

Anatomy of a Fadal AC Servo Amplifier

The advantages of AC motors are pretty common these days, but it was not until 1995 Fadal began using them in the mass production of their machines. Haas was already producing machines with AC drives and motors, so Fadal got the hint and began doing the same thankfully.

AC servo motors are more reliable than their DC ancestors and develop more torque and power in a smaller package. With high resolution encoders and motors using Hall phasing, the torque on high precision moves is unmatched. This is why they have become so popular and now on every machine tool made today.

Let's keep it short and simple. I will start with the amplifier chassis where the amps mount and discuss the power and signals routed through the chassis on our way to understanding how to properly troubleshoot these AC amplifiers.

AMP CHASSIS

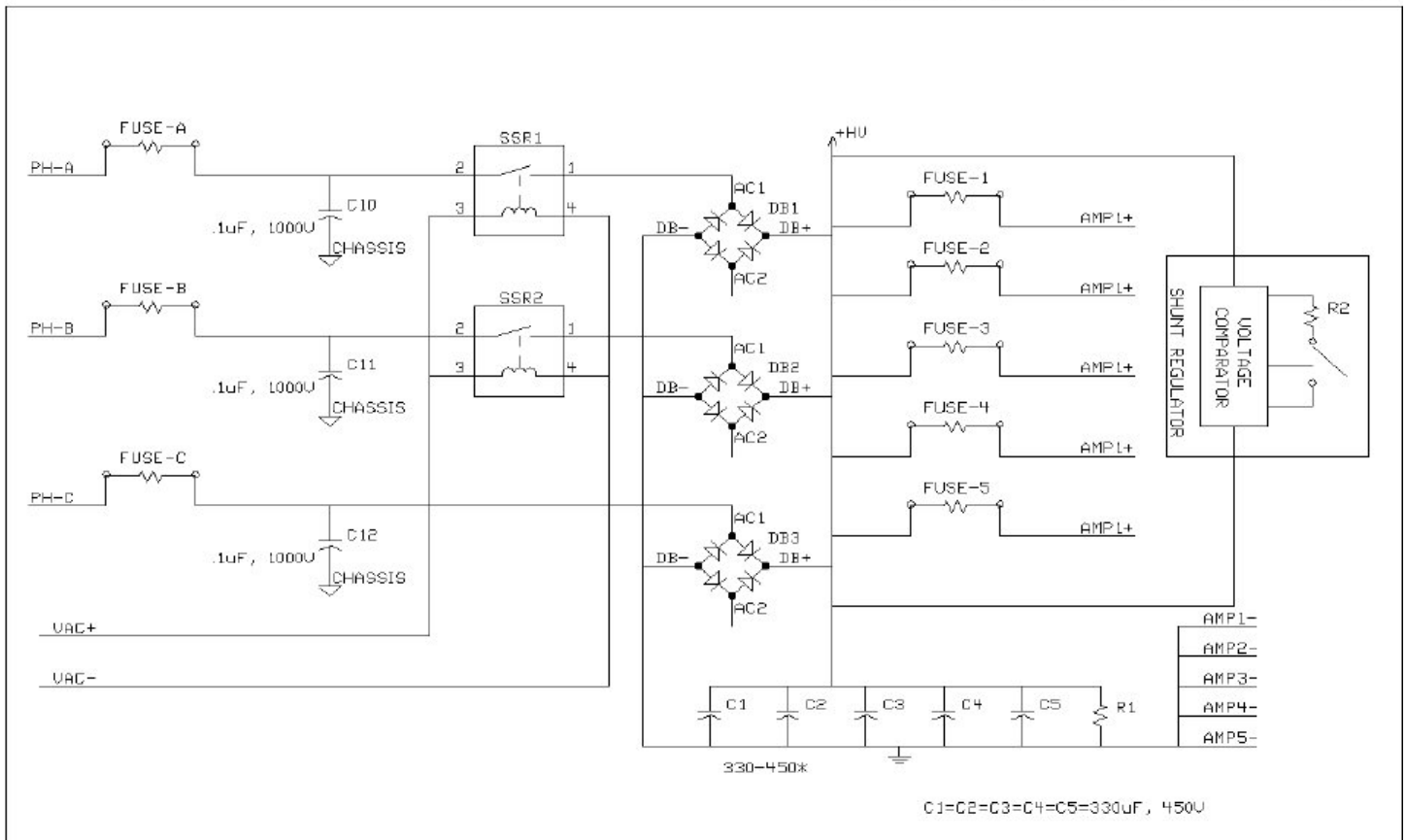
The AC amp chassis is fed with either single phase 120VAC (AMC Chassis) or 3 phase 86VAC voltage (Glentek Chassis). Either brand of chassis works fine for powering the amps, and all amps are interchangeable between amp chassis. In other words, the AMC AMP-0034 works fine in the Glentek chassis.

You also have 120VAC for the cooling fans coming from the 1100-1 board at TB2-1 & TB2-2. The control signal comes from the 1100-1 board at terminals TB1-8 & TB1-9. This fires the solid state relays which then pass the AC voltage to the dual bridge rectifiers that convert and pass the DC voltage to the capacitor you see on the amp chassis. The voltage on this capacitor should be about 160VDC when operating normally & is passed to the amplifiers. Here is the sequence:

- Throw power switch on. 160VDC on amp chassis not present yet.
- Press Green Control On Switch & here is what happens: K2 pulls in, 120VAC goes to amp chassis control circuit, bridge rectifiers develop 160 VDC for amps. Power is passed to B+/B- terminals of amps.

AMP CHASSIS WIRING DIAGRAM

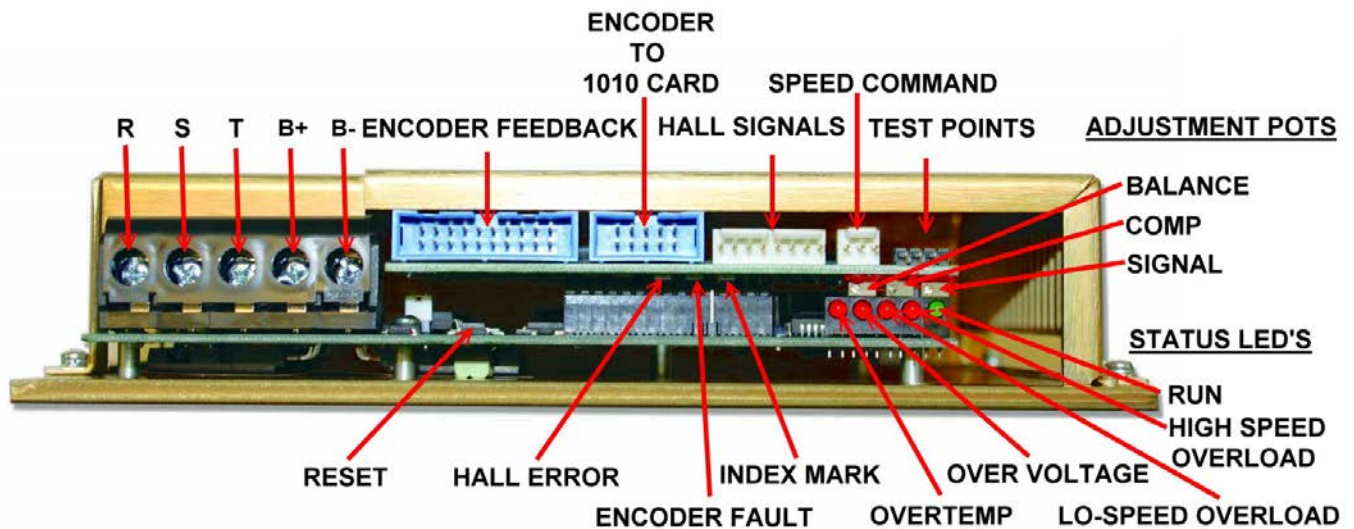
FUNCTIONAL BLOCK DIAGRAM FADAL AC DRIVE CHASSIS



AMPLIFIER I/O's

The Fadal AC servo amplifier is a quite simple device from the outside. You simply have 160VDC input, 3 phase output, a drive signal and some inputs from the Hall devices in the motor. The feedback from the motor encoder goes to the controller card, but is indeed routed through the amplifier at the blue 20 pin connector shown below, then to the controller card through the 10 pin connector next to it to J5 of the controller card.

Below is a complete diagram of a typical Glentek AMP-0040 AC Amplifier.



Remember, this amplifier is a "Dumb" device. It does what it is told from the controller card. That is about it.

Symptoms of a bad AC Amplifier card:

- Dead. No life at all.
- Jittery movements. Will not hold smooth surface finishes.
- Drifting. You have told the motor to stop, but it drifts past zero or past the commanded stop point.
- Poor tuning. The lag or position error will not tune properly.
- Bad Balance. You are unable to balance the amp.

FADAL AMPLIFIER TYPES

Fadal developed several amplifiers for all their AC Servo driven machines over time. One with an 8192 line count and one with a 5000 line count. The more widely used is the 8192 line count found in all machines with the exception to the VMC 3016 using primarily the 5000 line count



amps due to the pitch of the Ballscrews they used along with the max. feedrate. These were factors determining if they went to the 5000 from the 8192 unit.

As was the case with Fadal, they had two sources for these amps: Glentek and Advanced Motion Control. Glentek made primarily the following amplifiers:

AMP-0040 (8192)

AMP-0039 (5000)

They also made others such as the AMP-0041 (AC Rotary Tables), AMP-0054 (VMC 6535) & AMP-0056 (TRM only) which are available through FadalCNC.com.

Advanced Motion Control only made the AMP-0039 as a backup to the AMP-0040, but equally as powerful and robust as the Glentek models. Corporate politics got in the way of AMC's long term contract with Fadal and why you see mostly Glentek on machines. Fishing trips with the De Caussin's help as well.

TROUBLESHOOTING AMPLIFIER PROBLEMS

Because the amp is fairly stupid, troubleshooting them is very straight forward. Swap them. Simple as that. You should have all three the same, so if you suspect one bad unit, swap it with one of the other ones. A word of caution: Physically swap the amps. Do not just move the wires. You will likely cause other problems then need to replace the entire wiring harness and this is no fun. Here is a previous tech tip with more details on how to troubleshoot AC amplifier faults:

AC Amp Troubleshooting

If you swapped the X and Y amps thinking you have a bad X unit, now the problem will have moved to the Y axis if this is correct. If it stays with the X axis, you have a bad motor or cable likely. I would first rule out the controller card. See this previous Tech Tip on troubleshooting controller cards:

Axis Controller Card

As you see, the AC amp is far from intimidating and are quite easy to troubleshoot and replace once you have a handle on how your system works together. Time to make chips!