CONVERTERS AND INVERTERS - YOUR QUESTIONS ANSWERED

There is a lot of confusion about the difference between converters and inverters. This guide will attempt to put your mind at rest and help you arrive at the most appropriate solution for your requirement.

There are two distinct technologies available for operating three-phase motors from a single phase supply. The traditional phase converter (static and rotary) is based on the "Steinmetz" capacitor principles first applied by the American, Charles Steinmetz, in the late 19th century. The old adage "you can't get something for nothing" holds true for phase conversion like anything else. There is, always has been and always will be an element of artificiality about the supply a phase converter produces. Despite the idiosyncracies associated with the nature of the supply, phase converters continue to offer a proven and reliable compromise for people wishing to operate three-phase machinery in single phase environments. Simply put, "Why fix it if it ain't broke" ! The TRANSWAVE Converter is proof of this adage - over 18000 units have been sold world-wide since 1984.

Inverters (also known as frequency converters/motor controllers/variable speed drives) offer a 21st century approach to the dilemma. Most people who are aware that a device exists to operate 3-phase equipment from single phase tend to know about inverters and assume that the concept has superceded the traditional phase converter. However the two products will always co-exist as they service different requirements.

Generally speaking a converter varies the voltage in the conversion (240 to 415) but fixes the frequency (50Hz) so there is no motor control available. The transformer/capacitor/motor or rotary transformer make-up of a converter means that the supply remains "AC" throughout the conversion. A phase converter is a so-called "Linear Load". No EMC issues, No supply disturbances, No Harmonic distortion. No filters required. No supply quality issues, simply a question of supply adequacy - will your single-phase supply cope with the demand of the three-phase load?

In contrast, an inverter fixes the voltage in the conversion (240) but varies the frequency (e.g. 0-400Hz) thereby offering motor control. The 3-phase supply at 240-volt is created by rectifying the AC supply to DC and inverting it back to AC. The involvement of DC means that inverter supplies are defined as "Non-Linear". The input and output supply is subject to EMC regulation as DC distorts the AC single phase supply. Harmonic distortion is a direct consequence. Filters are generally required to ensure your contractual obligations to the electricity supply company are not compromised. Inverter manufacturers do not offer product in excess of 3kW because they run the risk of contravening European Standards relating to supply quality such as BSEN 61000-3-2:2006 and BS EN 61000-3-12:2005.

The output from a converter retrofits directly to a machine that is wired for 3-phase operation so no machine modification is necessary. An inverter output cannot be accommodated without machine modification. Remote access to the inverter software is required via modified machine wiring or a pendant control (see below) offering stop/start/forward/reverse/speed-control options.

The output from a converter is flexible and (within reason) can be applied to a variety of different machines whether operated one at a time or simultaneously. An inverter output can only be applied to one motor.

Converters are available to support any motor requirement, provided there is enough single phase supply available to support the three-phase demand. Inverters are typically only available to a maximum of 3kW/4hp for reasons outlined above.

INVERTER/CONVERTER - FREQUENTLY ASKED QUESTIONS

Q - What is the difference between an Inverter/Frequency Converter and a TRANSWAVE converter?
1. A frequency converter varies the frequency of the supply to the motor thereby varying the motor speed. The TRANSWAVE is a fixed frequency system. Variation in motor speed from a TRANSWAVE can only be achieved by mechanical means.
2. A single-phase frequency converter only offers the motor a three-phase supply at 220/240 volt. The TRANSWAVE offers the motor a supply at 380/415 volt, establishing an artificial third phase at 380/415 volt via an interaction with the motor in the driven machine (static converter) or inherently via its own motor or rotary transformer (rotary converter).
3. Connection of a frequency converter to a machine will result in modifications to the machine circuitry (see below). The vast majority of machines connected to the output of a TRANSWAVE require no modification. DC Braking circuits and control transformers must be connected to specific phases. Refer to installation and operating instructions or seek advice from our sales engineers.

Q - When should I consider the use of an Inverter/Frequency Converter?
1. For single motor applications where motor control and/or soft start/stop is required independently of or in conjunction with a mechanical variation of speed.
2. For single motor applications where a dual voltage motor gives the facility to accommodate an inverter. The inverter is usually cheaper than a TRANSWAVE converter and significantly smaller/lighter.

Q - When should I consider the use of a TRANSWAVE converter?
1. For multi-motor applications or multi-operator environments.
2. For larger motor sizes (typically in excess of 2.2kW).
3. For applications where no motor control is required or where machine modification is unacceptable.
4. For applications where the motor cannot be connected for operation from a 200/240-volt three- phase supply (e.g. multi-speed motors).

Q - Do I have to modify my machine to accommodate a Frequency Converter?
1. All motor connections must be wired in the 220/240-volt configuration.
2. The motor must be connected directly to the frequency converter output, bypassing the traditional wiring loom (start/stop/forward/reverse/motor protection). In many instances the wiring loom can be modified so that

existing switchgear/levers/limit switches etc can be used. Seek advice from a competent electrician/technician before wiring any switches or contacts to the frequency converter control terminals.
3. Be wary of ancillary motors such as coolants and table feeds. These are likely to have to be disconnected completely and fed from an alternative source, as are lighting circuits and control transformers.

Q - When a motor is connected to a Frequency Converter, does it lose torque/power?
1. There is a direct relationship between the torque of a motor and the frequency at which it operates. Users of traditional voltage/frequency converters are recommended to pre-set the frequency window between 20Hz and 75Hz to ensure that the level of torque available is acceptable. Jaguar CUB simplified torque vector frequency converters enhance the torque performance at low frequencies compared to the iDrive.
2. For small machine tool applications this facility should be used in conjunction with, rather than as a direct replacement for, an existing mechanical variation of speed. I.e. it is better to achieve a 50rpm shaft speed from a 100rpm geared speed at 25Hz than a 250rpm geared speed at 10Hz.
3. At particularly low frequencies it may be necessary to consider the implications of secondary motor cooling since the fan built into the motor could lose its ability to cool the motor effectively. The frequency window outlined above typically eliminates this requirement. At higher frequencies than 50Hz it is in the user's interest to check that the integrity of the driven motor/machine will not be compromised.

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SINGLE TO THREE PHASE CONVERSION WITH ELECTRONIC MOTOR CONTROL

The speed of an induction motor is directly related to its supply frequency. An inverter or frequency converter offers the facility to electronically vary the speed of a three-phase motor from a single-phase supply by varying the frequency of the supply to the motor.

DUAL-VOLTAGE MOTORS

Most small single speed three-phase motors are wound for operation from either a 380/415-volt or a 220/240-volt three-phase supply. A typical "dual-voltage" motor plate will indicate a voltage rating such as "V 220-240/ V 380-415" together with two current ratings. The lower current will refer to the higher voltage, the higher current to the lower voltage.

STAR CONFIGURATION

In the "Star" configuration the motor will run on a three-phase supply from 380V to 415V phase to phase. The "Y" sometimes appears as a three-pointed star.

DELTA CONFIGURATION

In the "Delta" configuration the motor will run on a three phase supply from 220V to 240V phase to phase. The "Delta" sometimes appears as a "Triangle"

A typical motor terminal arrangement for the star configuration involves three motor terminals linked together with a set of three brass/copper links. The other three terminals (commonly marked U1, V1 and W1) are then connected to the three-phase 415-volt supply (L1, L2 and L3).

For a typical motor terminal arrangement for the delta configuration, the three brass/copper links are simply removed and rearranged. The other three terminals (U1, V1 and W1 as before) are then connected to a three-phase 240-volt supply or the output of an inverter/frequency converter.

If the motor plate does not display a 240-volt three-phase connection facility, it may still be possible to reconfigure the voltage rating from 415-volt to 240-volt three-phase. Seek advice from a local motor repair or rewind company.

Note that it is not possible to vary the speed of a single-phase motor. A dual-speed three-phase motor can only be connected for 380/415-volt so is usually incompatible with the output of a single-phase frequency converter.

It is the user's responsibility to ensure that the selection of higher frequencies than 50Hz does not compromise the integrity of the driven motor/machine.

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