



FAQ's - Drives

Adjustable Speed Drives Frequently Asked Questions

The following information is intended to answer commonly asked questions about AC variable frequency drives (VFDs).

[Installation](#) | [Programming](#) | [Diagnostic](#) | [Application](#)

Installation Questions:

How much space is required around the VFD?

Depending on the VFD series that is being used, maintain the following spacing around each VFD:
Micro Series: 2 inches below 5 HP; 4 inches for 5-25 HP; 6 inches for 25-60 HP; 8 inches above 60 HP.
SM Plus Series & SM-Series: 1 inch on each side and 2 inches on the top and bottom for 10 HP and below; 1 inch on each side and 4 inches on the top and bottom for 15-25 HP.

How are enclosures sized if someone wants to mount a drive inside a panel?

Enclosure manufactures typically determine the size of enclosure needed based on entering some data into a computer program they can access for the purpose. They need to know the ambient temperature that the drive can operate in (50C for NEMA 1, 40C for NEMA 4/12) and how much heat is dissipated by the drive. Use the following formula for a guideline only: Watts Dissipated = (HP x 750 x .04) climate space /EFF OF MOTOR. Consult the manual for further information (section 5.0).

Can VFDs be mounted above one another?

It is not recommended to mount VFDs above other VFDs or other heat producing equipment that would impede the cooling of the VFD, unless sufficient space and additional cooling (fans, blowers, air conditioners, etc.) are provided.

What precautions must be taken when running the VFD's power conductors and control wires?

When running the power and control wires, the following guidelines should be followed:

- Install the AC input power wiring in its own rigid steel conduit.
- Install the output motor leads in their own rigid steel conduit.
- Install the control wiring in its own rigid steel conduit. Low voltage DC control wiring and 120 Vac control wiring should be run in separate conduits.
- Make sure that all grounds are tightly connected, and properly earth grounded.

NOTE: If multiple VFDs are mounted near each other, the input power wiring for each VFD can be run in the one conduit, and the control wiring for each VFD can be run in a second conduit, but each set of motor leads MUST be in a separate conduit. However, if one VFD is used to run multiple motors, the output wiring for all of the motors can be run in the same conduit.

Is the VFD phase sensitive?

The VFD's input is insensitive to the phase sequence of the input voltage. Therefore, changing the input phase sequence will not change the rotation of the motor. However, changing the phase sequence of the VFD's output will change the motor rotation. When applying a VFD, the motor

Catalog Number

ex.110088



[Competitors](#) Catalog Number



Model Number

ex.M6C17FB10



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rotation should always be checked prior to connecting the driven equipment. If the motor is rotating in the wrong direction, reverse any two of the AC motor leads to change the rotation of the motor. Do not change the motor direction via the VFD's software parameters. Although changing the VFD's parameters can change the motor rotation, if the parameters are reset to the factory defaults, the motor will then rotate in the opposite direction.

What will happen if the incoming AC line voltage is wired to the VFD's output terminals?

Applying the incoming AC line voltage to the VFD's output terminals (T1, T2, and T3) will cause severe damage to the VFD's output power components, and will void the warranty.

Does the VFD require any type of circuit breaker or input fuse protection?

Yes. Branch circuit protection via a circuit breaker or disconnect switch and fuses must be provided to comply with the National Electric Code (NEC) and all local codes. Consult Article 430, Section H, of the NEC handbook for more information.

What size circuit breaker or input fuses should be used to protect the VFD ?

Select a magnetic circuit breaker or fuse rated at 1.5 times the input current rating of the VFD. For the Micro Series, SM and SM-Plus Series, the minimum fuse size should be 10 amps, regardless of the input current. The 10 amp minimum is required to accommodate the inrush during power up. The VFD provides motor protection.

Bussmann current limiting type fuses with low I 2 T values, rated 200,000 AIC are recommended. Similar fuses with equivalent ratings by other manufacturers may also be acceptable.

Fuse types are listed below:

- For 240 / 120 Vac and 240 / 200 Vac models, use a KTK-R or JJN type, 250 Vac rated fuse.
- For 480 / 400 Vac models, use a KTK-R or JJS type, 600 Vac rated fuse.
- For 590 / 480 Vac models, use a KTK-R or JJS type, 600 Vac rated fuse.

What is the maximum distance the motor can be from the VFD?

The motor should be located as close to the VFD as possible (100 feet or less). For applications where the motor is to be located more than 100 feet away from the VFD, a load reactor or dV/dt filter should be installed. As motor lead length increases, voltage spikes generated by the VFD's output transistors become amplified. In extreme cases, these spikes can result in premature insulation breakdown in the motor. Adding an output reactor or dV/dt filter reduces the spikes.

Most LEESON motors are now using IRIS (inverter rated insulation system). Motors with this feature allow longer motor leads (200-300 feet) without the use of an output reactor or filter.

What is the input voltage tolerance of the VFDs?

LEESON'S VFDs have input voltage tolerances of +10% and -15%. The VFDs have dual voltage ratings (e.g. 240 / 200 Vac), and these tolerances apply to both ratings.

- 240 / 120 Vac models: 240 Vac = 204 Vac - 264 Vac; 120 Vac = 102 Vac - 132 Vac.
- 240 / 200 Vac models: 240 Vac = 204 Vac - 264 Vac; 200 Vac = 170 Vac - 220 Vac.
- 480 / 400 Vac models: 480 Vac = 408 Vac - 528 Vac; 400 Vac = 340 Vac - 440 Vac.
- 590 / 480 Vac models: 590 Vac = 502 Vac - 649 Vac; 480 Vac = 408 Vac - 528 Vac.

NOTE: Although the VFDs have dual voltage ratings, not all models have dual current ratings. Therefore, a larger VFD may be required to meet the motor's current requirements when operating in the lower voltage range. Consult the VFD's installation and operation manual for current ratings.

What is the voltage imbalance tolerance?

The three phase input voltage imbalance must be less than 2% phase to phase. An imbalance of greater than 2% can shorten the life of the VFD and result in severe damage to the VFD's power components.

What type and size wire should be used for control wiring?

Both shielded wire and twisted pair are sufficient when wiring to the VFD's Control Board. Belden part number 8760 (2 wire), and Belden part number 8770 (3 wire), or equivalent wire is recommended. The minimum wire size used should be # 18 AWG.

Where should the shield be connected when wiring to the control board?

The shield should be connected to ground at only one end of the cable to avoid ground loops. The shield can be terminated at terminal 2 on the control board, or the ground lug on the chassis. Insure that the power has been disconnected prior to connecting the shield to VFD chassis ground.

When should input and output reactors be used?

Input and output reactors serve very different purposes. An input (or line) reactor helps protect the VFD from power line disturbances that could cause nuisance tripping or damage, and also reduces harmonics that the VFD can generate back onto the line.

Therefore, input reactors should be used in the following cases:

- The supply power is subject to disturbances such as surges, spikes, dips, transients, etc.
- The supply power is very stiff (greater than ten times the kVA rating of the connected VFDs)
- Harmonics are a concern (VFDs with input reactors almost always meet the IEEE-519 harmonics standard).

An output (or load) reactor, on the other hand, is used to protect the motor if the wiring distance between the VFD and motor is very long. The general rule of thumb is that an output reactor should be used if the motor leads are over 100 feet. As motor lead length increases, voltage spikes generated by the VFD's output transistors become amplified. In extreme cases, these spikes can result in premature insulation breakdown in the motor. Adding an output reactor protects the motor by reducing the spikes. However, the motor itself has a lot to do with the wiring distance limitation. Most new motors are now made with inverter rated insulation system wire, which allows much longer motor leads (200-300 feet) without the need for an output reactor.

NOTE: If the motor leads are extremely long (500 feet or more), a dV/dt filter should be used instead of a reactor. A dV/dt filter provides better motor protection than a reactor at extreme wiring distances.



Programming Questions:

What is the factory default password for the VFDs?

The Micro Series default password is 0019. The SM-Plus & SM Series default password is 225. For models with 2-digit display, the password default was 1225 (cont.) entered in two parts as '12' and '25'.

Can the factory password be changed to another password?

Yes. In the Micro Series, the password can be changed to any value from 0000 to 9999. In the SM-Plus & SM Series, the password can be set to any value from 000 and 999.

NOTE: Setting the password to "0000" in the Micro Series or "000" in the SM-Plus Series & SM Series

disables the password function.

What happens if the password is changed, and then the new password is forgotten?

Contact LEESON for a special password that will allow the operator to enter the programming mode and view the password setting.

Will the VFD retain customer parameter settings when there is a loss of input power?

Yes. The VFDs are equipped with non-volatile memory that is not affected by removal of power. A low voltage condition could cause the VFD to lose memory.



Diagnostic Questions:

Does the VFD display a fault message if the drive shuts down due to a protective trip?

Yes. The VFD will display the name of the fault that caused the trip, and it will also store the fault message in the VFD's fault history log. Consult the troubleshooting section of the manual.

How is a fault cleared?

On the Micro Series, press the STOP key on the keypad or open the Stop circuit between terminals 1 and 2 on the terminal strip. On the SM-Plus & SM Series, open the stop circuit between terminals 1 and 2. Faults can only be cleared if the condition that caused the fault has passed.

Note: Power sag & control faults cannot be cleared by simply pressing the "STOP" command. You must reset the drive using parameter named "PROGRAM". Once in this program, choose "RESET 60", or "RESET 50", if your base frequency is 50HZ. At this point, all settings will be reset to factory settings and you will lose your "USER" settings.



Application Questions:

What type of AC motor should be used with the VFD?

In general the VFD will operate with any standard three phase NEMA Design B induction motor that has a full load current rating less than or equal to the VFD's output current rating.

Can a VFD operate a smaller horsepower rated AC motor?

Yes. The VFD comes standard with an electronic thermal overload. This function allows the VFD to deliver 150% of the rated output current for one minute, and higher current levels for shorter periods of time. The VFD's electronic thermal overload can be adjusted to protect a smaller motor.

Can a motor contactor or disconnect switch be installed between the VFD and the AC motor?

Operating a motor contactor or disconnect switch between the VFD and the AC motor, while the VFD is running, can cause severe damage to the VFD. Such devices can be used if they are only operated when the drive is in a STOP state.

Can more than one AC motor be operated from a single inverter?

Yes. A VFD can operate multiple motors as long as the full load current ratings of ALL of the motors added up is less than or equal to the output current rating of the VFD. Per the NEC, multiple motor applications must have individual thermal overload protection for each motor. All of the motors

connected to the output of the VFD will start and stop together, and will operate at the same speed. Do not use contactors to start and stop individual motors (see question 22 above).

Can single-phase motors be used with VFDs?

No. VFDs are designed to operate three-phase motors only, and will not work with single-phase motors. Drives that are referred to as "single-phase" will operate on single-phase input power, but the output is still three-phase, thus requiring a three-phase motor.

Do the VFDs have a power supply for customer use?

The standard Micro Series VFDs does not have a power supply for customer use. The SM-Plus and SM Series have a 12 VDC supply rated at 50 mA. Consult LEESON for more information on custom configurations.

What speed range can be run with an inverter?

The Micro Series drives are capable of 0-120Hz, SM & SM-Plus 0-240Hz, but the speed range possible is limited primarily by application and motor considerations. Please see our 1050 Stock catalog for approximate speed ranges. The high end of the speed range is limited by several factors including the maximum safe speed of the driven equipment and the ability of the motor to spin at that speed without having any mechanical problems like excessive vibration, premature bearing failure, or flying apart. It is also important to note that the torque is no longer constant above its nameplated speed, so torque begins to drop off as you overspeed the motor. At the lower end, the limitation is primarily related to thermal considerations of each individual motor design. Since a motor's fan will be spinning at a slower speed, it will be much less effective at maintaining a motor winding temperature that is acceptable for its insulation class rating. This means that without some other means of external cooling, (like a blower kit) motor life could be severely reduced.

Can a drive be controlled by remotely mounting the keypad?

Yes, LEESON has remote keypads for the Micro, SM-Plus & SM Series VFDs as well as their SM Vecotr and SM2 Flux Vector inverters

Can a drive be remotely controlled by any other means from longer distances?

Yes, most functions can be controlled remotely from the terminal strip with the addition of customer supplied switches, potentiometers speed reference signals etc. There are several examples and descriptions in the manual that comes with the drive. Practical distance for control wiring is about 50' based on proper wiring practices.

How do you change the user definable software settings?

Once the correct password has been entered, scroll to the parameter you wish to change with UP or DOWN ARROW keys, hit enter/mode (cursor moves to the right) then change the value by hitting an ARROW key, then hit enter/mode again to put the change into the memory. When an attempt to change the parameters is made without first entering the proper password, an error display comes up reading: ERR: MONITOR MODE. This is your cue that the password needs to be entered before you can change the settings.

Can our inverter drives be used in explosion proof environments?

NO! The drive is not rated for use in an explosive environment and such use could cause an explosion. Even with the drive mounted in a location that is not in the hazardous area, it is important to note that inverters cause motors to run hotter than normal and this could cause the skin temperature of the motor to exceed the flash point of the environment causing an explosion. Please

consult factory for using their explosion proof motors with an AC Inverter.

Can an inverter be used with a brakemotor?

Yes, but the brake coil can't be wired directly into the motors leads. The waveform that the drive uses to vary the speed of the motor is not suitable for energizing the brake coil because the voltage decreases as a lower speed is commanded from the drive. An electrician at the site need to wire a control circuit using relays to properly engage, and disengage the brake through its own connection to the AC line. The Micro Series drive has two small relays, one normally open and one normally closed. Either one of these could be used to control a separate customer supplied relay that is used to properly switch the brake on and off. The relays in the drive are controlled by a parameter called RELAY. Setting this for value RUN will change the state these relays any time the drive is in a run condition. In this way the relay for the brake coil can be controlled to release the brake when you want the motor to run; and to engage the brake when you want it to stop. The drive should also be set to coast to a stop. (Locked rotor amps are high; it would cause an overload trip if the brake is engaged while the drive is trying to ramp down according to the deceleration ramp setting.)

Can the drive be programmed to read out in values other than Hz?

Yes, by changing a couple of software settings. Hz UNITS changes only the units on the display to RPM or some other choice, and then another parameter called Hz MULTIPLIER is used to get the right numerical value. As an example for a 4 pole motor, 60Hz x 30 = 1800 RPM.

What needs to be done if you use a smaller motor than the drive's rating?

The parameter, MOTOR OL will accept a scaling factor to provide for the use of a smaller motor than the drive is rated for. It works by accepting a value calculated by dividing the motor's FLA rating by the output current rating for the drive.

If the drive trips on a fault, can it be programmed to restart the application?

Yes, a parameter selection called AUTO RE will, once enabled, try to start up again from 1-5 times. (15, 30, 60, 120, 240 seconds) The AUTO RE- selection is found as a choice under the START parameter.

Note: Requires 2 wire start/stop control with a maintained start contact. The start command must be present for this function to operate.

Does LEESON VFDs accept single phase input?

LEESON does have a line of Micro, SM-Plus, and SM-Series VFDs that will accept either 115 or 230 single phase input power. Please see our catalog for these ratings. In addition, all of our 230 volt VFDs will accept 230 volts single phase on the input side but, you must derate the motor 1/2 the size of the VFD.

Can I operate my 460 volt VFD on 230 volt input power?

No. The VFD's input voltage can only be within the voltage ranges listed in question #9.

Can you program a VFD while it is running?

Yes, however, the change will not take place until you stop the VFD and re-start it.