O, making it easy to see if control I/O signals are present. Backup ensures there is always a valid list of "as commissioned" parameters to revert back to in case of editing errors. Forced I/O mode allows testing of the I/O configuration without real signals. Similarly drive's I/O output can be forced for any state for testing the behaviour of external equipment.	☐
Startup assistant	Ensure keypad contains an assistant which guides user through basic drive start-up, requesting only motor information and control information to be entered. Help screens should be available with this assistant to find data needed to enter into drive.	Quick and easy setup of drive, which reduces time taken to get system up and running. Because startup is guided, it is more difficult to miss out important steps. Assistant allows user with little drives experience to get drive operating properly and effectively.	☐
Intelligent diagnostics assistant	If a fault occurs drive reports problem then starts diagnostic menu, which guides user to cause of problem, suggesting reasons why fault has occurred and how to fix it. Drive contains a list of signals which can be used to track a problem, including I/O status and power stage values.	Faults are quickly resolved by saving down time. Most faults associated with drives come from driven application so diagnostic tool guides user to most appropriate reason quickly. Any faults are stored with a time stamp, so time of day can be determined and association with plant issues resolved, again helping to diagnose real root cause more effectively. Assistant allows users with limited drives knowledge to diagnose problems with system.	☐
Mechanical resonance avoidance	Mechanical resonances can be avoided by programming "disallowed" fan or pump speeds. These speeds are specific to mechanics of system, so have to be tuned according to natural system resonant frequencies. Once discovered, drive prevents motor from turning at these speeds and hence avoids resonance build up.	Resonances can damage mechanics of system, so preventing build ups avoids expensive mechanical damage. Resonances can also generate high levels of audible noise which can affect occupants of a building or premises.	☐
Audible noise smoothing	VSDs can cause motor to generate audible noise. Adjustable switching frequency range ensures lowest possible motor noise, but still allows you to have full current when you need it.	Building occupants sometimes complain about noise from VSD controlled systems. This mode reduces motor noise to be more comfortable in tone for building's residents.	☐
Energy optimisation and efficiency	This automatically controls motor magnetisation across speed range to minimize energy being used at all points. Energy optimization can typically reduce energy being used by 10 to 15 percent (greatest energy savings are achieved at partial loads).	It is essential that motors are controlled using the least possible energy so drive must automatically detect changes in load and control motor to lowest possible level, thus saving energy. Energy savings can be transmitted via system fieldbus to central logging equipment.	☐

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Energy efficiency counters	Energy counter calculates energy savings compared to equivalent direct-on-line, showing savings in kWh, MWh, CO_2 emissions and money saved.	Energy counters allow easy end-user monitoring of consumed energy and realized energy savings.	☐
Load analyser	Statistical tool to analyse and interpret drive behaviour and to analyse process energy efficiency and operation.	Provides information on system maintenance needs and can be used to illustrate and control system's energy efficiency. It allows user to identify periods of unexpectedly high (or low) load and can point towards system optimization improvements.	☐
PC based commissioning, monitoring and parameter editing tool	Allows access to all parameter settings and allows drive to be controlled and tuned from a laptop. Further, the free Drive Composer PC tool is availalble for all all-compatible drives eliminating the need for special hardware.	Modern drives require a PC tool to allow parameterization and parameter storage. Ability to edit and tune parameters whilst monitoring signals live in monitor window makes the free Drive Composer entry an ideal commissioning aid. Offline parameter files can also be generated (and saved), so configurations can be generated before arriving at site. Backups can be made and parameter set-up lists can be generated for client documentation.	☐
Mobilephone apps to support commissioning, monitoring and parameter editing	The Drivetune app allows service engineers and installers to easily connect to a drive via wireless Bluetooth connection.	Using a user-friendly smartphone interface, the installer can more quickly and efficiently commission and tune a drive's performance.	☐
Input/output capacity	Ensure that all I/O is fully programmable for maximum flexibility.	Extensive control configuration capabilities, since all I/O points are programmable; they can be connected to internal functions and supervision parameters, so I/O can give indications as well as controls. I/O can be either hardwired, or can be accessed via serial communication network, effectively utilizing unused onboard drive I/O as remote I/O across fieldbus.	☐
Designed for a lifetime	Typically main components should be designed to have long lifetime and to operate in poor environments and elevated temperatures. For example, fans should be designed to operate for minimum six years at a normal ambient of 40 degrees; increasing to nine years at an ambient of 30 degrees.	Drives are designed to be a high end quality product. Great care is taken to ensure components and equipment are designed and manufactured to highest standard.	☐
Every single drive tested on a real motor at full load	Test every single VSD on production line on a real motor at full load and at elevated temperature for at least 45 minutes.	Testing VSDs on fixed inductors does not exercise power bridge of a VSD properly and latent failures can be missed. Only true test for a VSD is to run it on a fully functional motor. Motors used in test department are mounted back-to-back with a generator, so load energy being taken from VSD is regenerated back to mains supply of factory, so test department aspires to be energy efficient as well.	☐
Extensive warranty	Look for at least 24 months from manufacture, with extensions available up to 60 months.	Drives come with extensive warranty coverage to ensure peace of mind with regard to product quality and reliability. Worldwide coverage ensures continued support regardless of location.	☐

The right drive and advice for your application

Service checklist
There is more to specifying VSDs than the product. As much emphasis should be given to the levels of service and support that a manufacturer offers. Here is a further checklist of key considerations when selecting a drive manufacturer or supplier:

Service and support	Consideration
HVAC application and market expertise	Your supplier should have the expertise and support literature to help resolve any technical issues within your project, on complex subjects including: dimensioning, EMC and harmonics.
Harmonics surveys	Ensure extensive harmonic knowledge is available to offer appropriate advice in relation to harmonic mitigation techniques. The company should offer advice and recommendations to ensure adequate measures are chosen to reduce risk of future problems as a result of harmonics. Look out for services such as desktop harmonic analysis and on site harmonic measurement surveys.
Training and product support	A good supplier offers certified training for its drives along with extensive support to ensure users can get the best out of the products. Bespoke training courses should be available according to specific customer requirements.
Energy analysis and free energy appraisals	Does your supplier have an established partner network? Can they offer free site energy appraisals, designed to maximise energy savings and returns on investment for fan and pump applications? Can the same network install new drives and carry out before and after proof of savings? Are loan drives available to prove energy savings?
Technical support and sales support	A dedicated team of technical support engineers should be on hand to help with all your queries. If commissioning assistance or setup help is required, engineers will help guide you through. Your supplier should be able to assist in all aspects of sales process, helping with specification of options, details of deliveries and information regarding purchase and supply of drives.
Worldwide network	A supplier should offer product and application support, commissioning, service, repair and replacement by ensuring a local presence regardless of location of VSD.
Rapid delivery	Drives available at short notice from local ABB's global stock and from the local partner stock.
Complete product offering	Your drive supplier should be able to help you with associated technology such as motor starters, flowmeters, pressure transducers, power quality filters, contactors, relays, fieldbus solutions and switchgear.
Control panel and system design	If your drives are part of a larger control system, you may want your drive supplier to help design complete overall system.

For more information, please contact
your local ABB representative or visit

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