NAHMAT DRIVE

Centrifugal drives

Our power package for the sugar industry

nahmat DRIVE

SIEMENS

NAHMAT Drive AC centrifugal drives

NAHMAT® DRIVE
Centrifugal drives
Our power package for the sugar industry comprising
- Motor
- Converter
- Control system
- Monitor unit
- NAHMAT DRIVE software

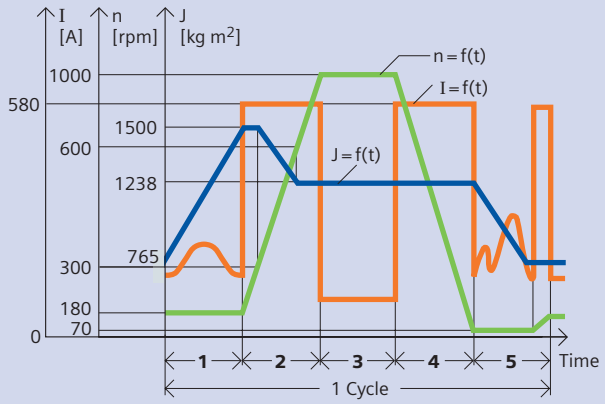
Because batch centrifugals are run at different speeds at different stages of the process, the sugar crystals are treated more gently than in continuous centrifugals that are run at a single constant speed. The centrifugals are charged with massecuite while running at between 50 and 250 rev/min. The actual centrifuging takes place somewhere between 1000 and 1500 rev/min and discharging of the sugar layer at between 50 and 100 rev/min. The precise values of speed depend on the particular make of centrifugal, the condition of the massecuite, and the product to be processed.

The diagram in Fig. 1 shows a typical operating cycle for a centrifugal with a capacity of 1750 kg. The largest centrifugals currently available can handle up to 2300 kg of massecuite in a single charge.
Variable-speed AC drive systems are normally used for the centrifugals because they require very little maintenance, are robust and long-lasting, can operate continuously throughout a campaign, and offer much better reliability than the variable-speed DC drives that are now only rarely used.

The motors are standard three-phase squirrel-cage induction machines which can also be equipped with special types of rotor or windings if necessary. SINAMICS® S150 (PWM pulse-controlled AC converters) are used for the converter-fed drives. All the drives satisfy the requirements of DIN ISO 9001.

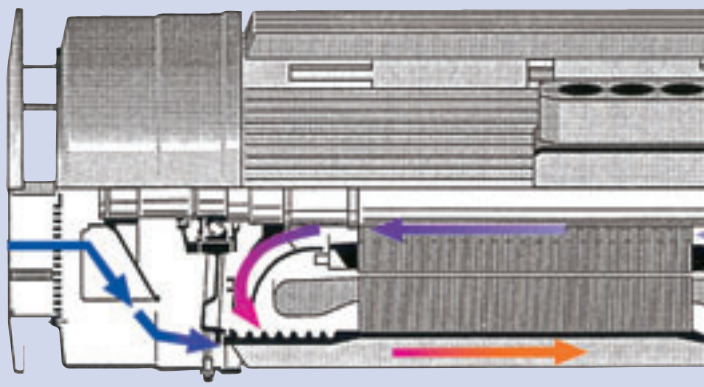
Decades of experience in project design, engineering, manufacture, and commissioning allow us to produce top-class drive systems for the sugar industry. NAHMAT DRIVE – centrifugal drives from Siemens

Fig. 1: A typical operating cycle for a 1750-kg centrifugal



J Moment of inertia [kg m²] n Speed [min⁻¹] I Motor current [A]

Fig. 2: Longitudinal section through a 1PQ8 317-8 motor



Robust motors to keep the campaign going

When motors are powered through converters, the operating conditions are somewhat different from those that prevail with normal standard motors because they are optimized for being fed directly from the power mains.

When SINAMICS S150 pulse-controlled converters are employed, the motors are fed with a pulsating voltage and near sinusoidal current. The resulting harmonic currents and the reduced amount of cooling at low discharge speeds place an extra thermal load on the motors. The insulation of the windings is also subject to greater stress due to the high rate of voltage rise arising from the pulse-controlled operation.

Consequently, we employ motors that have been specifically designed to cope with these extreme conditions:

- Self-ventilated Series 1LG4/1LA8 motors or
- Separately-ventilated Series 1LG4/1PQ8 motors for the even more stringent requirements imposed by frequent duty cycles, high ambient temperatures, or short spinning times.

Our Series 1LA8/1PQ8 machines are especially suitable for use with converters due to their separate internal and external cooling circuits (Fig. 2). This ensures uniform temperature distribution without any pronounced hot-spots in the windings and low bearing temperatures at the drive and non-drive ends. All the motors conform to the relevant German standards and specifications, e.g. DIN VDE/IEC/EN, and also to most of all major international standards and specifications.

Advanced motor design – feature by feature:

- **Type of construction IMV1** without canopy to DIN IEC 34. If there is a danger of pollution from above, the motors can also be supplied with a canopy fitted or for retrofitting.
- **Degree of protection IP55**, i.e. complete protection against electric shock and harmful dust deposits in the interior, also hose-proof from all directions.
- **The measuring-surface sound-pressure level** to DIN EN requirements does not exceed 81 + 3 dB(A) even when being converter-fed.
- **The motor bearings** have a regreasing device. The used-grease storage compartment is designed for the maximum number of regreasings possible within the nominal service life of the bearings (LH10). The bearings would normally be regreased before the beginning of a campaign.

  If necessary, the main bearings can be fitted with SPM measuring nipples so that the condition of the bearings can also be checked while the campaign is in progress. Nominal bearing life is at least 40,000 hours of operation.
- **Frame** The frame and the bearing end-shields are made of cast iron, are highly vibration-resistant, and provide excellent dissipation of heat through large-area external fins.
- **Flange and shaft extension** conform to DIN standards. The shaft extension does not normally have a keyway because the motor-end half couplings are pull-fitted and secured with clamping devices.
- **Balance quality** All the motors are dynamically balanced to Vibration Severity N (normal) in accordance with DIN EN requirements.
- **Anti-condensation heaters** prevent any accumulation of moisture inside a motor when it is stationary. The heaters are switched off automatically when the motor is running.
- **Speed actual-value transmitter** is no more necessary; if required the motors can be fitted with a maintenance-free, corrosion-resistant rotary pulse encoder suitable for heavy-duty applications. The encoder produces 1024 pulses per revolution and has an IP65 degree of protection.
- The motors are **painted** grey (RAL 7030). The paint has permanent thermal resistance up to 100 °C and up to 120 °C for short periods of time. It contains no toxic substances. The surfaces are shot-blasted to remove any rust before an alkyd resin-based undercoat is applied. The paint finish is suitable for climate groups conforming to DIN IEC 60721; a special worldwide paint finish can be provided for harsher conditions.
- The motors are normally supplied conforming to the new **DIN IEC-rated voltages of 400 V/690 V** which allow a tolerance of ± 10 %. DIN EN with a tolerance of ± 5 % applies to other voltages.
- The **rated power output of the motors** to DIN VDE 0530 is applicable to a coolant temperature of 40 °C and a site altitude of up to 1000 m above sea level. You should enquire for advice if the actual conditions differ from these. In general, however, the power rating is not quoted in kW but in duty cycles per hour because this gives a more accurate picture of the actual performance of a centrifugal station.
- The motors have Class F **insulation** which is tropic-proof and provides excellent mechanical and electrical strength (DURIGNIT® IR 2000). The maximum permitted values of this high class of insulation are not actually utilized fully in converter-fed operation and will not exceed insulation Class B.
- **Motor protection** employs a KTY84-130 temperature sensor in the winding to allow the continuous acquisition of temperature. The characteristic of the sensor is similar to that of the Pt100 sensor. The response values for warning and tripping are issued to the converter via parameters. The actual value of motor temperature is displayed on the monitor unit at the centrifugal.

The right converter for the right application

The latest technology

SINAMICS S150 and S120 Cabinet Modules converters are used for the centrifugal drives. These converters are of the voltage-source type employing all-digital microprocessor technology and IGBTs in the inverters.

The main advantages of SINAMICS S150 converters:

- Automatic self-parameterizing during commissioning simply by entering the rating plate data of the motor, with subsequent self-optimizing.
- Operator prompting and extensive operating, warning, and fault alarms on the comfort AOP30 operator panel or via a serial interface.
- Large number of functions.
- Function changing of inputs and outputs and open-loop and closed-loop control by means of parameters.
- Standard operating philosophy throughout the whole power range of the series from 75 to 1200 kW.
- Suitable for all the usual voltages used in the world from 380 to 690 V.
- The modular system allows all customer needs to be satisfied, e.g. whether as a single individual drive or as a multi-motor drive from a common DC bus (Fig. 6/7).
- Communication with the programmable controller over PROFIBUS-DP / PROFINET; the programmable controller being the master and the converter the slave.
- Part of the control gear is housed together in the converter cubicle (Fig. 3).
- The requirements of the European Low-Voltage Directive 73/23/EEC are satisfied and the CE Mark has been awarded.

Fig. 3: Converter cubicle with integral control system

- Integral flying restart circuit to allow the converter to be switched on to a running motor so that a drive can be returned to service in the shortest possible time.
- The basic software contains free functional modules for computing and controlling, logic already provided.
- The sophisticated STARTER® system allows menu-assisted commissioning and diagnosis under Windows (upread & download).
- Approved by all the main international certification authorities such as EN, CSA, IEC, and UL.
- Shock-hazard-protected to VDE 0113/VBG4.
- Standard dimensions: height 2000 mm (IP20), depth 600 mm.

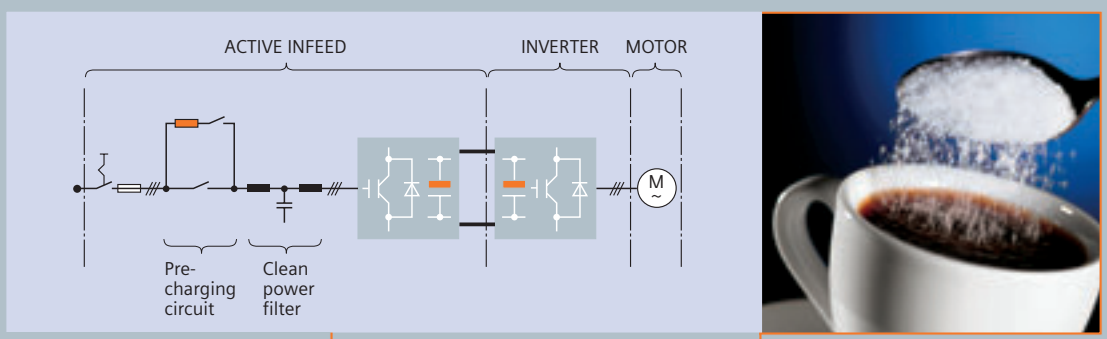
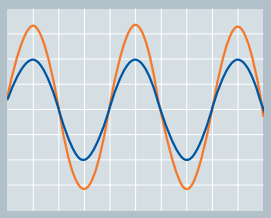


Fig. 4: Converter with Active Infeed

The right converter for the right application



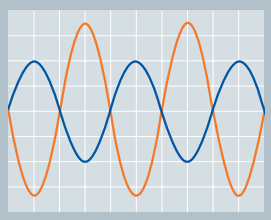


Fig. 5: Variation in mains voltage and current when the Active Infeed setting is cos phi = 1

The Active Infeed used as a standard feature in the converters of centrifugal drives also provides several other important benefits:

- Self-commutated converters with IGBTs and clean power filter in the input.
- Sinusoidal currents and voltages with no mains-typical harmonics and so absolute minimum mains pollution on the line side (Fig. 5). Thus, compensation and filter circuits are no longer needed and the **overall** power factor is cos phi = 1.
- No conduction-through with fuse tripping in response to mains undervoltage or failure in generator mode thanks to active tripping. Therefore, especially suitable for weak or unstable systems.
- Compensation of mains undervoltages by voltage step-up mode.
- Exceptional dynamic response.
- No mains voltage distortion due to commutating voltage dips.
- No effects on mains voltage caused by mains system resonance due to harmonics.

For a whole centrifugal station, the alternative to individual drives is a common DC bus for the inverters.

For safety reasons, in this case it is necessary to have a second infeed unit that will allow rapid changeover in the event of the first unit suffering a malfunction.

To avoid having to shut down the whole station should one of the drives fail, the circuitry has been designed so that the drive can be isolated from the live DC busbars and returned to them (Fig. 6).

The most important advantage of this solution is the reduced amount of equipment needed for the infeed from the main distribution switchgear, i.e. only **one** outgoing feeder and **one** outgoing feeder cable. However, the solution only offers price advantages when there are more than 4 or 5 drives per station, depending on the design of the drive system.

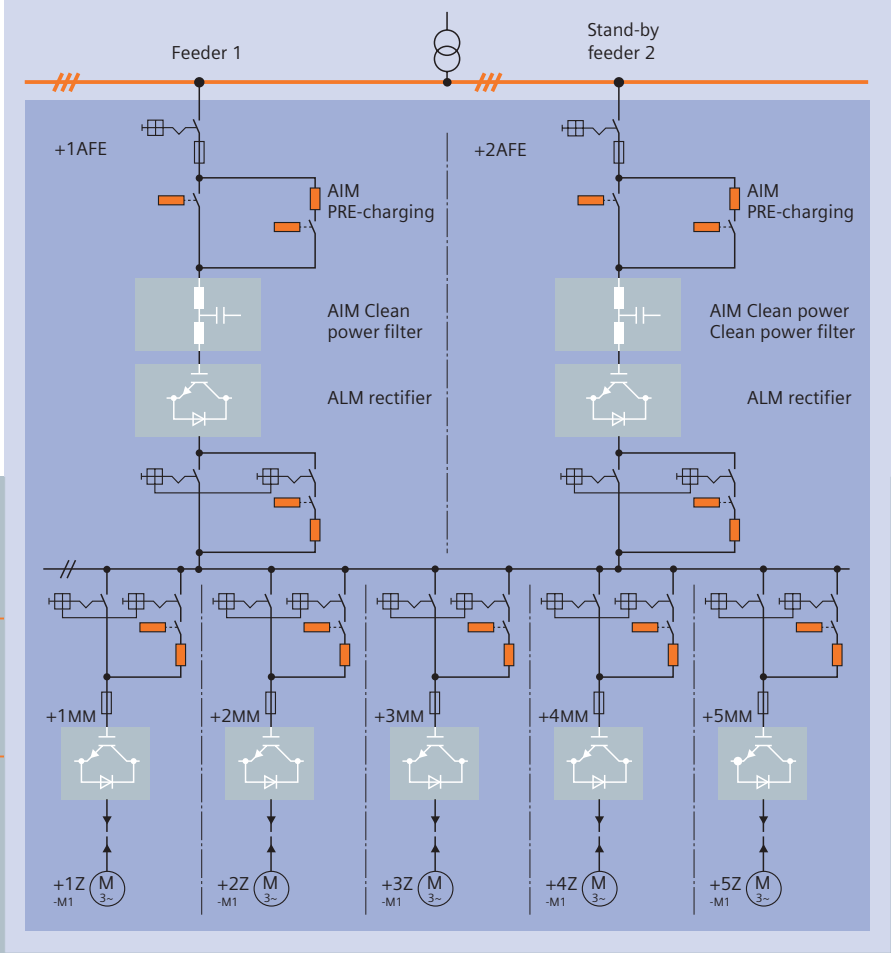


Fig. 6: Centrifugal station with Active Infeed and common DC

Everything under control

As Fig. 7 shows, the power demand for one station with the arrangement shown in Fig. 6 is no higher in total than the power demand for one drive due to the energy balance that takes place on the DC busbars.

The deciding factor for the design of the infeed system is the "worst case" scenario, i.e. how many drives need to be accelerated or decelerated simultaneously in the event of a malfunction, e.g. should the centrifugals start oscillating.

The converters are fed directly from the main low-voltage distribution board or from a central feeder cubicle by cable or busbars.

The converter cubicles are housed in an air-conditioned room offering an IP20 degree of protection; higher degrees of protection are possible if necessary.

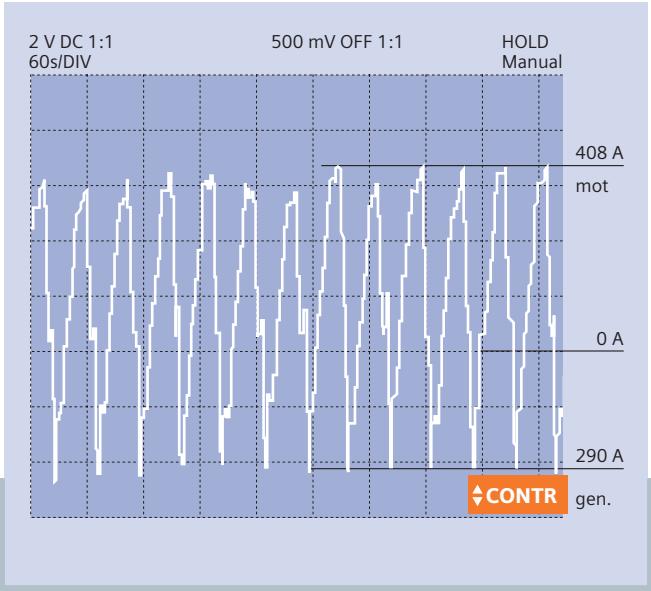


Fig. 7: Total power demand in the infeed in accordance with the arrangement shown in Fig. 6 in interlocked continuous operation (U = 3-phase AC, 50 Hz, 690 V) for centrifugals with 2100 kg per charge and 24 cycles per hour

The control system is designed for fully automatic, interlocked, continuous operation. In the event of a fault or for maintenance purposes, it is also possible to run a single fully automatic cycle, or the principal functions of the centrifugal cycle, under manual control.

For the standard models of centrifugals on the market, there are ready-made programs available that have been well tried and tested in a wide range of applications.
A programmable controller is a standard feature of the control system and only a few electromechanical switching elements are needed for safety functions.
All external signals are displayed by LEDs so that any faults outside the programmable controller can be pinpointed very quickly. The signal voltage for limit switches, proximity switches, and valves is normally 24 V DC.

In order to prevent a fault in the programmable controller producing a dangerous state, all the principal output functions such as "Charging valve open," "Closing hood open" and "Discharger swing in/travel down" are prevented by speed monitors from being activated when the speed is high. This monitoring is independent of the programmable controller.

A number of safety functions have been incorporated in the control sequence – over-speed protection and blocking, monitoring of cycle duration, limit switches/proximity switches, control valves, speed actual value, etc.
Appropriate displays are provided on the monitor unit to assist with pinpointing these faults.
All special control functions such as "With/without sugar dissolving," "With/without bus coupling," "With/without vibration monitor," etc. can be selected directly by programming "Centrifugal parameters. "

Data transfer between converter and control system is effected by PROFIBUS. For greater immunity to interference, a fiber-optic conductor link can be used between the programmable controller and the converter/monitor unit.

Linking to a higher-level bus system is possible so that all the most important signals can be transferred to a process control system. Special drivers are available for linkups to non-Siemens systems.

Local monitoring and control

There are two alternative solutions for local monitoring and control of the centrifugals and their drive systems:

- An operator panel with OP177B
- An operator panel with MP370

For safety reasons, the operator panel also incorporates the following operating device hardware:

- Illuminated push button for "Control supply On." In normal service, the signal lamp indicates a trouble-free state with a steady light and starts flashing if a fault occurs.
- Push button for "EMERGENCY STOP" (control supply Off). When the push button is operated, all inputs/outputs of the programmable controller and the main contactor are deactivated by means of a SIGUARD contactor combination. This satisfies the EMERGENCY STOP and STOP functions for Category 0 (to VDE 0113-1 and EN 60204-1), i.e. uncontrolled shutdown with immediate disconnection of the power supply.
- Illuminated push button for "Fast stop." If this push button is operated while the centrifugal is running at high speed, mechanical and regenerative braking are employed to reduce the speed to 100 rev/min; only mechanical braking is used if the initial running speed is lower.

- Centrifugal parameter display
- Process times display
- Fault display
- Limit values display
- Measured-values display
- Control and visualization display
- Contact person display
- Password display

The operator panel OP177B has 32 function keys assigned with normal control functions for operating the centrifugal:

- Start
- Select automatic operation
- Select discharge speed
- Select charging speed
- Select intermediate spinning speed
- Select spinning speed
- Increase charging valve opening
- Decrease charging valve opening
- Open hood manually
- Discharger Emergency Stop
- Discharger Automatic
- Reversing flap
- Water by hand
- Steam by hand
- Select continuous automatic operation
- Select starting interlock

The functioning of the various keys when selected is indicated by means of associated LEDs.

In order to prevent misuse of the various functions, there is a total of 9 levels of hierarchy for inputs that are accessible by using special passwords.
The operator panel has an IP65 degree of protection. The housing is normally painted grey (RAL 7035) but a stainless-steel version is also available to order.

The operator panel with MP370 touch panel provides the same amount of information as the operator panel with OP177B plus the following extra options:

- Full-graphics, touch-sensitive color display (see Fig. 9).
- Only what is accessible for operation in the current display is shown so that no searching for softkeys or cursor keys is needed – simply touch what you want.
- Realistic graphic display of the centrifugal and its drive system.
- Dynamic display, i.e. the display adapts itself automatically to the individual steps of the cycle.
- Process display with graphs, e.g.
  – Speed reference value
  – Speed actual value
  – Current actual value
  – Vibration actual value
  – Motor temperature actual value.
- Programmable controller inputs/outputs display. This allows the operator to gain an overview of the current status of the inputs/outputs directly at the centrifugal.
- Easier access to the individual displays compared with the OP operator panel.
- The touch-sensitive front can be protected against dirt and scratches with a sheet of plastic film.

Fig. 8: Operator panel with OP177B and small 5,7" STN touch panel

Fig. 9: Comfort operator panel with MP370 and 12" TFT touch panel

Central monitoring and visualization

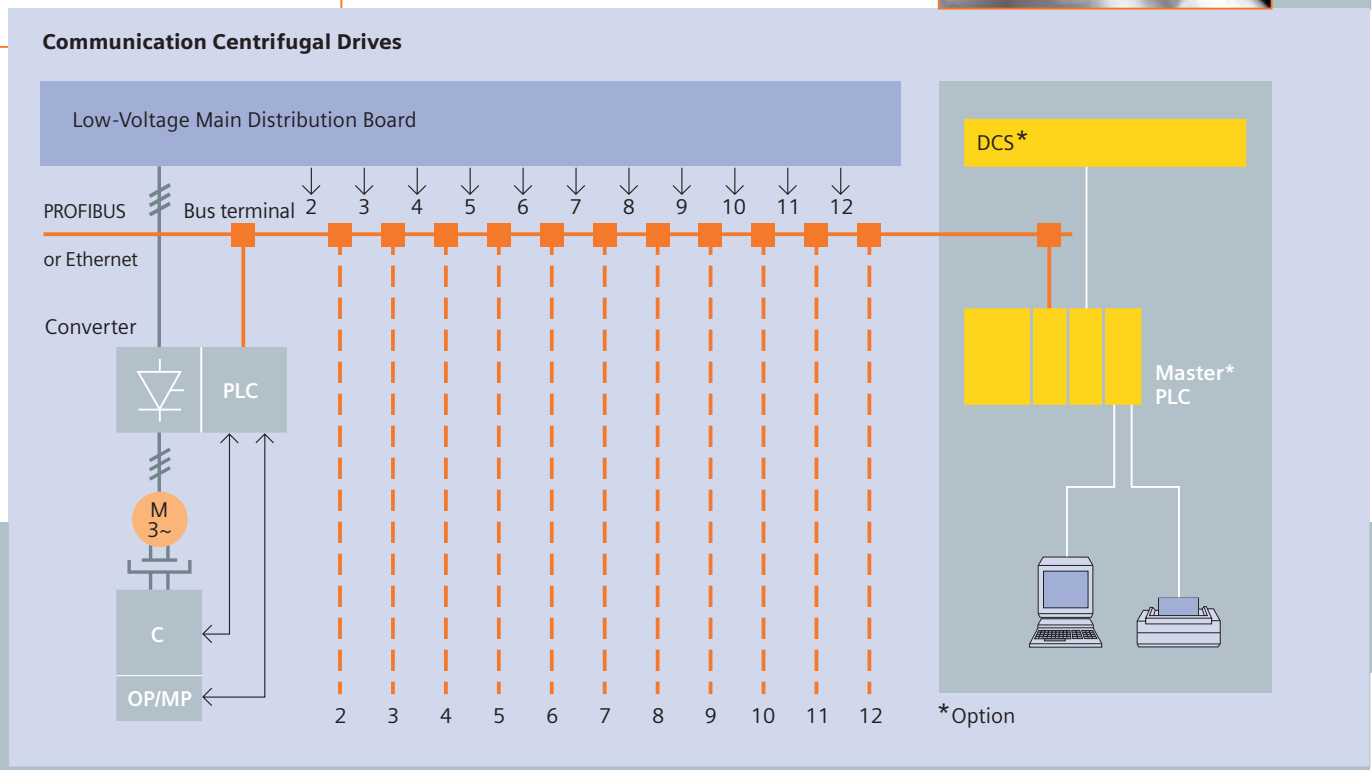
Visualization systems for drives in modern sugar factories have gradually acquired a standard format, i.e. all the principal data of the drives – such as load, speed in the case of variable-speed systems, operating messages, and fault alarms, etc. – is accessible from the central control console and/or is logged automatically. Since a centrifugal drive needs far more data than an ordinary drive, there must also be a much greater flow of data and information.

In a typical arrangement, all the drives are networked through a bus system (PROFIBUS or Ethernet) and all the most important data is transferred to a process control system. Naturally, local visualization by PC is also possible.

When longer transmission distances are involved, or in order to improve the integrity of transmission, it is possible to use a PROFIBUS system with fiber-optic conductors.

The transmission system can handle both process data (control and status values, reference values and actual values) and parameter values (read/write).

Fig. 10: Communication with the centrifugal drives



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Subject to change without prior notice 02/07 | Order No. E80001-A20-P500-X-7600 | 41C8275 MK.SP.XX.XXXX.52.4.02 WS 02072.0 | Printed in Germany |

Siemens AG

Automation and Drives

P.O. Box 48 48

90327 NUREMBERG

GERMANY

www.siemens.com/sugar