Using a Variable Frequency Drive
By Dennis Ford

I recently completed construction of a home built wood lathe. My lathe uses a Variable Frequency Drive (VFD) to power a three phase motor. The motor is connected to the spindle with a three step pulley system. This configuration allows a wide range of speeds. Most bowls are roughed and finished on the middle pulley set which allows a range of: 240 – 1400 rpm on my unit. This setup gives me very good torque with a 1.5 hp motor. **PHOTOS**

While most wood turners will not want to build their own lathe, some may want to upgrade their old lathe to a Variable Frequency Drive. This information is intended to assist those turners. Installation of a Variable Frequency Drive will require the following items:

- **Three phase motor**. (my cost was ~$150)
  - Selection of an appropriate motor should be the first step in the upgrade process. Used three phase motors are fairly inexpensive (eBay); Surplus Center (http://www.surpluscenter.com) is another source. The motor I have is the same as their model # 10-1828. The motor should be selected on the basis of:
    - Voltage –The motor should be 240 volt three phase. Many three phase motors can be wired for either 240v or 480v but some can not. Note; 220v, 230v and 240v ratings refer to the same voltage which may vary from 220 to 240.
    - RPM – Motors that turn 1100 – 1800 rpm are better suited to a wood lathe than 3600 rpm motors. The slower motors can not only be slowed down with the VFD but can also be run faster than their 60 Hz rating. Extra time spent figuring pulley ratios and motor speeds will be well rewarded with more torque and less wasted hp.
    - Frame size / shaft size – this will determine if the existing pulley can be reused and if the motor will fit the existing mounting system. The frame size is stamped on motor nameplate. Motors with the same frame size will have the same shaft size.
    - HP – Consider that a Powermatic 3520B comes with a 2 hp motor and an Oneway 2436 comes standard with a 1.5 hp (can be upgraded to 3 hp). The variable frequency drive will likely cost as much or more than the motor. Choose the horsepower you want to pay for.
- **Variable Frequency Drive** (my cost was ~$230)

- There is a bewildering choice available, be sure to get a unit that operates on single phase input of the correct voltage and is rated for at least as much horsepower as your motor. I purchased mine from www.driveswarehouse.com ; it is a Hitachi model L200-015NFU. They also sell motors. It is possible to get a drive with 115 volt input and 240 volt output if you only have 115 volt power available, these are more expensive and limited to 1 hp.
  - Most VFD manufactures recommend an AC line reactor to filter out voltage spikes that might harm the VFD. I did not purchase one and do not expect problems but do keep the unit unplugged when not in use. An AC line reactor costs about $100 for a single phase 2 hp VFD.
  - Connecting power to the VFD and connecting the VFD to the motor is fairly simple and is diagramed in the instruction manual. You should not connect a switch, fuse or breaker between the VFD and motor, these items should be between the VFD and the power supply.
  - The VFD must be programmed with data from your motor's nameplate and some user options must be selected before use. The Hitachi instruction manual is very good and I had no problems with the basic setup (I am an electrical technician). However once you have the basic configuration done, it could be easy to get lost in the more advanced programming options (most of these could be left at factory settings).
  - These units are made for general industrial use and have many set-up options, control wiring options and programming options. Expect to spend a few hours reading the manual and pushing the buttons. If it looks like Greek, ask for help.

❖ **Enclosure for Variable Frequency Drive** (my cost was ~ $25 for steel)

- The VFD is not designed to set in a dusty workshop; it should be inside an enclosure. A metal enclosure should be used for good heat transfer. Ideally this would be a NEMA type 1 (type 3 or 12 would be even better) enclosure with a hinged cover. Mine is home-made of sheet metal and the cover is attached with several screws. Note that the VFD requires 2" clearance on each side, and 4" clearance top and bottom (some units will need more). This allows room for wiring and for air circulation. The specs call for a "nonflammable vertical surface in relatively clean dry air"

❖ **Operator interface** (my cost was $0)

- Once the VFD is wired and configured, you will need some way to select speeds and to start / stop the motor without opening the enclosure each time.
  - Due to my DIY nature (and being cheap), I used a small junction box with 5 toggle switches from my "pile of parts" to select speeds and forward / reverse. By using different combinations of these switches, I have 7 motor speeds, forward / reverse and start / stop control. I made a chart with the

pulley selection and switch selection so that I know exactly how fast the spindle is turning for each possibility.

- You could use a rheostat for speed selection and switches for forward / reverse, start / stop. This would give an unlimited number of speeds over the same range but no feedback on what speed the spindle is turning. I may later change to this method and add a tachometer similar to the one Paul Coppinger describes on the club website.
- Another option would be to purchase a remote operator for the VFD (~$85). This would allow complete control of the VFD and a digital display. The remote display option requires a connection cable (~$80 seems unreasonable).

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