

VFDs and How They Work



Presenter Marty Redman



Why Use a VFD

- ❖ Solid State Controller
- ❖ Reduced Voltage Starting (easier on drivetrain and equipment)
- ❖ Soft-stopping (easier on drivetrain and equipment)
- ❖ Cost savings
- ❖ Motor protection
- ❖ Power Factor Correction
- ❖ Communications with other equipment
- ❖ Diagnostics and Fault Handling
- ❖ Reversing Load direction
- ❖ Momentary power loss ride-through
- ❖ Some can convert signal-phase to three phase
- ❖ Vary the speed of a three-phase induction motor



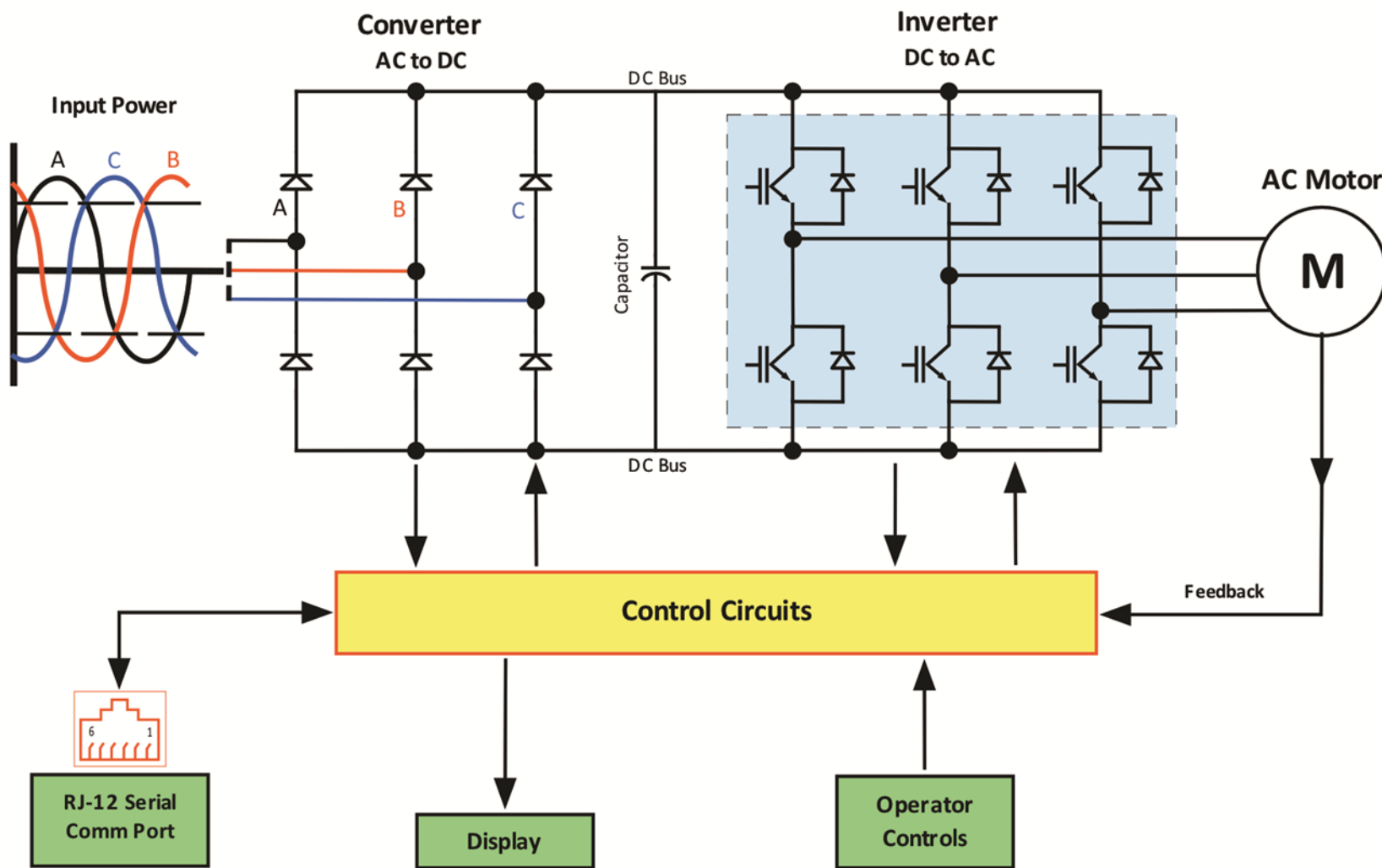
Safety and VFDs



- ❖ Mechanical Safety Considerations.
- ❖ Electrical Safety Considerations:
 - Shock
 - Arc-flash
 - Arc-blast
- ❖ You must follow all OSHA and NFPA 70E Safety Requirements.
- ❖ It is important that you follow the 8 step Process for Establishing & Verifying an Electrically Safe work Condition.
- ❖ Test Equipment for VFDs
 - Make sure your Digital Multimeter is a True-RMS meter
 - Your DMM should also have the correct Category Rating for the location you are in.



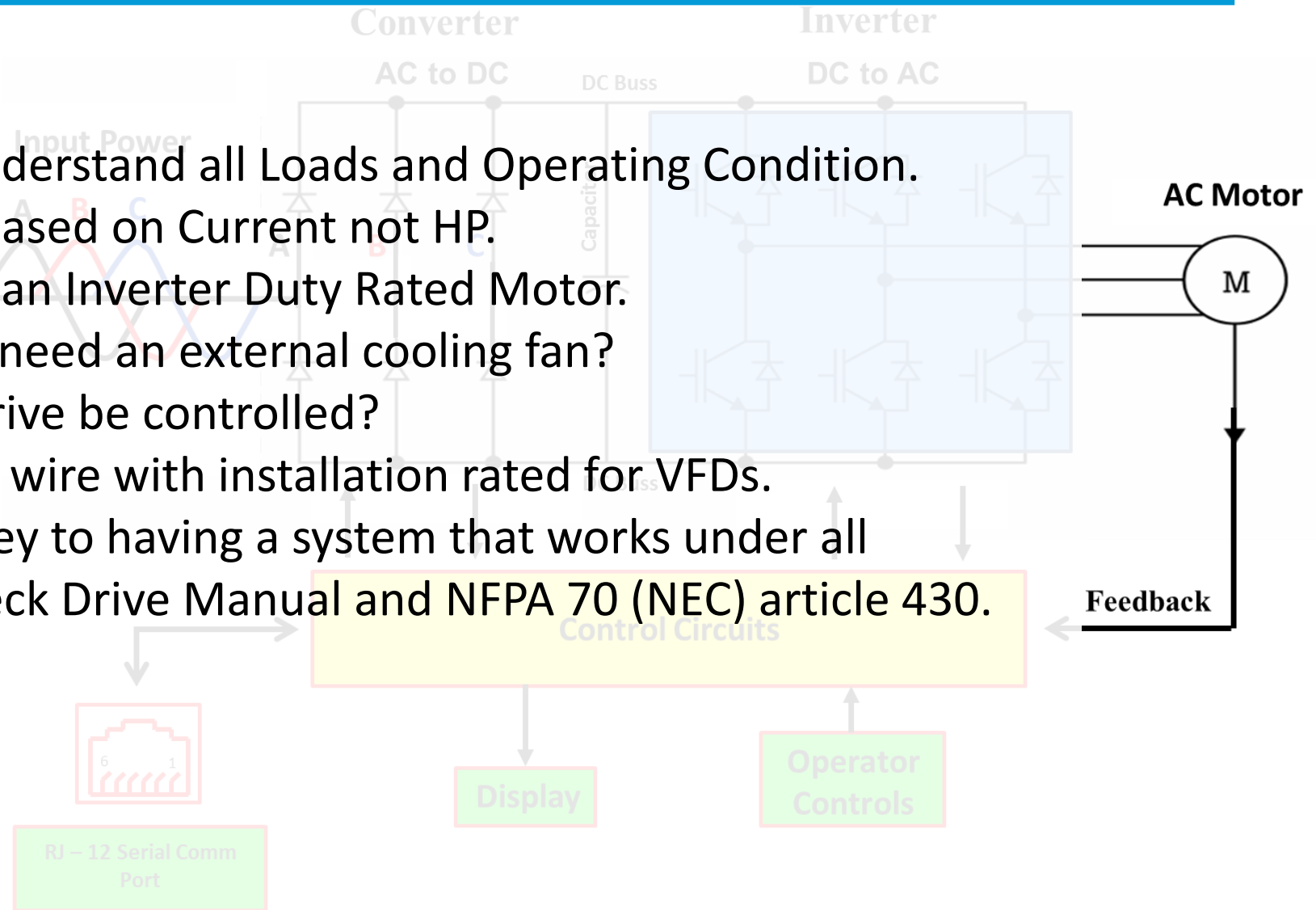
The Main Components of a VFD





The Most Important Items when selecting a VFD

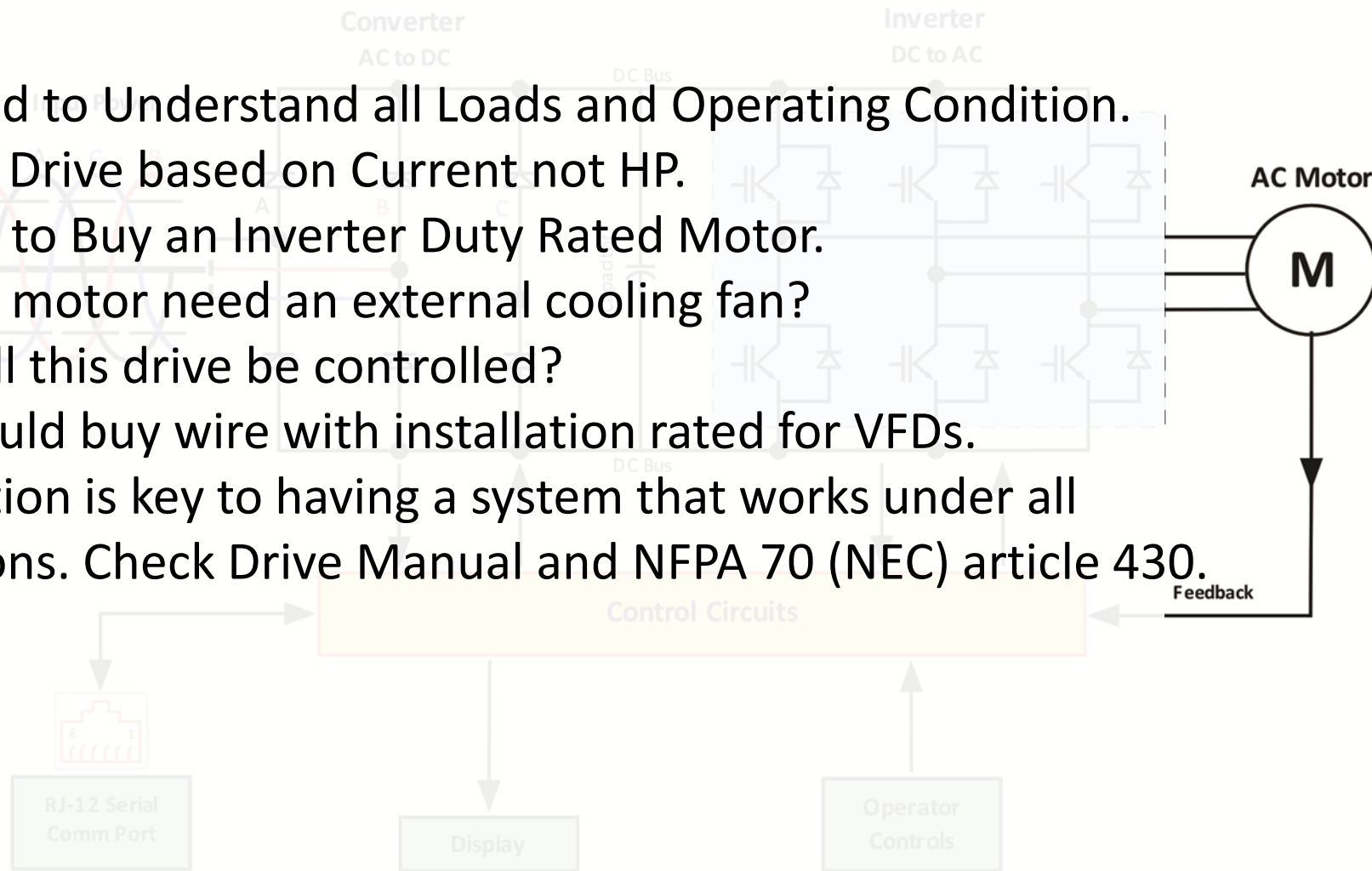
- ❖ You need to Understand all Loads and Operating Condition.
- ❖ Buy the Drive based on Current not HP.
- ❖ It's best to Buy an Inverter Duty Rated Motor.
- ❖ Will the motor need an external cooling fan?
- ❖ How will this drive be controlled?
- ❖ You should buy wire with installation rated for VFDs.
- ❖ Installation is key to having a system that works under all conditions. Check Drive Manual and NFPA 70 (NEC) article 430.





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Application and uses of a VFD

- ❖ Not all applications warrant using a VFD.
- ❖ It is important to write down all the reasons for speed and load control and is a VFD the best technology?
- ❖ Do you have an Overhauling Loads?
 - The load overhauls the drive motor and causes the drive to trip out
- ❖ Shock Loads
 - A sudden increase of the load can cause the drive to trip out
- ❖ Duty Cycle Loads
 - Frequent start/stop and reverse operations can resultant in over-temperature of the drive causing it to trip out



Application and uses of a VFD

❖ Constant Torque

- Constant load has the same torque applied over a range of speeds
- Torque is independent of speed
- Typical application – bulk material conveyor

❖ Constant Horsepower

- Horsepower demand is independent of speed
- Torque varies inversely with speed
- Typical application – drilling, turning metal, shaping

❖ Variable Torque

- Money saving application
- Torque and Horsepower both vary with speed
- Typical application – centrifugal pumps, fans, blowers



Common Concerns of VFD Operation

- ❖ Will the VFD operate more than one motor?
- ❖ Will the load be spinning or coasting when the VFD is started?
- ❖ Will the power supply source be switched while the VFD is running?
- ❖ Is the load considered to be hard to start?
- ❖ Are external disconnects required between the motor and drive?
- ❖ Is additional cooling required for the drive and or motor



VFD Maintenance Best Practices

❖ Visual and Mechanical Inspection

- ✓ Inspect physical and mechanical condition.
- ✓ Inspect anchorage, alignment, and grounding.
- ✓ Prior to cleaning the unit, perform as-found tests.
- ✓ Clean the unit.
- ✓ Ensure vent path openings are free from debris and that heat transfer surfaces are not contaminated by oil, dust, or dirt.
- ✓ Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.



VFD Maintenance Best Practices

❖ Electrical Tests

- ✓ Perform resistance measurements through bolted connections with low-resistance ohmmeter, if applicable
- ✓ Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
- ✓ Test input circuit breaker by primary injection
- ✓ Perform insulation resistance tests on all control wiring with respect to ground.
 - Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable.
 - Test duration shall be one minute. For units with solid-state
 - Components, follow manufacturer's recommendation.



VFD Maintenance Best Practices

❖ Electrical Tests

- ✓ Perform continuity tests on bonding conductors
- ✓ Perform operational tests by initiating control devices.
 - Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.
 - Verify operation of drive from remote start/stop and speed control signals.



Troubleshooting VFDs

The best troubleshooting tool you have is ?



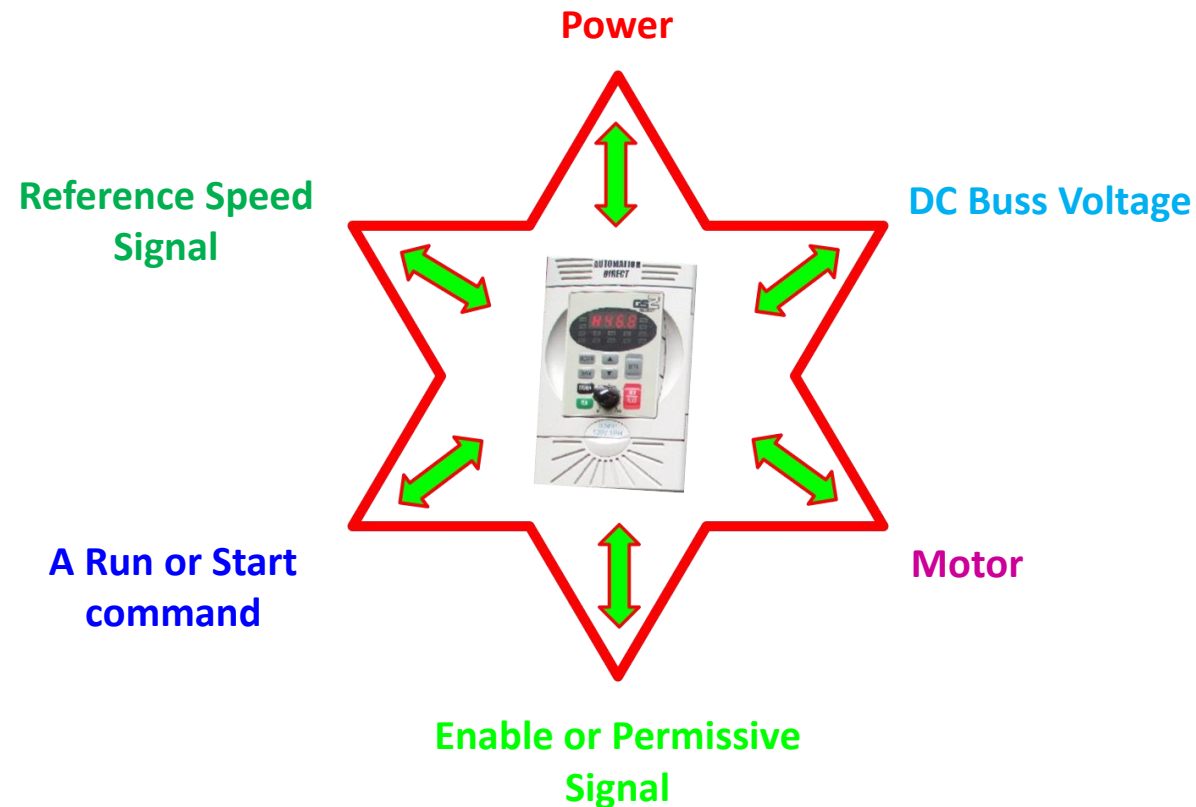
The Drive Manual





Troubleshooting VFDs

The 6 Conditions you should know about your VFDs so you can start troubleshooting very quickly

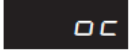




Troubleshooting VFDs

Check the Faults Codes

- ❖ The Drive Manual will tell you what parameter you need to go to Check Fault Codes

Fault Codes		
Fault Name	Fault Descriptions	Corrective Actions
	The AC drive detects an abnormal increase in current.	1. Check whether the motor's horsepower corresponds to the AC drive output power. 2. Check the wiring connections between the AC drive and motor for possible short circuits. 3. Increase the Acceleration time (1-01 or 1-05). 4. Check for possible excessive loading conditions at the motor. 5. If there are any abnormal conditions when operating the AC drive after short-circuit is removed, the AC drive should be sent back to the manufacturer.

- ❖ The Drive will tell you the present fault and it keeps a history of last Faults. Knowing the Fault Code History can help you in finding the problem sometimes.



New VFD Simulation from TPC coming soon!



Thank you for your time today!



***If you would like to learn more about VFDs,
TPC Training can help!***

Email: sales@tpctraining.com

Phone: (847) 808-4000

Remember we should never stop learning!