Wherever space is at a premium

PowerXL DM1 variable frequency drive

E·T·N

Powering Business Worldwide

Eaton – your partner for drive technology.

Whether it's starting a simple machine motor or controlling the speed of complex applications – Eaton has the right drive technology for your needs. The PowerXL™ family offers you the benefit of an optimized device series and a comprehensive range of energy-efficient products for use in numerous applications.

DE1/11 variable speed starter

The DE1/11 frequency-controlled variable speed starter combines ease of use with maximum reliability for your machine. Thanks to the integrated DOL and reversing starter with variable motor speed, the DE1/11 closes the gap between conventional motor starters and variable frequency drives and brings together the advantages of both in a single device.

DC1 variable frequency drive

With its compact design and IP20 and IP66 degree of protection, the DC1 variable frequency drive is particularly suitable for simple pump, fan and material handling applications. It can be quickly and easily commissioned, producing measurable cost savings even with high-efficiency motors (IE3/IE4).

DM1 variable frequency drive

The DM1 variable frequency drive offers the same advantages as the DG1 in a more compact housing with reduced installation depth. As such, it can even be installed in 200 mm housings. The control functions of this IP20 device are primarily designed for use in fan, conveyor belt, pump or multi-pump applications. The DM1, which is also available with IP21 degree of protection, can be used with PM (IE3/IE4) as well as asynchronous motors.

DA1 variable frequency drive

The DA1 variable frequency drive excels in demanding applications due to its high starting torque, powerful vector mode and safe operating conditions with STO functionality. Thanks to the comprehensive on-board communication protocols and the function block editor for customized configurations, the DA1 offers machine builders a maximum level of flexibility.

DG1 variable frequency drive

The DG1 series of variable frequency drives embodies the next generation of the PowerXL family. Thanks to its patented energy-saving algorithm, high short-circuit rating and rugged design, the DG1 offers increased efficiency, safety and reliability. The control, communication and installation options are highly versatile, making the series particularly suitable for use in demanding applications.

9000X variable frequency drive

The 9000X variable frequency drive has been designed for all types of premium applications. Two series are available, the standard SVX drive for controlling simple and complex motors in industrial machine building, and the SPX drive for all premium and high-performance applications.

Application	PowerXL						9000X			
	DB1	DE1	DC1	DM1	DA1	DG1	SVX	SPX	LCX	SPI/SPA
Single-phase power supply	✓	✓	✓	✓	✓	✓	–	–	–	–
Single-phase AC motors	–	–	115/230 V	115/230 V	–	–	–	–	–	–
Performance range: 230 V [kW]	1.5	2.2	11	15	75	90	90	90	–	–
400 V [kW]	4	7.5	22	22	250	630	160	1,100	2,150	1,500
575 V [kW]	–	–	–	22	90	630	132	1,800	2,300	1,800
690 V [kW]	–	–	–	–	–	–	200	2,000	2,800	2,000
OEM drive systems	•	•	•	•	•	•				
Cold plate	•									
HVAC			•		•		•			
General purpose drive				•		•	•			
High-performance drive systems					•			•	•	•
Water cooling									•	
Regenerative										•

The future, now

The demands placed on the machine-building sector are constantly on the rise. For many companies, competitiveness is increasingly dependent on their ability to understand the needs of end customers and to equip their machines and systems with future-proof technology. This is where Eaton comes in, as a globally experienced and competent partner. Whether it's effective individual components, efficient overall solutions or comprehensive global services – Eaton offers products and services that are tailored to the individual needs of each customer.

A focus on drive technology

Eaton's Moeller series of products has been a reliable partner for the machine-building industry for decades. Brands such as PKZ, DIL and RMQ-Titan are a case in point. Our other focus area is drive technology, where we are constantly innovating by adding new products. When it comes to product development, we put special emphasis on the efficiency of your processes and solutions.

Using SmartWire-DT in drive technology

By now, our intelligent connection and communication system SmartWire-DT is successfully established across many different markets and applications. SmartWire helps to identify and optimize workflows in machine building and control-cabinet design. From motor starters, through soft starters and all the way to variable frequency drives – we offer a comprehensive portfolio of SmartWire-DT-compatible devices that we are continuously expanding.

Eaton's machine-building products are suitable for global use.

Eaton assists customers on location in more than 150 countries: www.eaton.eu/electrical/customersupport
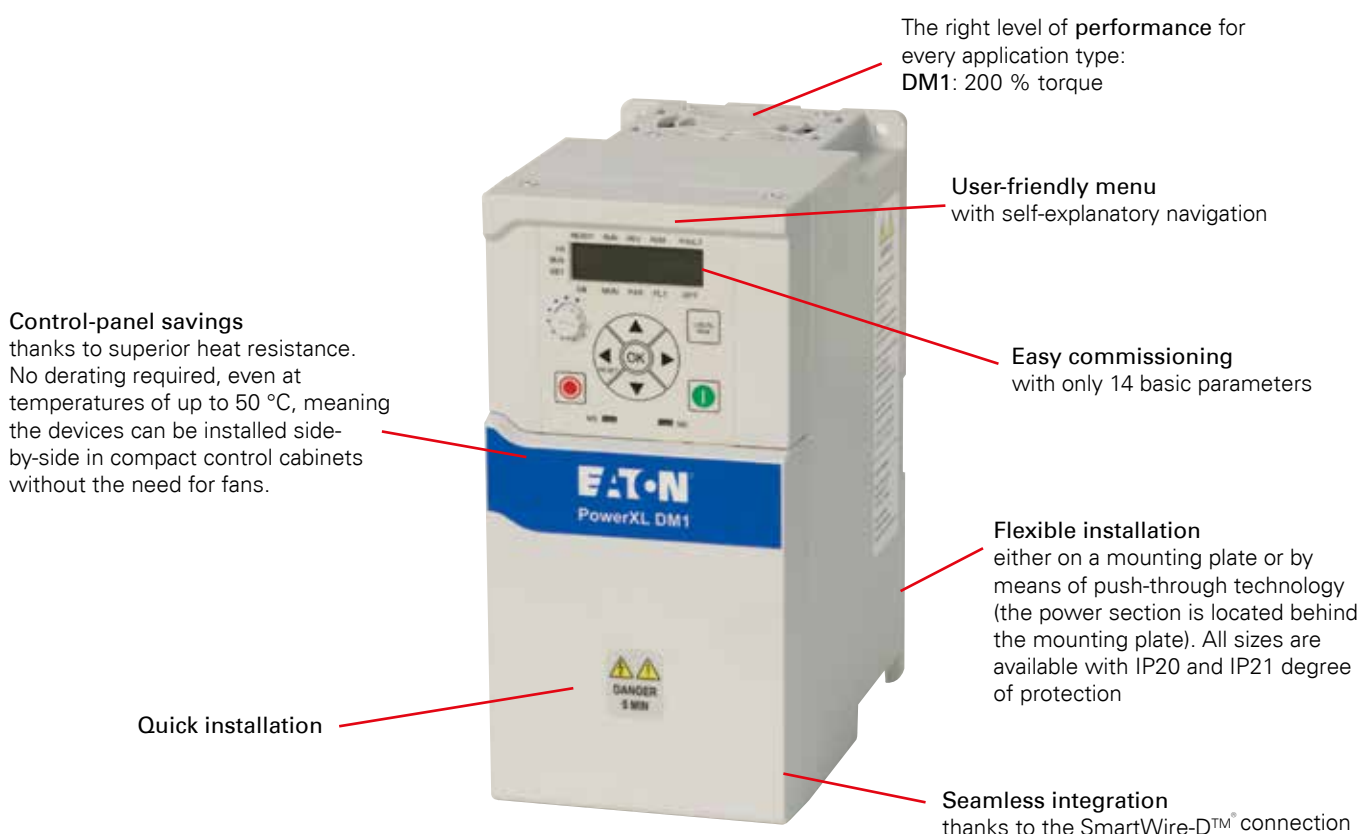
CAD data for our products are available at www.eaton.eu/cad

Interested? Order your copy of our new drive technology catalog now: Antriebstechnik@eaton.com

PowerXL – efficient technology in a compact design.

The DM1, the latest addition to the PowerXL family, is a micro inverter that is especially rugged and easy to use. Designed for use in pumps, fans and conveyor belts as well as in general machine-building applications, the DM1 expands Eaton's product range in a targeted manner. In this way, customers can always select the right product, from simple to complex applications – including the production of standardized systems and more.

The right level of **performance** for every application type:
DM1: 200 % torque

User-friendly menu
with self-explanatory navigation

Easy commissioning
with only 14 basic parameters

Control-panel savings
thanks to superior heat resistance. No derating required, even at temperatures of up to 50 °C, meaning the devices can be installed side-by-side in compact control cabinets without the need for fans.

Flexible installation
either on a mounting plate or by means of push-through technology (the power section is located behind the mounting plate). All sizes are available with IP20 and IP21 degree of protection

Quick installation

EATON
PowerXL DM1

⚠⚠
DANGER
5 MIN

Seamless integration
thanks to the SmartWire-D™ connection

Outstanding technology

Machine building, material handling systems and building services engineering frequently involve the driving of pumps, fans, conveyor belts or compressors. As such, it is particularly important that the applied technologies are both easy to use and energy-efficient. The PowerXL DM1 variable frequency drive has been specially developed for such applications and stands out for its durability, availability and universal functionality.

Rugged design

All the devices are highly resistant to heat and deliver full performance at ambient temperatures of up to 50 °C (IP20 and IP21). Moreover, their 100 kA short-circuit-proof output is currently best-in-class on the market. Exceptionally durable fans and an adjustable fan controller ensure improved reliability. The rugged design of the devices is also evident in their high degree of protection: The models with a power rating of up to 22 kW are available with IP20 and IP21.

Technology that makes work easier

Thanks to the self-explanatory type codes, auto-tune functions, user-friendly configuration with only 14 basic parameters, as well as fast project planning and commissioning, the PowerXL variable frequency drives help to minimize the costs of planning, installation and technical support. They can be programmed using a keypad and an external LCD display, or via a PC. In addition, parameter settings can be quickly copied to other devices using the external keypad.

Integrated potentiometer

The DM1 is available in two versions: The standard version comes without keypad and STO function but with Modbus RTU on board. The Pro version features a 7-segment keypad, an STO (SIL2, PLd, Cat.3) function, Modbus TCP and Bacnet MSTP / IP connections, Bluetooth, and an integrated web server. Both versions are equipped with a connection to the DG1 remote keypad, which displays all parameters in clear and simple English.

The Pro version also has an internal setpoint potentiometer for entering setpoints directly and easily on the device. The operation of the devices does not require any external wiring.

Tough in harsh environments: IP21 degree of protection and enhanced PCB protection

The DM1 devices offer enhanced PCB protection. As a result, the drives are able to withstand harsh environmental conditions, including high levels of humidity and aggressive ambient air. Thanks to their degree of protection (IP21), the devices can also be used in NEMA1 installations.

Optimized configuration

The configuration of the variable frequency drives is quick and easy, thanks to the built-in LCD display.
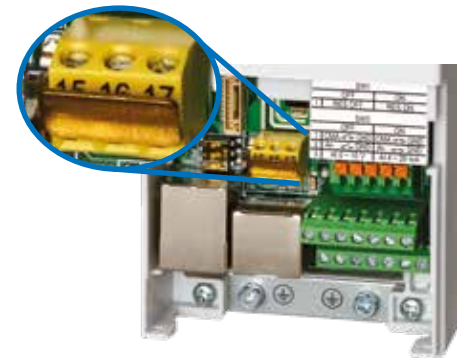
The DM1 devices come with an integrated STO function for emergency stops. Thanks to their yellow color, the STO terminals can be easily identified. What's more, they are also arranged separately from the normal control terminals, in accordance with the applicable safety standards.
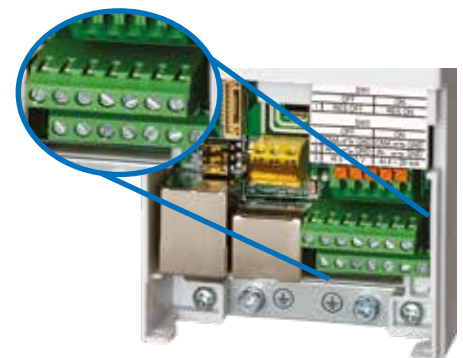
The DM1's compact control terminals make it easy to install and replace the devices.
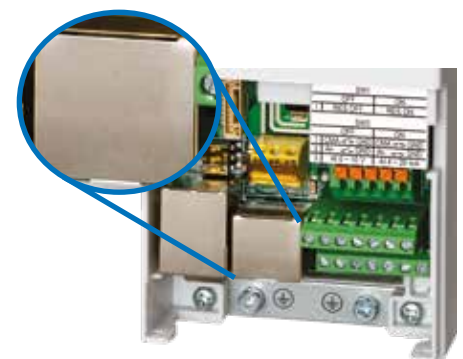
Up to 63 devices can be accessed via the integrated Modbus connection, while the HMI and TCP ports can be used to communicate with an almost unlimited number of devices. EtherNet/IP and Modbus TCP are available as standard.

DM1 – a compact and versatile drive for demanding applications.

The DM1 variable frequency drive is the perfect match for demanding variable-speed and torque-dependent applications. What makes the DM1 stand out is its power range up to 22 kW, its compact size and its high level of functionality. A dual rating is available to adapt the device to the needs of each application: 150 % overload for machine applications, and 110 % for pumps and fans. If an application only requires an overload of 110 %, a DM1 originally configured for an overcurrent of 150 % can also be used to drive a motor with the next higher rating.

The special PCB coating protects against dust, which makes the DM1 suitable for use in drive systems for vibrating screens in cement machines, for example.

Thanks to their cold-weather function, the devices can be safely used in cold environments, for example in outdoor applications.

The DM1 is the ideal choice for all types of fan drives and offers special functions for HVAC applications

Ready for all eventualities

Users have the option to choose from four standard application types with specially tailored parameter sets. The devices can thus be optimally tailored to the requirements at hand – any parameters and functions that are not required will simply be hidden.

Operational straight out of the box

Commissioning starts automatically when the device is switched on for the first time. During this process, users will be prompted to enter the basic application data, such as ramp times, motor specifications, the application type, the menu language and the time of day. The data in question are the same for all PowerXL drives.

Comprehensive functionality

The standard version of the DM1 Pro series covers the power range up to 22 kW and offers a wide range of functions, including Modbus RTU, Modbus TCP, Ethernet IP and Bacnet MSTP protocols, an integrated EMC filter (C2 for public grids) and a braking transistor.

The system includes the following four standard application types:

- standard
- HVAC
- pumps
- multi-purpose

The variable frequency drives can be operated using both sensorless vector control (SLV) and V/f control. Depending on the configuration, the two operating modes support the rated overload operation of the motor at 150 % and 110 %, respectively.

PM motors

In applications where maximum efficiency is required, such as in air-conditioning units or pumps, PM motors are the ideal choice. The DM1 is the right option for these applications and features optimized algorithms for SPM and IPM motors to ensure the best possible result for each motor type. The comprehensive PI controller for the speed control loop enables the fine-tuning of almost any application.

Powerful even at extreme overloads

The DM1 variable frequency drive is particularly strong in the overload range. With sensorless vector control (SLV), the torque can be temporarily increased to up to 200 %, making the DM1 ideal for applications with extreme overload requirements.

Ready for connection thanks to the built-in EMC filter

All DM1 devices come with a built-in EMC filter (category C2) for connection to the public grid in accordance with IEC/EN 61800-3. This eliminates the need for external components with additional wiring and space requirements inside the control cabinet.

No derating up to 50 °C

All DM1 series devices with IP20/IP21 degree of protection can be operated at ambient temperatures of up to 50 °C without derating, meaning they can operate at their full rated current. This enables machine builders and system integrators to achieve significant cost savings if no higher ambient temperatures are to be expected: There is no need to invest in additional ventilation, while the option to install the drives side-by-side saves space and costs because smaller control cabinets can be used.

Modules for all common fieldbus types are available.

The DM1 comes with a 7-segment LCD display as standard.
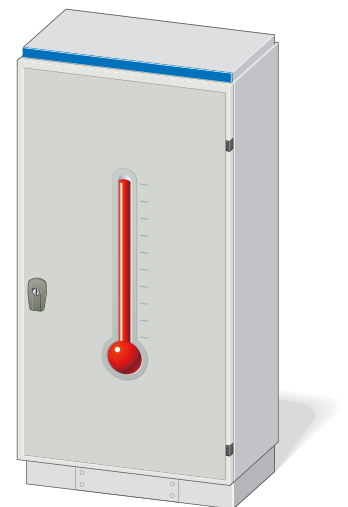
Power management

Energy saving function

The DM1's active energy control function minimizes energy losses through a patented process that dynamically adjusts the V/f curve to optimize efficiency. Compared to other out-of-the-box solutions, this enables energy savings of 2-10 %.

Energy cost calculator

The integrated energy cost calculator facilitates a direct comparison to conventional contactor-control systems. Once the energy costs of the local utility have been entered, it becomes immediately apparent how much money the operation of the DM1 has already saved. This makes it possible to keep operating costs (OPEX) under control at all times.

U/f energy savings in %
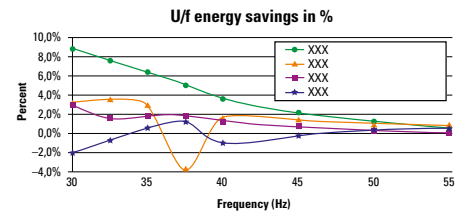
PI controller

Integrated cascade control

The DM1 is equipped with a user-configurable PI controller with extensive functionality. Setpoints, actual values and feedback can be changed during operation, in line with the requirements of the application, in order to maximize productivity and product quality without the need for any additional external controllers.

Adjustable display of process variables

In addition to percentage values and frequencies, process variables such as the pressure, flow rate, production speed or any other data relating to the application can be displayed directly. This eliminates complicated and error-prone conversions of technical variables such as frequencies into application-specific values.

Automatic sleep mode

If the pressure of a pump falls below a preset value, it can be automatically put into sleep mode to prevent it from idling. This reduces wear as well as energy and other costs.

Pumps and fans

Multi-pump drives

For water/wastewater applications, different modes are available to control and regulate systems consisting of several pumps. Since the DM1 uses the built-in PI controller for level and pressure control, there is no need for any external controller. The DM1 can control one or more master or back-up drives, while the real-time clock can also be used for runtime compensation of all pumps. This level of versatility not only reduces equipment costs but also increases system availability and efficiency.

Cold weather mode

The DM1 is also suitable for use in extreme weather conditions. It is heat-resistant up to 50 °C and comes with a special cold weather mode that allows it to operate at temperatures as low as -30 °C without the need for any external heating systems. As such, the DM1 is the perfect choice for outdoor applications involving extremely low temperatures.

Fire mode

If used for fire protection in buildings or in sensitive structures such as tunnels, the DM1 can be operated in fire mode. In this mode, internal safety features that would normally shut down the device are disabled to ensure that fire pumps and smoke ventilation systems remain operational. The fire mode can be configured using a comprehensive range of options, including fixed setpoints, switchable setpoint inputs and fail-safe activation.

Manual/automatic operation

Operators can switch between manual and automatic operation by means of a control command or via the keypad, enabling them to intervene in the control system at any time.

Connections made easy

Control terminals for all analog and digital connections

The basic version of the DM1 features a comprehensive range of analog and digital I/Os, including:

- 1 analog input
- 1 analog output
- 4 digital inputs
- 1 digital output
- 2 relays, including 1 changeover relay
- STO (Safe Torque off), SIL2, PLd, Cat.3

With safe torque off (STO), the Pro version of the DM1 provides the most basic drive-integrated safety function. This function not only ensures that the motor will remain torque-free when necessary, but also prevents accidental starting, for simple and cost-effective compliance with the EU's Machinery Directive.
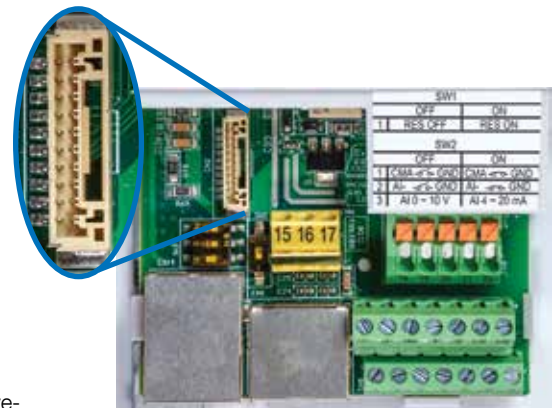
A slot for expanding the communication capabilities is also available.

Can be expanded as required

The DM1 comes with a slot for expansion cards.

To keep the size of the standard device to a minimum, all options are flanged externally. At present, the DM1 supports the same network cards as the DG1:

- Profibus
- CANopen
- Device Net
- Profinet is currently in preparation

Additional expansion cards from the DG1 range will follow (I/O expansions).

A real knack for communication

Comprehensive on-board interfaces and protocols

Constantly growing communication requirements present machine builders and system integrators with major challenges. That's why the DM1 comes with the Modbus RTU, Modbus TCP, Ethernet IP and BACnet MSTP protocols as standard. As a result, the devices can be networked immediately without the need for any additional hardware, for smooth integration into existing communication networks.

By means of option cards, the DM1 can also be expanded with the Profibus, CANopen and DeviceNet protocols for the North American market, as well as with a WLAN or GSM connection.

In addition to a Bluetooth connection, the DM1 Pro also features an integrated web server. Thanks to the web server, configuring the device couldn't easier. The handling is almost identical to that of the inControl software, which can also be used for communication with the DM1 Standard.

Remote control and maintenance can thus be easily implemented via any approved IP connection. It goes without saying that the DM1 also comes with IP address control to block any unauthorized access.

The devices are equipped with numerous on-board communication protocols.

Internal web server

Never install the wrong program again

Thanks to the internal web server, the DM1 can be configured without installing any software. Updates or incorrect versions are therefore a thing of the past.

Like the PowerXpert inControl software and the integrated startup wizard, the web server queries the most important data first. In the case of simple applications, this means that all necessary settings will be covered.

Monitoring and diagnostics

All essential parameters at a glance

The monitoring menu shows the latest actual values and status messages to provide a quick overview of the functioning of the application. For a better overview, the monitoring values are also displayed by means of a menu structure, so that the important values are clearly visible while any unnecessary ones are hidden.

Menu structure

**One menu for both the web server and the keypad**

The symbols are intuitive and self-explanatory, and the parameters and menu structure of the device display, the external DG1 keypad and the PowerXpert inControl software are identical. Seamless integration.
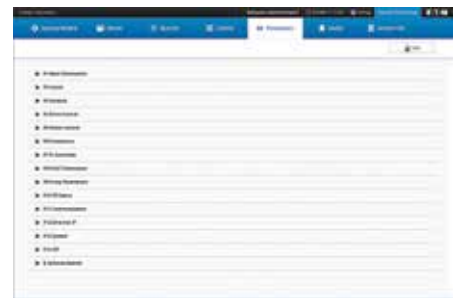
System settings

Setting the time and communication parameters

All DM1 device parameters can either be set via a direct connection or via the local network. The input screens are similar to those of the PowerXpert inControl software, so there is no need to become familiar with a new operating method.
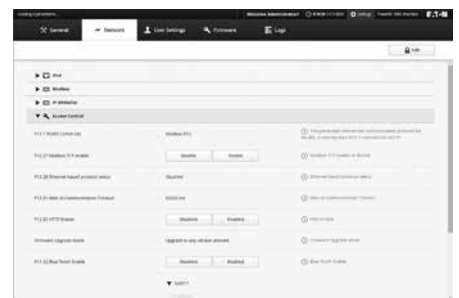
Adjusting the settings

The edit mode prevents unintentional changes

In edit mode, the display changes slightly, so that any editable values can be edited. After the "save" command has been issued, all values will return to read-only mode. This prevents any unintentional changes.
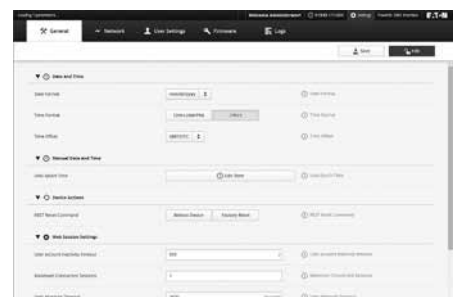
Motor and system protection

Flying start

Thanks to its motor pick-up function, the DM1 can "catch" spinning motors that were driven by a load before the drive itself was operational. This so-called flying start function catches the motor at its current speed and then brings it to the selected setpoint, which minimizes downtime during operation.

Skip frequencies

To prevent mechanical resonances in the application, up to three frequency bands can be hidden in which stationary operation will not be allowed. This reduces wear on the mechanical components and minimizes maintenance.

Motor identification run

Modern sensorless vector control requires additional data that go beyond those provided on the nameplate. This is why the DM1 comes with a built-in motor function for motor identification run, which makes it possible to easily and automatically detect any information that is missing from the nameplate without damaging the system in any way.

Electronic motor overload protection

The motor protection function monitors the motor temperature to protect it from overload. Using just one parameter, this makes it possible to set protection levels from CLASS 5 all the way to higher trip classes such as CLASS 40, which eliminates the need for external motor protection relays.

It is also possible to limit the motor current or to initiate additional actions including shutdown if certain adjustable signal thresholds are reached.

Stall prevention

An overload will cause the motor to stall, resulting in a dramatic drop in speed and possibly a standstill. The DM1 can detect this state before it occurs and will automatically take countermeasures to keep the motor and thus the application safely under control.

Password protection

Given the more than 700 adjustable parameters, trying to identify any values that have been inadvertently modified can be tedious without the help of a PC. For this reason, the parameters can be protected against unintentional or unauthorized changes by means of a password. While the parameters can still be viewed, they cannot be changed without knowledge of the password, which significantly increases operational safety.

Brake chopper

If a load with large inertia needs to be decelerated or supplies too much regenerative energy, the drive speed can be adjusted to the setpoint value using a brake chopper and an external brake resistor. Some application standards require the machine to be shut down for specified, usually very short periods, in which case a brake chopper is the ideal solution. The DM1 comes with a brake chopper as standard.

Flux brake

As an alternative to the brake chopper, a so-called flux brake is also available, which uses the motor's own magnetic field for electric braking and dissipates the braking power via the motor.
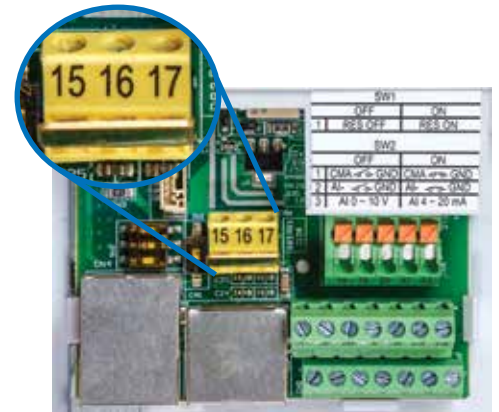
The integrated STO (safe torque off) safety function eliminates the need for a mains contactor.

Only a few parameters need to entered to set up the motor and the motor protection system.

In addition, the control and power terminals are easily accessible.

Operation made easy

Fixed frequencies

If operation at preset speeds is required, up to eight fixed frequencies can be set, which are then preselected via the digital inputs. This ensures that there are no temperature-dependent deviations, which could easily occur if a setpoint potentiometer were used.

Switchable ramp times

Some processes require different ramp times, such as conveyor belts in distribution centers, which must decelerate very quickly to ensure that loads are transferred as smoothly as possible to the next downstream belt. For this purpose, the DM1 offers two switchable ramps that

can be individually configured as S ramps, to allow for the kind of extra smooth transitions required by elevators and escalators.

Multi-motor applications

Even load distribution

If an application is driven by several mechanically coupled motors, the load must be distributed equally across all drives. To this end, it is possible to set a torque setpoint, in which case the master drive will provide the slaves with the actual torque value. This eliminates the need for a complex, external controller.

Equal speed

If several motors need to run at the same speed (indirectly coupled motors), it is not enough to simply specify an identical speed reference value, since deviations may arise as a function of both speed and load. The DM1 offers correction functions that are designed to counteract both types of errors in order to synchronize motor

speeds in a stable and controlled manner.

A real knack for monitoring

All data at a glance

The DM1 offers eight programmable values for application monitoring. If one of the set thresholds is reached, the drive can react in a targeted manner by activating a specific function or sending a signal to the higher-level control system. This can either be done via the relay output or via a communication link.

Ready to handle any fault

For almost all types of errors that the DM1 detects, it is possible to configure individual responses, from shutting down with a fault message to issuing a warning or simply ignoring the fault. As a result, specific application characteristics or environmental conditions can be individually taken into account.

Application-specific faults

The DM1 can be configured for up to three external errors. To ensure that these errors are not "faceless" and thus meaningless, it is currently possible to configure up to 12 different texts for external error messages. This allows operators to immediately recognize which type of error is present.

Fault log

Whenever there is a shutdown, it is crucial to know when and why it happened. This is where the fault log comes in. To speed up diagnostics and reduce downtime, maintenance personnel can also read the fault log remotely.

Automatic restart

The automatic restart function minimizes downtime by eliminating the need to stop the system every time there is a fault. If this function is active, the DM1 will attempt to reset the fault and will restart automatically at specified intervals. It is possible to define the number of times that a restart should be attempted for almost every type of error, so that a service call can be avoided in many cases.

Flexible short-circuit protection

When it comes to EN61800-5-1, the DM1 is a true trailblazer, both in terms of compliance with the standard and the components required.

The DM1 is designed so that no line choke is required to comply with this standard. Users can select the type of protection device they need in line with the system requirements, which saves components, space and costs.

FAZ circuit breaker

The FAZ series of miniature circuit breakers is suitable for applications with short-circuit currents of up to 10 or 14 kA. These devices protect the supply cables, while motor protection is provided by the DM1 drive.

PKZ and PKE motor protective circuit breaker

The PKZ can be used for applications up to 65 kA. As with the FAZ, motor protection is provided by the DM1 variable frequency drive, so that the motor protection function of the PKZ or PKE can be deactivated.

Fuses

For protection against even higher short-circuit currents, fuses need to be used, which can handle short-circuit currents of up to 100 kA. As a result, we can offer a cost-effective solution for every requirement.


Energy efficiency

A growing number of applications require the calculation of a system's energy efficiency, for which the DM1 delivers the necessary data. The relevant values are measured in accordance with EN61800-9-2. As part of the ongoing efforts to "go green", these data are increasingly in demand, and the DM1 is ready to deliver.

Power Xpert inControl – the Eaton platform for easy configuration.

The Power Xpert inControl software is a powerful commissioning tool for the PowerXL family. Besides configuration and diagnostics, the software can also be used to configure and read out the DM1's built-in oscilloscope, making it possible to obtain plots for up to eight channels using 10 ms intervals. The Power Xpert inControl platform is not only used for the DM1, but also for the DG1, DH1 and C445 series.
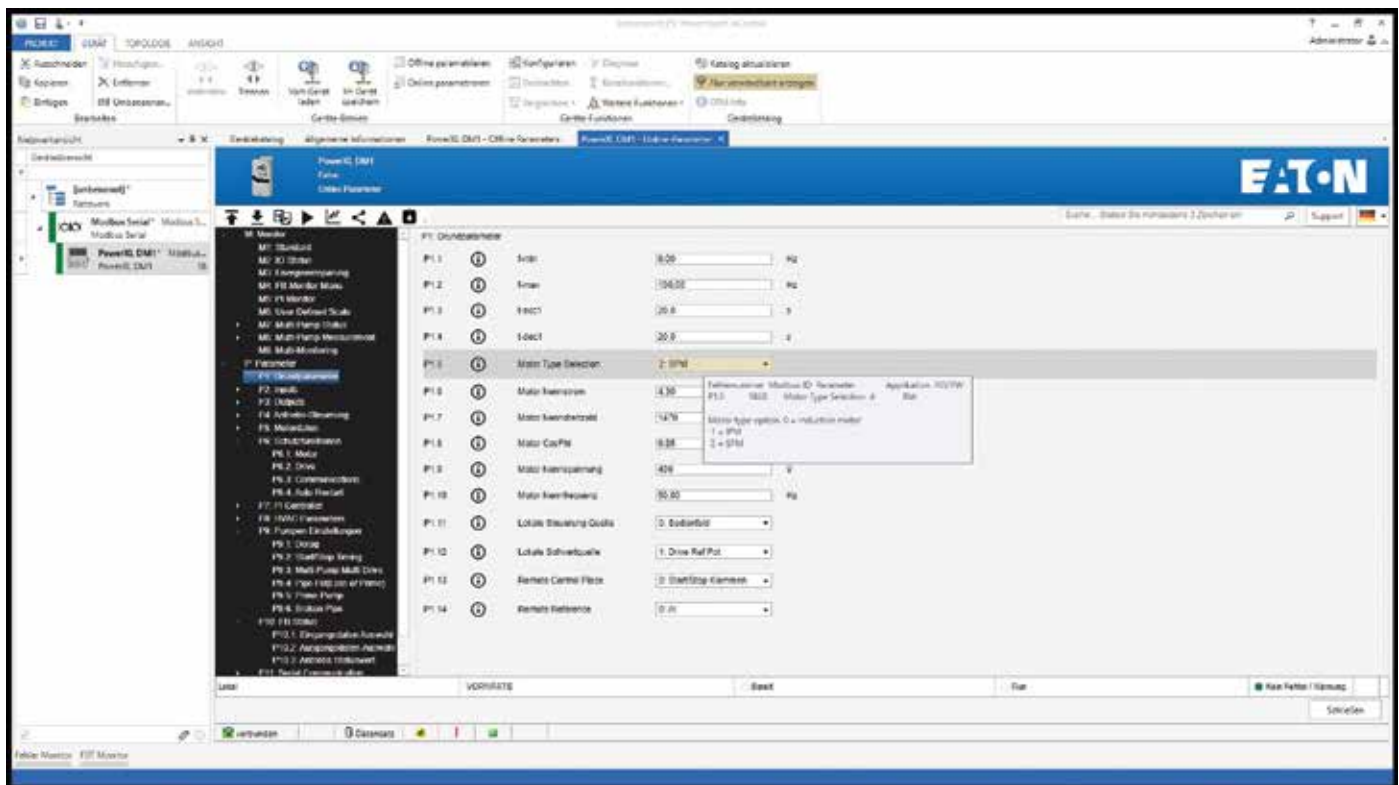
A serial and an Ethernet port are available

The connection to a PC can either be established via a serial RS485 port or via Ethernet. The DM1 comes with both types of hardware interfaces, for which Power Xpert inControl also provides the necessary drivers. Users are thus free to choose the interface they need. Moreover, Power Xpert inControl can also be used to control the DM1 via Bluetooth.

Configuration

Online and offline

The configuration user interface is simple and user-friendly. With the help of the editor function, users can configure the drives either online or offline, while the online mode also gives them to option to use monitoring data for diagnostics.

Built-in oscilloscope

Faster analytics in 10 ms intervals

If used together with Power Xpert inControl, the DM1 can plot up to 8 signals at the same time. However, most serial PC connections only allow for data to be sampled at relatively large time intervals, which is why the DM1 also features a built-in 8-channel oscilloscope. This enables the analysis of faster processes at 10 ms intervals, while the Power Xpert inControl software provides comprehensive options for configuring the oscilloscope and selecting trigger signals.
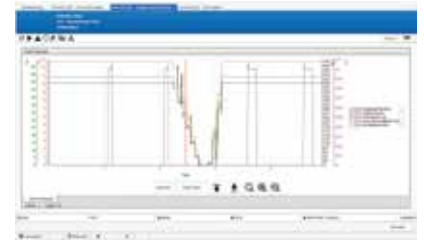
Comparing and documenting data sets

Online and offline

By means of the comparison function, the DM1 can quickly and easily compare a large number of parameters against a second data set. These data can be quickly and easily inserted into a spreadsheet program and filtered according to changed/different parameters – regardless of whether the comparison data comes from another device or from a stored or standard data set. This ensures that all changes are reliably documented, without the need for time-consuming scrolling through all parameters.

Exceptional memory

Tracking changes made easy

Did you accidentally make any changes? Or do you need to figure out why the drive suddenly stopped operating?

The DM1 stores the most recent 100 parameter changes including time stamps, which can then be read out and displayed by means of the Power Xpert inControl software.

This makes it easy to undo any unwanted changes.

PC connection

Cable (Modbus RTU):

Via Modbus RTU and a USB connection, up to 63 drives can be connected to a PC, and can then be easily configured using the Power Xpert inControl software.

Cable (Modbus TCP):

Via an Ethernet cable, almost any number of variable frequency drives can be connected to a PC, and can then be easily configured using the Power Xpert inControl software.

**Bluetooth wireless connection:**

The DM1 Pro can also communicate with PowerXpert inControl via Bluetooth, with access to all the functions that are available via a cable connection. This means that there is no need to open the control cabinet or to connect any cables, which increases safety when working on the machine during operation.

Selection aid

Efficient planning and engineering

Thanks to the selection aid, planning is easy, enabling you to select the right drive for your application, as well as the associated switchgear, protective devices, chokes and filters, including the relevant part numbers.

www.eaton.eu/selectiontools
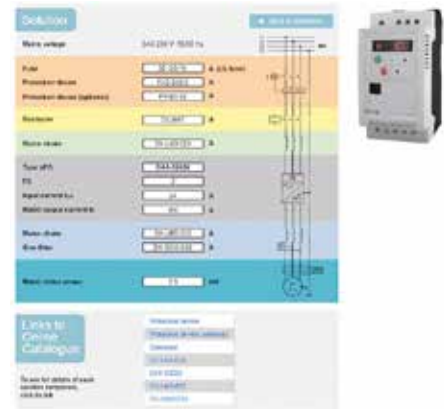
Harmonic feedback

Harmonic feedback into the mains

The Harmonics Estimator can be used to calculate the system's harmonic feedback into the mains. The tool can map the entire system, from the supply transformer to the connected variable frequency drives, in order to generate a comprehensive report.

electricalsector.eaton.com/forms/HarmonicsCalculator

Measuring energy savings

The Energy Savings Estimator is able to calculate the expected energy demand using just a few parameters, such as the motor data, load profile and operating hours.

The following types of savings are displayed:

- energy savings
- CO2 savings
- financial savings

In addition, the energy savings report features a choice of visualization options, including diagrams.

www.eaton.de/EnergySavingsEstimator

Application examples

On the following pages, we will present examples of the types of applications that the DM1 can support. While these examples illustrate only a small selection of the possible applications, they provide a good overview of the many possibilities offered by the DM1.

Featured applications:

- Booster pumps
- Refrigeration compressors
- Fire pumps
- Conveyor belts
- Screw conveyors (biogas plants)
- Fans

Reducing the costs of booster-pump operation

A dual rating is available to adapt the DM1 to the specific requirements of booster-pump applications: 150 % overload for machine applications, and 110 % for pumps and fans. If an application only requires an overload of 110 %, a DM1 originally configured for an overcurrent of 150 % can also be used to drive a motor with the next higher rating.

Outstanding system reliability

Automatic restart – this function automatically brings critical pumps back online after a power failure to reduce downtime and potential system errors.

Cleaning function – this function uses the real-time clock to automate the pump cleaning schedule to prevent deposits and clogging.

Water hammer reduction – this function protects against water hammer and cavitation by means of smooth ramp times and a pressure regulator.

Cold weather mode – this function facilitates the operation of pump stations even in extremely cold conditions without any external heating.

Energy savings in pump applications

Energy-saving function – the patented energy-saving function minimizes energy losses by dynamically adjusting the V/f curve in order to optimize efficiency. Conventional static approaches are unsuitable for this type of application, since load fluctuations will have immediate effects on load stability.

Sleep mode – this mode prevents continued rotation of the pump when the pressure drops below a preset value and the pump is no longer delivering. The automatic stopping of the pump reduces energy consumption, wear and costs.

Single-phase supply – this function enables the use of the DM1's full functionality even in single-phase operation (derating required).

Password protection – once this function has been activated, no further changes to the configuration can be made without entering the password, which is a mandatory requirement for safety-related applications.

Skip frequencies – this function reduces vibration and noise in speed ranges where the pump generates mechanical resonance.

Stall prevention – this function stops the motor and pump if the pressure rises sharply, for example when a return valve is closed.

Advanced fault handling – the fault log records the 8 most recent fault events, together with a time stamp and the system data at the time of the fault. This simplifies troubleshooting as well as maintenance and servicing.

Advanced pump control

Multi-pump drives – this function enables precise flow-rate control across a wide range by switching additional pumps on and off and alternating them to ensure equal running times.

1 PI controller – this function controls the pump system using the integrated PI controller, which reduces the need for external controllers.

Motor identification run – this function automatically determines the required motor parameters for improved performance and efficiency to match the current pump configuration.

Flying start – this control function ensures that the drive will smoothly "catch" a running motor, regardless of the direction of rotation, in order to reduce the mechanical load on the impeller.

System management and communications

Display of process variables in the PI controller – this function simplifies handling by making it possible to display the flow rates directly on a pump and to monitor them via the motor menu.

Communication – the comprehensive range of on-board protocols, including Modbus RTU, Modbus TCP, EtherNet/IP, and BACnet MS/TP, as well as the option of adding expansion cards for PROFIBUS, CANopen and DeviceNet, facilitate integration into all major network types.

Energy Savings Estimator – this function calculates the current energy costs and savings as compared to a DOL starter.

Track changes – the integrated log function supports troubleshooting during servicing, which reduces downtime and facilitates diagnostics in the event of unwanted changes.

Pumps and compressors

Refrigeration compressors

For refrigeration compressors, the DM1 variable frequency drive relies on the 110 % overload configuration. Sensorless vector control can be used as an alternative to V/f control, which yields optimum results in conjunction with the energy-saving function.

Advanced compressor control

Commissioning made easy thanks to the startup wizzard – only a few parameters are required to get the DM1 up and running, and the devices can usually be used straight away without any additional configuration, saving both time and commissioning costs.

PI controller – the built-in PI controller maintains a constant level of system pressure by continuously controlling the speed based on real-time data.

Display of process variables in the PI controller – this function simplifies handling by making it possible to display the flow rates directly on the compressor and to monitor them via the motor menu.

Maximum performance and system efficiency

Energy-saving function – the patented energy-saving function minimizes energy losses by dynamically adjusting the V/f curve in order to optimize efficiency. Conventional static approaches are unsuitable for this type of application, since load fluctuations will have immediate effects on load stability.

Smooth start – control algorithms and the motor identification function enable smooth starting. This protects the mechanical components and effectively suppresses inrush current peaks, as well as reducing peak-load demand.

Variable speed – this function makes it possible to adapt to varying demand, to reduce energy costs and improve system efficiency.

Comprehensive on-board I/Os – the DM1 comes with 4 DIs, 1 AI, 1 AO and 2 relays, each of which can be programmed with numerous functions. These I/Os provide maximum flexibility for application control while simultaneously reducing the need for external controllers.

Reliability and easy maintenance

Resistant to dust and aggressive gases – all PCBs of the DM1 variable frequency drives feature a protective coating that makes them resistant to dust and aggressive gases. This eliminates the need for expensive, protected enclosures to keep out any dust generated in the vicinity of the machine.

Advanced fault handling – the fault log records the 8 most recent fault events, together with a time stamp and the system data at the time of the fault. This simplifies troubleshooting as well as maintenance and servicing.

System management and communications

Communication – the comprehensive range of on-board protocols, including Modbus RTU, Modbus TCP, EtherNet/IP, and BACnet MS/TP, as well as the option of adding expansion cards for PROFIBUS, CANopen, and DeviceNet, facilitate integration into all major network types.

Always safe – the STO input in standard safety yellow simplifies integration in accordance with the EU's Machinery Directive. In the event of unwanted blockages in the system, for example if a coolant line is pinched or a diverting valve fails, the system must be shut down safely to prevent the coolant lines from bursting.

Individual configuration of fire pumps

Fire pumps are subject to special requirements. Ideally, these pumps should never have to be used, but in an emergency, they need to be ready for use beyond the limit. They therefore need to be especially rugged while preventing shutdowns in the event of a fault.

System control

Skip frequencies – this function reduces vibration in speed ranges where the pump generates mechanical resonance.

Password protection – once this function has been activated, no further changes to the configuration can be made without entering the password. This protects critical applications against unauthorized access.

Track changes – the integrated log function supports troubleshooting during servicing, which reduces downtime and facilitates diagnostics in the event of unwanted changes.

Flying start – this motor control function ensures that the drive will smoothly "catch" a running motor, regardless of the direction of rotation, in order to reduce the mechanical load on the impeller.

Motor control

Fire mode – the DM1 can be used to operate fire pumps and smoke extraction systems in buildings or tunnels. When this mode is enabled, faults do not lead to shutdown and a fixed direction of rotation can be specified. The DM1 will operate as long as necessary, even beyond the normal load limits of the device.

Fire mode test – in order to test a system under safe conditions, the DM1 features a fire mode test function to simulate an emergency situation while all protective functions remain operational.

Outstanding reliability

Rugged design

All devices deliver full power at ambient temperatures of up to +50°C (IP21) and are equipped with an output that is short-circuit proof up to 100 kA – the best in its class.

Exceptionally durable fans and an adjustable fan controller ensure improved reliability.

The rugged casing and the mechanical components are designed to continue working even under extreme loads. To identify and eliminate any weak points, the devices have been subjected to numerous tests that go well beyond the permissible ambient and operating conditions.

System management and communications

Communication – the comprehensive range of on-board protocols, including Modbus RTU, Modbus TCP, EtherNet/IP, and BACnet MS/TP, as well as the option of adding expansion cards for PROFIBUS, CANopen, and DeviceNet, facilitate integration into all major network types.

Safe and reliable handling of material on conveyor belts

Sensorless vector control can maintain constant speeds even in the event of load fluctuations, making it the technology of choice in conveyor belt applications. Since overloads can occur during operation, the configuration with 150 % overload and linear characteristic curve is ideal for such applications.

Conveyor belt motor control

200 % starting torque – this function provides additional torque for starting a fully loaded or inclined conveyor system.

Speed and torque control – this function uses the parameters from the motor identification run to enable accurate control with different loads.

STO input – the STO input in standard safety yellow simplifies integration in accordance with the EU's Machinery Directive.

DC braking – this function can bring even large centrifugal masses to a standstill without any external braking resistors.

Skip frequencies – this function reduces vibrations in speed ranges in which the conveyor belt generates mechanical resonance.

System control

Joystick operation – this function makes it possible to manually move conveyed material to a (starting) position.

Advanced fault handling – the fault log records the 8 most recent fault events, together with a time stamp and the system data at the time of the fault. This simplifies troubleshooting as well as maintenance and servicing.

The Terminal to Function Logic enables a simple assignement of inputs to a function. This logic prevents from complex relations of multi-function inputs that can execute multiple functions with only one signal.

Eight fixed frequencies – the digital inputs can be used to define set speeds to ensure that everything runs smoothly.

Controlled acceleration and deceleration – this function reduces the load on the mechanical components, especially if the S ramp is used, which in turn minimizes mechanical wear and extends the service intervals. A second set of ramp parameters is available for transferring loads to the next conveyor belt as smoothly as possible.

Load-drop monitoring – this function immediately detects if an unexpected load drop occurs, for example due to a broken conveyor chain, and brings the system to a safe stop to prevent any further damage.

Stall prevention – in the event of an overload, this function can respond more quickly than overcurrent protection, for example if a conveyor belt or other material handling system is overloaded. Enhanced system protection.

System management and communications

Communication – the comprehensive range of on-board protocols, including Modbus RTU, Modbus TCP, EtherNet/IP, and BACnet MS/TP, as well as the option of adding expansion cards for PROFIBUS, CANopen, and DeviceNet, facilitate integration into all major network types.

SmartWire-DT integration – almost any number of modules can be integrated via the SWD gateways, as the gateway only requires one address.

The ideal solution wherever sheer power is required – screw conveyors

Extruders and screw conveyors require larger torques than most other applications. If a machine is cold or the material being conveyed has compacted, extreme overloads will occur.

The DM1's sensorless vector control (SLV) provides up to 200 % torque for short periods of time, making the devices ideal for applications with extreme overload requirements.

Motor control

200 % peak torque – in addition to providing 150 % overload for 60 seconds every 10 minutes, the DM1 can also deliver 200 % peak torque for 2 seconds every 20 seconds in critical situations. As such, the DM1 variable frequency drive is ideal for applications with extreme overload requirements. The DM1 will also detect if even this peak torque is not enough to run the application, and will safely switch off with an error message before the device or machine is damaged.

Motor identification run – this function automatically determines the required motor parameters for improved performance and efficiency to match the current drive configuration.

Extruder protection

Stall prevention – in the event of an overload, this function can respond more quickly than overcurrent protection, for example if material is jammed. Enhanced system protection.

Electronic motor overload protection – in demanding environments and applications, it is essential that the motor protection functions properly in order to prevent motor damage. To this end, the DM1 offers flexible programming of the motor protection functions.

System safety

STO input – the STO input in standard safety yellow simplifies integration in accordance with the EU's Machinery Directive.

Biogas plants are subject to stringent safety requirements. For example, emergency shutdowns are required in the following situations:

- If the gas pressure drops below the minimum threshold
- If the maximum permissible gas pressure is exceeded
- If an emergency-stop button has been activated
- If the control power drops out
- If the gas detection or fire alarm system is triggered
- If the temperature monitoring systems are triggered (ambient air, coolant, etc.)
- If the ventilation system fails
- If the maximum speed is exceeded

The safe torque off function (the STO input) can handle these requirements without any problems.

Automatic restart – this function automatically brings screw conveyors back online after a power failure to reduce downtime and potential system errors.

Energy-efficient ventilation systems

While machine applications require configurations with 150 % overload, 110 % is sufficient for fan applications. This means that a DM1 with the next lower power rating can be selected to reduce acquisition costs.

Saving energy in fan applications

Energy saving function – in fan applications, energy savings are one of the top priorities. The DM1's energy saving function helps to meet this requirement and to minimize unnecessary partial load losses.

The active energy-saving function minimizes energy losses by dynamically adjusting the V/f curve in order to optimize efficiency. Conventional static approaches are unsuitable for this type of application, since load fluctuations will have immediate effects on load stability.

The integrated energy saving function reduces losses by 2-10 % compared to most standard configurations.

Energy cost calculator – the integrated energy cost calculator provides a direct comparison to conventional control systems (DOL). This enables instant checks of how much money the DM1 has saved compared to a DOL solution, as well as the total costs incurred by the operation of the drive.

System protection

Belt-break monitoring – thanks to the underload detection function, the drive will react safely if a belt breaks. Should a belt be broken, the application will no longer operate, but the motor will run at maximum speed. The DM1 is able to detect this and will safely switch off the motor, thereby preventing unnecessary wear.

Electronic motor overload protection – in demanding environments and applications, it is essential that the motor protection functions properly in order to prevent motor damage. To this end, the DM1 offers flexible programming of the motor protection functions.

Skip frequencies – this function reduces vibrations in speed ranges in which ventilation systems generate mechanical resonance.

System control

Manual/automatic operation – operators can switch between manual and automatic operation by means of a control command or via the keypad, enabling them to intervene in the control system at any time.

Automatic restart – in the event of small voltage drops or short power outages, the fan does not need to be shut down. The automatic restart function automatically brings the fan back online after a power failure in order to minimize downtime and potential system faults.

Flying start – this motor-control function ensures that the drive will smoothly catch a running fan regardless of the operating direction, reducing the mechanical load on the fan wheel in the process.

Display of process variables in the PI controller – this function simplifies handling by making it possible to display the flow rates directly on a pump and to monitor them via the motor menu.

Sleep mode – this mode prevents continued rotation of the fan when it is no longer delivering. The automatic sleep mode reduces energy consumption, wear and costs.

PM motor control – permanent magnet (PM) motors allow for machines that are particularly efficient due to significantly lower losses in the partial load range. In addition, PM motors are synchronized with the supply frequency and thus enable highly accurate control.

System management and communications

Communication – the comprehensive range of on-board protocols, including Modbus RTU, Modbus TCP, EtherNet/IP, and BACnet MS/TP, as well as the option of adding expansion cards for PROFIBUS, CANopen, and DeviceNet, facilitate integration into all major network types.

Extensive on-board I/Os – the DM1 comes with 4 DIs, 1 AI, 1 AO and 2 relays), each of which can be programmed with numerous functions, thereby providing maximum flexibility for application control while reducing the need for external controllers.

SmartWire-DT integration – almost any number of modules can be integrated via the SWD gateways, as the gateway only requires one address.

Energy Savings Estimator – this tools enables the estimation of cost savings in advance.

Harmonics Estimator – this tool makes it possible to calculate the harmonic feedback on the grid.

DM1, all types

150 % OL			110 % OL				DM1 with EMC filter	DM1 without EMC filter	DM1 Pro with EMC filter		DM1 Pro without EMC filter	
P$_H$ [kW]	P$_H$ [HP]	I$_H$	P$_L$ [kW]	P$_L$ [HP]	I$_L$	Size	3~ supply	3~ supply	1~ supply	3~ supply	1~ supply	3~ supply
100 - 120 V												
0.18	0.25	1.6	0.37	0.5	3	1			DM1-111D6EB-S20S-EM		DM1-111D6NB-S20S-EM	
0.37	0.5	3	0.55	1	4.8	1			DM1-113D0EB-S20S-EM		DM1-113D0NB-S20S-EM	
0.55	1	4.8	0.75	1.5	6.9	2			DM1-114D8EB-S20S-EM		DM1-114D8NB-S20S-EM	
0.75	1.5	6.9	1.1	2	7.8	2			DM1-116D9EB-S20S-EM		DM1-116D9NB-S20S-EM	
208 - 240 V												
0.25	0.25	1.6	0.55	0.5	3	1	DM1-321D6EB-N20B-EM	DM1-321D6NB-N20B-EM	DM1-121D6EB-S20S-EM	DM1-321D6EB-S20S-EM	DM1-121D6NB-S20S-EM	DM1-321D6NB-S20S-EM
0.55	0.5	3	1.1	1	4.8	1	DM1-323D0EB-N20B-EM	DM1-323D0NB-N20B-EM	DM1-123D0EB-S20S-EM	DM1-323D0EB-S20S-EM	DM1-123D0NB-S20S-EM	DM1-323D0NB-S20S-EM
1.1	1	4.8	1.5	2	7.8	1	DM1-324D8EB-N20B-EM	DM1-324D8NB-N20B-EM	DM1-124D8EB-S20S-EM	DM1-324D8EB-S20S-EM	DM1-124D8NB-S20S-EM	DM1-324D8NB-S20S-EM
1.5	2	7.8	2.2	3	11	2	DM1-327D8EB-N20B-EM	DM1-327D8NB-N20B-EM	DM1-127D8EB-S20S-EM	DM1-327D8EB-S20S-EM	DM1-127D8NB-S20S-EM	DM1-327D8NB-S20S-EM
2.2	3	11	4	5	17.5	2	DM1-32011EB-N20B-EM	DM1-32011NB-N20B-EM	DM1-12011EB-S20S-EM	DM1-32011EB-S20S-EM	DM1-12011NB-S20S-EM	DM1-32011NB-S20S-EM
4	5	17.5	5.5	7.5	25	2	DM1-32017EB-N20B-EM	DM1-32017NB-N20B-EM	DM1-12017EB-S20S-EM	DM1-32017EB-S20S-EM	DM1-12017NB-S20S-EM	DM1-32017NB-S20S-EM
5.5	7.5	25	7.5	10	32	3	DM1-32025EB-N20B-EM	DM1-32025NB-N20B-EM		DM1-32025EB-S20S-EM		DM1-32025NB-S20S-EM
7.5	10	32	11	15	48	4	DM1-32032EB-N20B-EM	DM1-32032NB-N20B-EM		DM1-32032EB-S20S-EM		DM1-32032NB-S20S-EM
11	15	48	15	20	61	4	DM1-32048EB-N20B-EM	DM1-32048NB-N20B-EM		DM1-32048EB-S20S-EM		DM1-32048NB-S20S-EM
380 - 500 V												
0.55	0.5	1.5	0.75	1	2.2	1	DM1-341D5EB-N20B-EM	DM1-341D5NB-N20B-EM		DM1-341D5EB-S20S-EM		DM1-341D5NB-S20S-EM
0.75	1	2.2	1.5	2	4.3	1	DM1-342D2EB-N20B-EM	DM1-342D2NB-N20B-EM		DM1-342D2EB-S20S-EM		DM1-342D2NB-S20S-EM
1.5	2	4.3	2.2	3	5.6	1	DM1-344D3EB-N20B-EM	DM1-344D3NB-N20B-EM		DM1-344D3EB-S20S-EM		DM1-344D3NB-S20S-EM
2.2	3	5.6	3	5	7.6	1	DM1-345D6EB-N20B-EM	DM1-345D6NB-N20B-EM		DM1-345D6EB-S20S-EM		DM1-345D6NB-S20S-EM
3	5	7.6	5.5	7.5	12	2	DM1-347D6EB-N20B-EM	DM1-347D6NB-N20B-EM		DM1-347D6EB-S20S-EM		DM1-347D6NB-S20S-EM
5.5	7.5	12	7.5	10	16	2	DM1-34012EB-N20B-EM	DM1-34012NB-N20B-EM		DM1-34012EB-S20S-EM		DM1-34012NB-S20S-EM
7.5	10	16	11	15	23	2	DM1-34016EB-N20B-EM	DM1-34016NB-N20B-EM		DM1-34016EB-S20S-EM		DM1-34016NB-S20S-EM
11	15	23	15	20	31	3	DM1-34023EB-N20B-EM	DM1-34023NB-N20B-EM		DM1-34023EB-S20S-EM		DM1-34023NB-S20S-EM
15	20	31	18.5	25	38	4	DM1-34031EB-N20B-EM	DM1-34031NB-N20B-EM		DM1-34031EB-S20S-EM		DM1-34031NB-S20S-EM
18.5	25	38	22	30	46	4	DM1-34038EB-N20B-EM	DM1-34038NB-N20B-EM		DM1-34038EB-S20S-EM		DM1-34038NB-S20S-EM
525 - 600 V												
2.2	3	4.5	4	5	7.5							DM1-354D5NB-S20S-EM
4	5	7.5	5.5	7.5	10							DM1-357D5NB-S20S-EM
5.5	7.5	10	7.5	10	13.5							DM1-35010NB-S20S-EM
7.5	10	13.5	11	15	18							DM1-35013NB-S20S-EM
11	15	18	15	20	22							DM1-35018NB-S20S-EM
15	20	22	18.5	25	27							DM1-35022NB-S20S-EM

Size	H x W x D [mm]	Weight [kg]
1	152 x 72 x 180	1.2
2	220 x 109 x 180	2.6
3	260 x 130 x 180	3.7
4	300 x 184 x 195	6.3

Description	Length	Article
Programming cable RJ45/USB	3m	DXG-CBL-PCCABLE

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