Centroid Allin1DC CNC Control Installation Manual

CNC CPU combination DC Servo drive w/ PLC and Spindle control
CNC12 v4.14+

Introduction and Discussion
What's Included
Bench Testing Hardware Setup
Windows and CNC software install
Bench Test
Electrical Cabinet Installation
Final CNC Software Configuration
Appendices
4 Digital to Analog Outputs
4 Analog to Digital Inputs

PLC Add 1616
Add 4 AD 4 DA

Optional I/O Expansion Boards
Add up to 4 in any combination for up to 272 IN / 272 OUT

Note: The Allin1DC includes enough preconfigured I/O for typical milling machine/lathe applications. Optional expansion boards are available for complex retrofits requiring additional I/O above and beyond the included I/O.

16 Inputs (5, 12, 24 VDC)
16 Relay Outputs

"All-in-1-DC" Single Board DC Servo CNC Control
Includes Motion Control CPU, on-board 3-axis DC servo motor drive (expandable to 6 axes total), 16 IN 9 Relay OUT CNC PLC and Spindle Control
Starting at $2249 with CENTROID Mill or Lathe software

Optional Manual Pulse Generator (MPG)
Optional Auto Tool Set - TT-2
- TT-1
Optional Touch Probe & Software - DP-4
- DP-7

110/220/440 VAC to DC Power Supply (No Transformer, use your own):
- 110 VAC to DC Power Supply
- 220/440 VAC to DC Power Supply

Use your DC Servo Motors
Up to 40 in lb (4.52 Nm)
- OR - Add CENTROID DC Servo motors (encoders and cables installed)
  - 16 in-lb w/16ft cable: $10667
  - 29 in-lb w/16ft cable: $10816
  - 40 in-lb w/16ft cable: $10935
  - Motor Cable (custom lengths over 16ft (4.8m)):

Encoder or Scales
Servo Motor Cables
Encoder Cables
Spindle Control

CNC PC choices:
OR:
OR:
OR:

Optional Console (#11144)
Optional Manual Pulse Generator (MPG)
Optional Auto Tool Set - TT-2
- TT-1
Optional Touch Probe & Software - DP-4
- DP-7

Optional Touch Screen CENTROID CNC Console
Console, Display, & Cabinet optional mounting hardware
Conduit and Cable package* for console w/ CNCPC ($11028)
Conduit and Cable package* for console w/o CNCPC ($13150)
Custom Length Console Cable for Conduit over 6ft add
Console mounting arm kit ($13933)
Console to Arm mounting hardware (use w/ your arm) ($13932)
Rolling floor stand $10512

Related Hardware and Cable kits
M39 style Display/keyboard tray with arm ($10240)
Operators Pendant mounting hardware ($10491)
MPG internal cable 20' w/bulkhead con. ($11086)
Probe internal cable 6' w/bulkhead con. ($11085)
Operators control panel internal cable 20' ($11029)
OEM/DIY console cable connector set ($13138)

Your Windows 7/8/10 PC must meet minimum performance requirements, you install software.

Touchscreen All-in-One PC (11084tb) (with factory installed software)

Our CNC PC cabinet & your display (factory installed software)

Preassembled, standard length: 6 ft. of conduit combined with 16' of cable.

* 16' limit on USB cables when CNCPC is not mounted in console

** 16' limit on USB cables when CNCPC is not mounted in console
**All-in-One-DC** CNC Controller:

A complete CNC control on one printed circuit board. All you need for a typical mill, router or lathe.

Includes built-in 3-axis Digital DC Servo drive, preconfigured CNC PLC with 16 IN and 9 Relay Out, and Analog out Spindle Control.

Optional Expansion boards for more complex machines with automatic tool changers, 4,5,6 axis, slaved axes and multi spindles.

All-in-One-DC eliminates cables, connectors and power supplies and simplifies installation while providing robust performance.

Runs with CENTROID Mill or Lathe CNC software on a Windows 7 or 8 PC.*

Cable to Windows PC*

CENTROID
159 Gates Road, Howard, PA 16841 USA
(814) 353-9290
www.centroidcnc.com

**Optional Manual Pulse Generator (MPG)**

Plug and Play Operator's Control Panel

Plug and Play

Operator’s Manual Pulse Generator (MPG)

Plug and Play

**Preprogrammed Relay Outputs**

Greatly simplify CNC control machine tool integration and reduce wiring, connections and associated parts and labor cost. Use our standard included PLC programs or create/modify your own for limitless custom applications. Preprogrammed for a wide variety of typical CNC machine tool functions such as: Lube pump control, Flood pump, mister solenoid, and anything you want to control automatically with G&M codes.

**Allows fully programmable spindle speed control with a simple connection to a wide variety of AC motor inverters. User selectable: 0-5, 0-10, +-5, +-10 Vdc output. User selectable 4 range Analog Input .**

**9 Fused Relay Outputs**

Built-in: Hi-Performance DSP CNC Motion Control CPU

Built-in: 3-axis DC Servo Motor Drive up to 180 VDC & 15 amps per axis!

**Analog Spindle OUT/IN**

16 PLC Inputs

16 PLC Inputs, preprogrammed for typical CNC machine tool inputs such as: Limit Switches, Home Switches, Gear range indicators, Hi/Lo range indicator, E stop, Lube level sensor, Spindle Fault, etc. User definable and editable for custom installations. User configurable voltage and polarity.

Six Servo Motor Encoder Inputs. Direct Encoder feedback to Motion Control CPU and DC Servo Drive for true closed loop CNC control operation. Any spare inputs can be used with Spindle Encoder for Rigid Tapping and Constant Surface Speed, Scales or additional MPG’s!

**Optional Touch Probes, Plug and Play**

**DC Servo Motor Power Supply:** Reuse existing DC servo motor transformers OR directly rectify 110 VAC when using CENTROID DC Servo Motors, eliminating need for transformer when 110 VAC is available. Convenient “CAP and Bridge” power combo board available for either case.

**110, 220, 380, 440 VAC IN**

DC servo power into All-in-One-DC

**DC OUT**

**16 Inputs (5, 12, 24 VDC)**

**16 Relay Outputs**

**4 Digital to Analog Outputs**

**4 Analog to Digital Inputs**

**PLC Add 16**

**Add 4AD4DA**

**Optional I/O Expansion Boards**

Add up to 4 in any combination Up to 80 In / 73 Out

Note: The All-in-One DC includes enough preconfigured I/O for typical milling machine/router/lathe applications, optional expansion boards are available for complex retrofits requiring additional I/O above and beyond the included I/O.

**Optional DC1:**

Single Axis DC Servo Drive. Add up to three DC1’s for a total of 6 axes
SERVO DRIVE WARRANTY DOES NOT COVER DAMAGE BY FAULTY MOTORS OR WIRING.

The information provided by CENTROID relating to wiring, installation, and operation of CNC components is intended only as a guide, and in all cases a qualified technician and all applicable local codes and laws must be consulted. CENTROID makes no claims about the completeness or accuracy of the information provided, as it may apply to an infinite number of field conditions.

As CNC control products from CENTROID can be installed on a wide variety of machine tools NOT sold or support by CENTROID, you MUST consult and follow all safety instructions provided by your machine tool manufacture regarding the safe operation of your machine and unique application.

Servo Motor Handling

When working with servo motors:

- NEVER pick up or carry the motor by the cables or the shaft. (Always carry by the frame.) Use a crane or lift to move the motor when necessary.

- NEVER drop or subject the motor to impact. The servo motor is a precision device.

- NEVER set heavy or sharp objects on the motor or cables. Do not step or sit on the motor or cables.

- NEVER use a metal hammer on any part of the motor. If it is absolutely necessary to use a hammer, use a plastic hammer.

Keep the motor properly secured and away from the edge of the work area when servicing the motor, as a dropped motor could cause personal injury or destroy the motor.
Basic Safety Procedures and Best Practices

For Motors

**Be safely dressed when handling a motor.** Wear safety shoes and gloves. Avoid loose clothing which can get caught on the motor. Be careful not to let hair get caught in the rotary section of the motor. Do not handle the motor with wet hands.

Shut off the power before working on a motor. Wait at least 5 minutes after the motor is shut off before touching any power terminals.

Ensure that the motor and motor related components are mounted securely. Ensure that the base or frame to which the motor is mounted to is strong enough.

Do not touch the rotary section of the motor when it is running unless instructed to.

When attaching a component having inertia to the motor, ensure any imbalance between the motor and component is minimized.

Be sure to attach a key to a motor with a keyed shaft.

Use the motor in appropriate environmental conditions. Do not store flammables in close proximity to the motor. When not in use, store the motor in a dry location between 0° to 40° C.

Do not remove the nameplate from a motor.

For Circuit Boards

Minimize handling circuit boards as much as possible. If you must hold a circuit board, grab it by the edges as shown below in figure 2. Avoid touching any of the circuits, components, or component leads. Improper handling lead to ESD (electrostatic discharge) which can damage the PCB, and shorten the operational lifespan.

![Figure 1. Improper PCB Handling](image1)

![Figure 2. Proper PCB Handling](image2)

Keep the work area free from static generating materials such as Styrofoam, vinyl, plastic, and fabrics.
Table of Contents

Introduction..................................................................................................................................................7
Before You Begin........................................................................................................................................7
Useful Resources........................................................................................................................................7

CHAPTER 1 WHAT'S INCLUDED

1.1 ALLIN1DC...........................................................................................................................................8
1.2 Crimpers................................................................................................................................................9

CHAPTER 2 BENCH TEST HARDWARE SETUP

2.1 Introduction To Bench Testing...........................................................................................................10
2.2 ALLIN1DC Setup................................................................................................................................11
2.3 Encoder Requirements......................................................................................................................13
2.4 ALLIN1DC LED States......................................................................................................................15

CHAPTER 3 SOFTWARE INSTALLATION

3.1 Windows Software Preinstallation Requirements...........................................................................17
3.2 CNC12 Software Installation............................................................................................................18

CHAPTER 4 BENCH TEST

4.1 CNC12 Software Configuration.........................................................................................................23
4.2 ALLIN1DC Bench Test......................................................................................................................30

CHAPTER 5 CABINET WIRING

5.1 Introduction to Electrical Cabinet Layout.......................................................................................33
5.2 Electrically Configuring Inputs on the ALLIN1DC..........................................................................36
5.3 Wiring VM..........................................................................................................................................38
5.4 Wiring Servo Motors.........................................................................................................................40
5.5 Setting Current Limiting....................................................................................................................41
5.6 Wiring E-Stop.....................................................................................................................................43
5.7 Wiring Limit Switches........................................................................................................................45
5.8 Wiring Lube Pump..............................................................................................................................46
5.9 Wiring Coolant Pump..........................................................................................................................48
5.10 Wiring Spindle...................................................................................................................................49

CHAPTER 6 FINAL SOFTWARE CONFIGURATION

6.1 Introduction To Software Configuration............................................................................................52
6.2 Confirm Encoder Communication.......................................................................................................52
6.3 Motor Software Setup.......................................................................................................................53
6.4 Spindle Setup.....................................................................................................................................57
6.5 Coarse Adjustment of DRO Position

6.6 Homing the Machine

6.7 Tuning Maximum Feedrate

6.8 Manually Tune the Acceleration

6.9 Fine Adjustment of DRO Position

6.10 Backlash Compensation

6.11 Software Travel Limits

6.12 Deadstart

6.13 Performing a System Test

CHAPTER 7 APPENDICES

Appendix A – Windows 10 Configuration

Appendix B – Troubleshooting

Appendix C – Servo Motor Compatibility & Recommended Parameters

Appendix D – ALLIN1DC Individual Circuit Schematic Set
INTRODUCTION

This manual describes how to install the Centroid CNC (Computer Numerical Control) system with an ALLIN1DC servo drive. The PC based system provides up to three axes of closed loop servo interpolated motion, controlled by industry standard G-Codes.

The ALLIN1DC can be used for the CNC control of milling machines, routers, lathes, flame cutters, plasma cutters, laser cutters, water jet cutters, drill presses, grinders, and other specialized applications.

This installation manual covers the most common ALLIN1DC hardware setups. For the rest of the manual, we will assume the installation is a three axis mill.

BEFORE YOU BEGIN

Before getting started, please take the time to familiarize yourself with the schematics, manuals, and installation instructions.

While doing the installation, it is very important that you follow the instructions exactly and in order. Doing the installation incrementally and testing as you go will allow you to immediately isolate the cause of any problems that you may run into. Additional troubleshooting is included in the appendices.

USEFUL RESOURCES

Centroid Product Manuals: http://www.centroidcnc.com/centroid_diy/centroid_manuals.html
Centroid’s YouTube Channel: Centroid CNC Technical Support
martyscncgarage YouTube video series: Centroid All in One DC Control - Knee Mill Retrofit.
Free community support: Centroid Community CNC Support Forum
Centroid Allin1DC and Accessories: http://www.centroidcnc.com/centroid_diy/allin1dc_cnc_controller.html
Centroid CNC Components: http://www.centroidcnc.com/centroid_diy/cnc_components.html
Typical ALLin1DC Installation Photo Album https://photos.app.goo.gl/7iGrzZT3bpyhD6VF9
The ALLIN1DC is a complete motion control solution, providing a 3-axis servo drive and full PLC. Make sure your kit is complete and has not been visibly damaged in shipment.

The following components are included with your ALLIN1DC [1]

1. ALLIN1DC ................................................................................................................................... Part Number 11144
2. DC Logic Power Cable .................................................................................................................. Part Number 13106
3. Meanwell RQ-65D ....................................................................................................................... Part Number 7820
4. Twenty position terminal block ................................................................................................... Part Number 3450
5. 2 Ten position terminal blocks ................................................................................................... Part Number 3904
6. Seven position terminal block ..................................................................................................... Part Number 2611
7. 4 Twenty four volt SIPS (color and appearance may vary) ........................................................ Part Number 4152
8. 4 Five volt SIPS (color and appearance may vary) ..................................................................... Part Number 3956
9. 24 Crimp pins for jog panel connector and probe connector ...................................................... Part Number 5511
10. Ten pin probe connector ............................................................................................................ Part Number 5918
11. 26 Crimp pins for MPG connector ............................................................................................ Part Number 5983
12. Twelve pin jog panel connector .................................................................................................. Part Number 5919
13. Twenty four pin MPG connector ................................................................................................ Part Number 5984

[1] The list above contains the minimum quantity that should be included in each parts bag. Some parts bags may have a few extra items.
1.2 CRIMPERS

Crimp Pin Part Number 5511 (Used for making jog panel and probe cables)
The appropriate hand crimpers are available from TE Connectivity as "PRO-CRIMPER III Hand Tool Assembly 91387-1 with Die Assembly 91387-2 (26-22 AWG)" or "PRO-CRIMPER III Hand Tool Assembly 91388-1 with Die Assembly 91388-2 (22-18 AWG)". These tools are sold separately and can be purchased from most major electronics components distributors such as Digi-Key.

Fully assembled cables for jog panels and probes can be bought through Centroid.

Crimp Pin Part Number 5983 (Used for making MPG cables)
The appropriate hand crimpers are available from JST as "YRS-245". These tools are sold separately and can be purchased from most major electronics components distributors such as Digi-Key.

Fully assembled cables can purchased through Centroid using these part numbers:
#11211 6' Internal Probe Cable.
#11086 up to 20' MPG cable
#11029 up to 20' Jog Panel Cable
#10830 up to 16' DC encoder Cable. DB9 to DC encoder flat connector
The first step in installing your new system is performing a bench test. A “bench test” is connecting all of the electronics together to test them before installing the system in a machine. This test is usually done on a work bench, hence the name. A bench test allows you to:

- Troubleshoot hardware and software problems early on, before they can cause permanent damage to the system.
- Identify missing or defective hardware before installing the system.
- Allows for greater visibility when troubleshooting than an electrical cabinet.
- Should a serious issue arise, it gives the user a knowledge base that allows technical support to more quickly and efficiently solve the problem.

The bench test ALWAYS needs to be performed BEFORE applying HIGH VOLTAGE to the servo drive. Applying high voltage to an improperly configured system could cause permanent damage to the hardware and physical harm to the technician or operator. Figure 2.1.1 below shows an example of an ALLIN1DC system set up for a level test. In the following pages we will guide you step-by-step through the setup and execution of a bench test.

**Tools and Equipment Needed**

- **Picking a good location** – A bench test needs to be performed on a large table or desk with good lighting and easy access to electrical outlets. The surface should NOT be made out of metal or contain metal scraps or shavings, as we will be resting powered circuit boards on the surface. Do not use fabric covered surfaces because they put the PBC high risk for ESD (electrostatic discharge) damage. Anti-static mats are normally conductive and make a poor surface for powered boards. Plastic is acceptable, but could put the board at risk for static damage. A wooden surface is an ideal test bench location.

- A PC with an internet connection, or a Centroid console unit (comes with CNC12 already installed). The PC must meet the specifications listed in Technical Bulletin #273, which can be found here.

- A small screwdriver set.

- A digital multimeter

---

Figure 2.1.1
Example of equipment set up for a board level test.
1. **Provide power:**
Connect the supplied DC Logic Power cable to the Mean Well power supply and then plug it into H1 on the ALLIN1DC. Splice a 110 V power cord to the power supply’s AC input. **Live to L, Neutral to N, and Ground to ground.**

2. **Connect the Ethernet Cable:** Connect a shielded Ethernet cable from your ALLIN1DC to the PC. A shielded Ethernet cable will have a metal clip around the RJ-45 connector it as shown by the blue cable in Figure 2.3.9 Centroid recommends using snagless patch cables from StarTech. **StarTech ID# S45PATCH25BL.** This information is outlined in **Technical Bulletin #251**, the latest version can be found [here](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/251.pdf).

3. **NOTICE:** An unshielded cable can cause intermittent PC Data receive errors in the software due to electronic noise and interference.

---

![Unshielded Ethernet cable (gray) compared to Shielded Ethernet cable (blue)](image)

**Figure 2.2.1**
Unshielded Ethernet cable (gray) compared to Shielded Ethernet cable (blue)

---

3. **Connect Any Accessories:** If you have any accessories such as an MPG, jog panel / pendant, or DC1 servo drives. When you are finished, the ALLIN1DC should be wired as shown in the diagram in Figure 2.2.2. (next page) and the picture in Figure 2.1.1 (previous page).
Figure 2.2.2
ALLIN1DC Wiring
2.3 Encoder Requirements

1. The ALLIN1DC uses DC incremental quadrature encoders. Please connect your encoders to the ALLIN1DC, starting at encoder 1 for the first axis. Do not hook up the motor power wires at this time.

If you are making your own cables or using your own encoders, make sure they adhere to the guidelines listed below:

1. **Encoder Cables:** The encoder cables **MUST** be twisted pair shielded cables. The shield wire of the encoder cable needs to be grounded to the metal shield of the DB-9 connector as seen in figure 2.3.1. If the D-sub connector does not provide a method of attaching the shield wire, the shield wire should be soldered to the metal shield DB-9 connector.

1. **NOTE:** Failure to ground the cable shield may cause encoder errors in the software.

![Figure 2.3.1](image)

Cable shield ground attached using solder to the metal shield of the D-sub connector.

2. **Encoder Output:** Encoders must have RS422 type (differential) quadrature outputs with A, B, and Z channels to work with ALLIN1DC. A low encoder count creates poor performance and accuracy. Centroid supplies and recommends 2000 line to 10,000 line encoders for most applications. Ex: 2000 lines = 8000 counts/rev.

**Tips for choosing an Encoder:** Optimal performance requires at least 20,000 Encoder Counts per inch. (Encoder Lines * 4 * ball screw Turn ratio = Counts/Inch)

- Knee mills with a typical turn ratio of 5 turns/inch work well with 2000 line encoders. (2000*4*5=40,000 counts/inch)
- Routers with Rack and pinion axis with a typical 1 turn/inch ratio need minimum 5000 line encoders (5000*4*1=20,000 counts/inch)

The following link lists encoders and premade encoder cables available though Centroid.

http://www.centroidcnc.com/centroid_diy/cnc_components.html

3. The outputs have additional voltage level requirements described in the table below:
4. **Wiring Code**: Wire the encoder according to the figure 2.3.2 and the table shown below. Refer to the encoder manufacturers data sheet for the wiring color code.

1. **Note**: The +5V is an output provided by the ALLIN1DC.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Quadrature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not used</td>
</tr>
<tr>
<td>2</td>
<td>Common (ground)</td>
</tr>
<tr>
<td>3</td>
<td>Z-</td>
</tr>
<tr>
<td>4</td>
<td>A-</td>
</tr>
<tr>
<td>5</td>
<td>B-</td>
</tr>
<tr>
<td>6</td>
<td>Z+</td>
</tr>
<tr>
<td>7</td>
<td>A+</td>
</tr>
<tr>
<td>8</td>
<td>B+</td>
</tr>
<tr>
<td>9</td>
<td>+5V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder channel low level</td>
<td>0.0</td>
<td>0.3</td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>Encoder channel high level</td>
<td>3.0</td>
<td>3.5</td>
<td>5.0</td>
<td>V</td>
</tr>
</tbody>
</table>
2.4 ALLIN1DC LED States

Power up the ALLIN1DC

Wait approximately 30 seconds after starting up the ALLIN1DC before checking the status of the LEDs. The first group of LED are located behind the limit switch header as shown in Figure 2.4.1. A second set of LED's are located in the top corner of the board next to the analog section as shown in Figure 2.4.2. You do not need to remove the cover, but pictures with the cover removed are included for your reference. Check to see that all LED's initialized as defined below in the table of LED states. If any of the LEDs are not initialized properly, check Appendix C for troubleshooting help.

### LED States

<table>
<thead>
<tr>
<th>LED Name</th>
<th>LED Function</th>
<th>Nominal State</th>
</tr>
</thead>
<tbody>
<tr>
<td>+12V Analog</td>
<td>The drive has +12.0 volt power to analog circuitry</td>
<td>Solid Green</td>
</tr>
<tr>
<td>-12V Analog</td>
<td>The drive has -12.0 volt power to analog circuitry</td>
<td>Solid Green</td>
</tr>
<tr>
<td>+3.3V</td>
<td>The drive has +3.3 volt power</td>
<td>Solid Green</td>
</tr>
<tr>
<td>+5.0V</td>
<td>The drive has +5.0 volt power</td>
<td>Solid Green</td>
</tr>
<tr>
<td>+12.0V</td>
<td>The drive has +12.0 volt power</td>
<td>Solid Green</td>
</tr>
<tr>
<td>-12.0V</td>
<td>The drive has -12.0 volt power</td>
<td>Solid Green</td>
</tr>
<tr>
<td>FPGA OK</td>
<td>The FPGA is working correctly</td>
<td>Solid Green</td>
</tr>
<tr>
<td>DSP OK</td>
<td>The DSP is working correctly</td>
<td>Solid Green</td>
</tr>
<tr>
<td>DSP Debug</td>
<td>Multiple functions, for full description see Appendix C</td>
<td>Flashing 1 time per second</td>
</tr>
<tr>
<td>PLC OK</td>
<td>PLC is working correctly</td>
<td>Solid Green</td>
</tr>
<tr>
<td>Drive Fault</td>
<td>Status of the drive fault relay</td>
<td>Turns on after communication is established with the software and all faults are cleared.</td>
</tr>
</tbody>
</table>
Wait approximately 15-30 seconds after the ALLIN1DC has started up. LED1 will display a number. If the seven segment display is displaying a solid number without a decimal point, it indicates the Drive Bus order as seen in Figure 2.4.3. If LED1 is flashing with a decimal point, it indicates an error as shown in Figure 2.4.4.

If you have a blinking “4”, that means the ALLIN1DC is not seeing the limit switches. Since we have not hooked up limit switches yet, you can disable them using SW4 as pictured in Figure 2.4.5. Move the limit switched from the down position to the up position if the switch is black and from the up position to the down position if the switch is blue. If done correctly, your ALLIN1DC will all be displaying it's order in the drive bus chain. For users running an ALLIN1DC without a DC1 drive attached, LED1 will always display a “1”. A table of other drive errors and their definitions is provided below.

<table>
<thead>
<tr>
<th>Error Number</th>
<th>Meaning</th>
<th>Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power Failure (Revision 100315 and earlier only)</td>
<td>The logic power supply is indicating to the ALLIN1DC that it is operation out of specification.</td>
<td>Check power supply wiring. Replace power supply.</td>
</tr>
<tr>
<td>2</td>
<td>15A Not Available</td>
<td>Only applies to “Low Power” versions of the ALLIN1DC. The current select switches on any axis are set to 15A, but the servo drive is not equipped with the appropriate FETs for long term use at 15A, so the servo drive will drop back to 12A</td>
<td>Select 12A or lower current settings or use a “regular” ALLIN1DC.</td>
</tr>
<tr>
<td>3</td>
<td>Null Error</td>
<td>The self adjustment routine has detected too large an offset on the current feedback. Usually indicates a failure of the ALLIN1DC's current sensors.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Limit Tripped</td>
<td>Any limit switch is tripped.</td>
<td>Move away from the limit, check limit switch wiring, or use limit defeat switch if a limit switch is not required.</td>
</tr>
<tr>
<td>Single dash (-) or other unusual behavior</td>
<td>ALLin1DC Logic problem</td>
<td>ALLin1DC Board logic not starting correctly.</td>
<td>Check Logic Power supply or Contact Centroid Support for RMA number. Send the servo drive back for repair.</td>
</tr>
</tbody>
</table>
3.1 **Windows Software Preinstallation Requirements**

1. If you have purchased a console unit or computer from Centroid, it already comes with Windows properly configured and the CNC12 software already installed. If you bought or built your own computer, it must meet the prerequisites listed on the Centroid Website here [http://www.centroidcnc.com/cnc_pc_performance_requirements.html](http://www.centroidcnc.com/cnc_pc_performance_requirements.html) and Tech Bulletin 273 - Centroid CNC PC Minimum Hardware and Benchmark Requirements.


   **Note:** Microsoft Windows 10 is supported with CNC12. Microsoft Windows 8.1, 7 and older versions of Windows are not supported. Mac OS and Linux operating systems are also not supported.

3. Before installing CNC12 all anti-virus, anti-malware, and 3rd party firewall software should be **uninstalled** (not disabled) and your computer rebooted.

   1. **Nearly 100% of all communication problems between CNC12 and the ALLIN1DC are caused by anti-virus and 3rd party firewall software.** Virus software works by stopping unusual or suspicious behavior in software, and will almost always detect the interaction between the ALLIN1DC and the PC as unusual/suspicious and interfere with the operation of CNC12. Firewalls work by blocking certain communication ports, and often these ports are needed for the operation of CNC12. The default firewall built into Microsoft Windows will work fine with CNC12 if you allow access as specified in this manual.

   2. If your corporate policy requires anti-virus software, a third party firewall, or that certain Windows security features be enabled to connect to the network, then Centroid recommends that you keep any computers with CNC12 installed disconnected from the network.
3.2 CNC12 Software Installation

With your bench configuration completely powered as described in Section 2.4 and your PC powered up, install the CNC12 Software as follows:

1. **Download the latest CNC12 Software version.** It is important that you download the latest version of the Centroid CNC12 software before continuing. Click on the link to download the latest version of CNC12 software: [Centroid Software](#).

2. **Navigate to the CNC12 Software you just downloaded.** Depending on your Windows settings, the file you downloaded will be displayed as “centroid-v414-D.zip”. Double click this zip folder.

3. **Drag the installation folder from the compressed file to your desktop as shown below in Figure 3.2.1.** The folder in this example is called cnc12-v414-D, your version may be newer but the name will be the same other than the “v412” which signifies the CNC12 version. Alternatively, you may extract the .zip folder to your desktop.

![Figure 3.2.1](#)

4. **Double click the install folder.** Then double click “centroid-oak-allin1dc-cnc12-v414-d_mill_and_lathe.exe” to begin CNC12 install as seen in Figure 3.2.2

![Figure 3.2.2](#)

5. If “**User Account Control**” is enabled, Windows will ask “Do you want to allow the following program from an unknown publisher to make changes on this computer?” Click “**Yes**”. Windows 10 systems may pop up a Windows Defender SmartScreen showing “Windows Defender SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk”. Click “**More info**”, Then Click “Run anyway”.

6. **Read License Agreement** Read the Software license agreement for using the CNC12 Software. If you accept the terms of the agreement, click “I Agree” to continue, Otherwise, click “Cancel”.
7. Select **CNC12 Mill** for a Mill installation as shown in Figure 3.2.3.

Select **CNC12 Lathe** for a Lathe installation. For the remainder of this document we will assume the system is being installed on a mill.

Click "**Next**", accept default installation servo drive and directory (c:\) and click "**Install**" as seen in Figure 3.2.4. The software will extract as shown in Figure 3.2.5.

![Figure 3.2.3 Selecting CNC12 Mill](image1)

![Figure 3.2.4 Select the C drive](image2)

8. **Click “Next” to continue.** Click "**Next**" in the “Installation Complete” window to continue.

9. **Network Adapter Setup:** (IMPORTANT: Allin1DC needs to be powered up and connected to the CNC PC via the provided Ethernet Cable). Click the down arrow to display the network adapters that are currently installed and select the network adapter that is connected to the ALLIN1DC as circled in Figure 3.2.7. Click "**Next**" to continue. When asked if you would like to change the IP address for the adapter selected, click “**yes**”.

1. **NOTE:** Centroid recommends using a computer with two Ethernet ports. One ethernet port and one Wifi adapter is also acceptable. That way one Ethernet port is used for the ALLIN1DC, and the second wired Ethernet port can be used to access the internet or a LAN. If you do have two Ethernet ports, install the CNC12 software with the Ethernet port that connects to the LAN/internet disconnected. This way the software will install to the correct Ethernet port.

2. **NOTE:** Your IP address will differ from those shown in the picture.

![Figure 3.2.7 Select the network adapter that is connected to the MPU11](image3)

10. **Installing a PLC program:** After the CNC12 software has been installed, the installer will prompt you to install a PLC
program, select “Yes”. Click on the “+” signs next to Mill and ALLIN1DC. Click on “_Centroid_Standard”, then click “Install” as shown in Figure 2.5.7.

1. **NOTE:** If you have a mill, the software should default to _Mill_ → _ALLIN1DC_ → _Centroid_ Standard. If you have a Lathe it should default to _Lathe_ → _ALLIN1DC_ → _Centroid_ Standard. Make sure the software is defaulting to the correct program.

![Figure 2.5.7 Install the PLC program](image)

2. **NOTE:** The following is a quick reference explaining each PLC program and which schematics work with the program.

The Standard ALLin1DC schematics can be downloaded here: Allin1DC DIY CNC System hookup schematics.
The latest version of the Chart is available as Tech bulletin 312 – Standard PLC Program Quick Reference.

### TB312 (Rev 0) – Standard PLC Program Quick Reference

**Purpose:** Provide a quick reference of all Centroid Standard PLC programs so end users can choose an appropriate program that matches the system schematic.

<table>
<thead>
<tr>
<th>Machine Type</th>
<th>Control Type</th>
<th>Machine Features</th>
<th>Feature Type</th>
<th>PLC Program</th>
<th>Purpose</th>
<th>Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill</td>
<td>ALLin1DC</td>
<td>Standard</td>
<td>Centroid</td>
<td>Centroid-Mill-Standard-ALLIN1DC-r2.src</td>
<td>PLC for ALLin1DC w/ wireless MPG and VCP</td>
<td>S14745, S14746, S14747, S14748, S14749, S14750, S14751, S14752, S14753, S14754, S14756</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard_ATC</td>
<td>Swingarm</td>
<td>Centroid-Mill-Standard-ALLIN1DC-ATC-Umbrella.src</td>
<td>PLC for MPU11 and allin1dc, 16/16 umbrella atc</td>
<td>S14817</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard_ATC</td>
<td>Umbrella</td>
<td>Centroid-Mill-Standard-ALLIN1DC-ATC-Umbrella-Skip-First-Count.src</td>
<td>PLC for MPU11 and allin1dc, standardized I/O, 16/16 umbrella atc with no throwaway count on carousel reversal</td>
<td>S14755, S14756, S14757, S14758, S14759, S14760</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Custom</td>
<td>BP-Boss</td>
<td>Centroid-Mill-Standard-ALLIN1DC-BP-Boss-r2.src</td>
<td>PLC for ALLin1DC w/ wireless MPG and VCP</td>
<td>S14758, S14761, S14762</td>
</tr>
<tr>
<td>Lathe</td>
<td>ALLin1DC</td>
<td>Standard</td>
<td>Centroid</td>
<td>Centroid-Lathe-Standard-ALLIN1DC-r2.src</td>
<td>PLC for ALLin1DC w/ wireless MPG and VCP</td>
<td>S14758, S14761, S14762</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard_ATC</td>
<td>Umbrella</td>
<td>Centroid-Lathe-Standard-ALLIN1DC-ATC-Umbrella.src</td>
<td>PLC for MPU11 and allin1dc, 16/16 umbrella atc</td>
<td>S14765, S14766, S14767, S14768, S14769, S14770, S14771, S14772, S14773, S14774, S14775, S14776, S14777, S14778, S14779, S14780, S14781, S14782, S14783, S14784, S14785, S14786, S14787, S14788, S14789, S14790, S14791, S14792, S14793, S14794, S14795, S14796, S14797, S14798, S14799, S14800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Custom</td>
<td>8 Tool electric turret</td>
<td>oak-lathe-8te-v2.src</td>
<td>PLC for ALLin1DC w/ wireless MPG and VCP</td>
<td>S14777, S14778, S14779, S14780, S14781, S14782, S14783, S14784, S14785, S14786, S14787, S14788, S14789, S14790, S14791, S14792, S14793, S14794, S14795, S14796, S14797, S14798, S14799, S14800</td>
</tr>
</tbody>
</table>

11. Click “Finish” to complete CNC12 software installation. After the PLC program installation has completed, click “Finish” to complete the installation.
12. Power off the computer and ALLIN1DC, then restart everything.

13. Configuring Windows Defender Firewall To Allow CNC12 to Communicate with The ALLIN1DC: The first time you run CNC12 under Windows 10, you will see a pop up window asking you if you wish to allow CNC12 to communicate with the ALLIN1DC. Check both the “Private” and “Public” check boxes, in the “Allow cncm.exe to communicate on these networks” section and then click “Allow access” to continue. If CNC12 timed out while trying to initialize the ALLIN1DC, see Appendix C for troubleshooting. During this first start, the software will update the ALLIN1DC. It is especially important that you do not shut off power to the ALLIN1DC during this update.

![Windows Defender Firewall](image)

Figure 2.5.8
Make a firewall exception

14. Confirm that CNC12 start up correctly. Close CNC12 and continue on to the next step.

1. **NOTE** On wide screen monitors, CNC12 will only take up 2/3rds of the monitor screen while running in “full screen”. Turning on Virtual Control Panel will fill the rest of this space.

**Troubleshooting**

If you clicked on the CNC12 icon to start the software and you are getting “**Timeout: MPU11 not responding**” errors, you most likely didn't have the right Ethernet port configured correctly.

Check your Ethernet card to make sure it is configured properly.

Go to “**Control Panel**, select “**Network and Internet**, and then “**Network and Sharing Center**”. Click on “**View network computers and devices**”, Click on the “**Ethernet**) for the connection being used by the ALLIN1DC, select “**Properties**”. Highlight “**Internet Protocol Version 4 (TCP/IPv4)**”, then click “**Properties**” again.

Select “Use the following IP address” then set the IP address and Subnet mask to:

- IP address: 10.168.41.1
- Subnet mask: 255.255.255.0

Click **OK** and then try to start the CNC12 software again.

For more in troubleshooting see Appendices C.
4.1 CNC12 Software Configuration

If your software has been configured correctly, you should see the screen below. If CNC12 does not start because it timed out waiting for the MPU11, see the troubleshooting listed above and Appendix C.

1. **Enter the Software Unlock Demo Code** To enter a software unlock press **F1-Unlock Option** as shown in Figure 4.1.1. In “Enter Unlock #:” enter 297 for demos or 298 for permanent unlocks as shown on your unlock sheet. Press **ENTER**. Look at the value in the “Software Unlocks” sheet that shipped with control. Enter the value next to the unlock number. Press **ENTER**. Continue to the main menu.

2. **Did you install the correct PLC program?** Access the options screen again by pressing **F7 – Utility → F8-Option → F1-Unlock Option**. This time the options screen should contain some additional information. Look for a box labeled “**MPU PLC**” as shown in Figure 4.1.2, check to make sure the correct PLC program is installed. For a mill, the PLC program should read “allin1dc-basic-v2.src” or newer. If your program is not version 2 or newer, it does not support over-riding of the I/O. Therefore, older versions are not support by this documentation.

3. **Install All Other Unlocks** Enter all unlocks provided on your unlock sheet using **F1-Unlock Option** like you did earlier. If you have a permanent unlock **AND** a demo mode code, install both. This will put the features you did not purchase into “Demo mode” allowing you to try out such features as rigid tapping, Intercon, or DXF Import. When the demo expires, the software add-ons labeled “**DEMO**” will go away and any options labeled “**ON**” will remain. To get back to the main menu from the Software Add-Ons menu screen press the Esc key.

From now on when using CNC12, you can always go up one menu level by pressing the escape key (**ESC**). Tapping escape multiple times from any menu will eventually take you back to the main menu.
In the following pages we will be temporarily disabling the fault logic built into your MPU11 based CNC system. CNC12 monitors the signal levels of hardware such as jog panels and encoder inputs, and will generate a fault if any hardware does not respond as expected. In addition, the ALLIN1DC-Basic-V2.src PLC program contains default logic that monitors the inputs for Limit Switches (inputs 1-8), Lube Fault (input 9), Spindle Fault (input 10), Estop (input 11), and Axis Drive Faults (inputs 17-20). If ANY of these inputs are open a fault will be issued.

4. **Change Machine Home Type** Navigate to the “**Control Configuration**” screen as seen in Figure 4.1.3. From the main screen press **F1-Setup → F3 -Config.** The password is 137. Then press **F1 Contrl.** Using the keyboard space bar change "Machine home at power up" to "Jog". Press **F10-Save**

1. **TROUBLESHOOTING TIP** If you cannot save any of your changes in CNC12, close CNC12 by pressing **F10-Shut Down → F9 Exit CNC12.** Right click on CNC12 desktop shortcut. Select **properties.** Click on the **Compatibility** tab. Check the box labeled “**Run this program as an administrator**”. Click “**Apply**”. Click “**OK**”. Start the CNC12 software and try again.

5. **Disable Jog Panel Communication Faults** *(If you have a jog panel or pendant, connect it and skip this step.)* Disable Jog Panel communication faults as seen in Figure 4.1.4. Use the arrow keys to select “Jog Panel Required” in the Control Configuration and press the space bar to toggle to "**No**". Press **F10-Save.**

After saving, press **escape** to go back to the Main Screen. Press **F10-Shutdown, → F2 Power Off.** After the computer shuts down, cut the power to the ALLIN1DC and the PC via switching off your outlet strip. Wait 30 seconds and power everything back up.
6. Disable PLC faults for Limit Switches, Lube, Spindle, Estop and Axis Faults. At the main screen press the alt and i keys to bring up the real-time I/O display as shown in Figure 4.1.5. Using the arrow keys, move the selection box to the top left of the inputs. The screen should read “INP1 Ax1_MinusLimitOk” as circled below. Press the ctrl, alt and i keys simultaneously to invert this input.

You will notice that the LED will turn from red to green and a line will be drawn over the top to indicate that it the state of the input has been programmatically inverted. Repeat the process until inputs 1-11 and inputs 17-20 are green as shown below. If the input is already green, leave “as is” and don’t invert. When your done, press alt and i again to exit the override menu.

1. **NOTE**: Using ctrl, alt and I simultaneously to disable I/O only works for those using the latest version of the default Centroid provided PLC program. On a custom or outdated PLC programs (versions before ALLIN1DC Basic Version 2), this feature may need to be added to the PLC code. If your PLC code supports this feature, it will have a variable named “SV_enable_override” in the .src file used by the PLC.

![Figure 4.1.5](image_url)  
*Disabling inputs using alt + i*

7. **Label the Axes**: From the main menu, press F1-Setup → F3 -Config. The password is 137. Press F2 Mach. → F2 Motor. Under “Label” configure the software for the correct number of axes and label them appropriately. Typical set up for a mill is axis 1 labeled X, axis 2 labeled Y, axis 3 labeled Z. Any unused axes should be set to “N” to disable the axis as seen in Figure 4.1.6. The Spindle Axis will be set up in section 6.4.

![Figure 4.1.6](image_url)  
*Labeling the axes.*
8. **Configure Drive Bus Assignment** – The CNC12 software needs to be configured to know where each axis of the ALLIN1DC is. The ALLIN1DC uses something called “Drive Bus” to communicate with the CNC12 software. For a three axis mill, ALLIN1DC axis 1 (labeled axis 1 on the ALLIN1DC drive cover) should be configured as **drive bus channel 1**, ALLIN1DC axis 2 should be configured as **drive bus channel 2**, etc...

These parameters can be reached by pressing **F1-Setup → F3 -Config** from the main menu. The password is 137. Press **F3-Parms** then **F8-Next Table** multiple times until parameter 300 – 307 is displayed. Typical configuration for a three axis CNC is to set parameter 300 = 1, 301 = 2, 303 = 3 as seen in Figure 4.1.7. **Unused axises need to be set to zero, or errors will occur!**

![Figure 4.1.7](image)

**Setting up the Drive Bus and encoders**

9. **Configure Encoder Assignment** – Just like in the previous step, the CNC12 software needs to be configured to know where each encoder of the ALLIN1DC is. Unlike the previous step, the ALLIN1DC does not use “Drive Bus” to allow the encoder to communicate. Instead, the ALLIN1DC uses the on board MPU11 encoder channels via parameters 308 – 315. For a three axis mill parameter 308 = 1, 309 = 2, 310 = 3. Unused encoders axes can be left “as is”, they do not need to be set to zero.

10. **Disable Spindle Axis**: Disable spindle errors by disabling the spindle in the parameters. The machine parameter menu can be reached by pressing **F1-Setup → F3 -Config** from the main menu. The password is 137. Press **F3-Parms**. Use the arrow keys to navigate to the field labeled “35”. Click enter to edit the field. Type a zero to disable the spindle. Press enter, then F-10 save.

![Figure 4.1.8](image)

**Disable the spindle axis**
11. **Configure Encoder Counts per Revolution** The encoders need to be set up for the correct number of counts per revolution. A quadrature encoder line count is multiplied by 4 to get the counts per revolution. For older Centroid DC servo motors with 2,000 line encoders, the correct setting is 8,000 counts per revolution. Current Glentek DC motors sold by Centroid come equipped with 5,000 line encoders or 20,000 counts/rev. “High resolution” encoders(10,000 line) are 40,000 counts/rev. From the main menu, press **F1-Setup → F3 Config**. The password is 137. **F2-Mach → Motor F2**. Enter the counts into the “Encoder counts/rev” field as circled in Figure 4.1.9. Repeat this for each axis.

![Figure 4.1.9 Encoder Counts/Rev](image)

12. **Disable Stall Detection** – Stall detection must be disabled from the PID menu. From the main menu, press **F1-Setup → F3 Config**. The password is 137. Press **F4 – PID**. Press the “Ctrl” key and the “V” key simultaneously to disable stall detection. If done correctly text saying “Stall detection disabled” will appear right below the status window.

1. **NOTE**: Every time you restart the ALLIN1DC, you will have to disable stall detection again.

![Figure 4.1.10 Disabling Stall Detection](image)
13. Clear Software Ready Faults  Anytime the CNC12 software has been exited and restarted without the hardware also being powered off and restarted, the CNC12 software will report a “Software Ready Fault” as demonstrated below in Figure 4.1.11. A “Software Ready Fault”, like spindle, lube, encoder and position fault is a “stop fault”. A “stop fault” removes power from all servo motors, prevents program or MDI operation, turns off all drive and spindle enables, and requires that the Estop input MUST be cycled in order to clear the fault. During the bench test we will trick the software into thinking we cycled the E-stop (not connected yet), by toggling the input 11.

To clear a stop fault, press the alt-i keys to bring up the real-time I/O screen. Use the arrow keys on the keyboard to select the “INP11 EStopOK” as shown below in Figure 4.1.12. Press the ctrl, alt, and i keys to toggle the EstopOK input until it turns red then green.

Notice that as you toggle the EstopOk input to red “406 Emergency Stop Detected” is displayed in the status window as shown above in Figure 4.1.13. When the emergency stop is pressed notice how “2099 Message Cleared” is displayed, referring to clearing the “9039 stop fault”. Toggling EStopOK back to green displays “335 Emergency Stop Released”.

![Figure 4.1.11](image1)

**Figure 4.1.11**
Software Ready Fault

![Figure 4.1.12](image2)

**Figure 4.1.12**
Toggling E-stop

![Figure 4.1.13](image3)

**Figure 4.1.13**
Status window showing the emergency stop clearing faults.
14. **Clear Any Existing Faults Before Beginning Bench Testing.** To confirm that all faults have been cleared before continuing, press F3 MDI from the main menu. If all faults have been cleared correctly, the screen should look like Figure 4.1.14.

If the screen shown in Figure 4.1.14 is not displayed, there is an existing fault. Please check the status window to determine the cause of the fault and then cleared of faults. Confirm that all parameters are set as required and that all inputs (1-11 & 17-20 green) are in the correct state.

**Troubleshooting Tip:** CNC12 keeps a log file containing all errors and faults, along with the time and date that these errors occurred at. You can access this log from the main menu by pressing F7 – Utility → F9 – Logs → F1 – Errors.

All faults shown in Figure 4.1.15 (as well as other faults) are “Stop Faults”. Stop faults cancel existing jobs, prevent new jobs from being started, stop the spindle, prevent motion, and require that the E stop PLC input be cycled (opened and closed) to clear the fault(s) before continuing. If you have any stop faults, they will have to be removed then E-stop will have to be toggled as shown in the previous step.

15. **Set up Virtual Control Panel (VCP).** The machine parameter menu can be reached by pressing F1-Setup → F3 -Config from the main menu. The password is 137. Press F3-Parms. Use the arrow keys to navigate to the field labeled “219”. Click enter to edit the field. Type a “1” to enable VCP. Press enter, then F-10 save. Use of the VCP requires support from the PLC program.

16. **Set up Wireless MPG.** Use of the CWP-4 Wireless MPG requires the USB MPG Software Unlock Option (Part# 14688) Start CNC12, and open CNC12 Utility Menu, press “Options” and “Unlock Option” and install the USB MPG plug-in code. USB MPG will be set to (ON). Got to F3-Parms and Set MPG CNC12 parameter #218 = 15 for 4 axis Mills/Routers, #218=7 for 3 axis Mills/Routers and #218 = 3 for Lathes. (MPG Type) Set MPG CNC12 parameter #348 = 15 (MPG ON) and #350 = 100 (100 steps per rev) Shut Down and restart CNC12 for new parameters to take effect.

17. **New Features.** As new features and parameters are defined, these will be documented in the CNC12 Mill and Lathe manuals as well as in Tech Bulletin 313 - Centroid CNC12 New Parameter Quick Reference.
4.2 ALLIN1DC Bench Test

Bench testing the ALLIN1DC will confirm that the ALLIN1DC is operational and that the software has been properly configured to begin the installation process. Bench Testing is **required** as it provides a known base configuration that our support engineers can refer to when trying to diagnose any issues that may arise. To complete Bench Testing, a DVM (Digital Volt Meter) is required.

1. **Set Home and load spindlebenchtest.cnc:** Home the machine by pressing start. From the main menu press **F2-Load.** Use the arrow keys to select the file spindlebenchtest.cnc

   1. If **spindlebenchtest.cnc** is **not present in the c:\cncm\ncfiles directory** it can be downloaded here: [spindlebenchtest.cnc](http://centroidcnc.com/usersupport/support_files/benchtest/spindlebenchtest.cnc)

   2. Download spindlebenchtest.cnc. If your web browser does not provide an option to download spindlebenchtest.cnc and instead displays a bunch of code, copy the code from your web browser into your default text editor (such as notepad++). Save the file as spindlebenchtest.cnc in the CNC12 root directory (see next step).

   3. Place spindlebenchtest.cnc in your CNC12 root directory.

      1. Right click on your CNC12 shortcut
      2. Click **properties** as shown in figure 4.2.1.
      3. A window will pop up, go to the "shortcut" tab and click **“open file location”** as shown in Figure 4.2.2.
      4. Open the folder labeled "ncfiles". Paste spindlebenchtest.cnc into the ncfiles directory.
      5. In the load menu of CNC12 press **F5-refresh**.

   2. With spindlebenchtest.cnc highlighted, press **F10 Accept.** If the DRO does not display when you press alt-s, you likely encountered a fault. See clearing faults is covered in section 4.2.3

   ![Figure 4.2.1](image1)
   ![Figure 4.2.2](image2)
   ![Figure 4.2.3](image3)

   **Figure 4.2.1**
   Right click on CNC11 and click “properties”

   **Figure 4.2.2**
   Select the “shortcut” tab and click “Open File Location”

   **Figure 4.2.3**
   Selecting spindlebenchtest.cnc
Testing the analog output for the spindle: The Alin1DC provides a 0 to +10VDC analog output to provide programmable spindle speed control using a VFD (variable frequency drive). The default maximum spindle speed specified in the Control Configuration is 3000rpm. This configures the control to scale the 0 to +10VDC from 0-3000rpm. A spindle speed command of S1500 will therefore output +5VDC, a command of S1000 will output +3.33VDC and so on.

1. Set a digital voltage meter to VDC

2. Connect the seven pin terminal block into connector H9

3. Insert the digital voltage meter leads into H9 as shown in Figure 4.2.4. Tighten down the screw terminals to firmly grip the probes.

4. With spindlebenchtest.cnc loaded, press Cycle start (alt-s) to begin. The following screen will be displayed: (You may have to press Cycle start twice)

5. Enter the voltage readings as pictured, and press Cycle Start to continue. Spindlebenchtest.cnc will throw an error if the spindle does not output as expected. Continue to press cycle start as requested until the program is finished. The program will exit and the status window will say “Job finished” after a successful completion.
1. Encoder Test

1. Make sure the encoders are connected to the ALLIN1DC

2. From the main menu press **F1-Setup → F3-Config**. The password is **137**. Press **F4-PID**.

3. Manually spin the output shaft of the servo motor counter-clockwise as shown in Figure 4.2.5. In the PID menu, confirm that absolute position (Abs Pos) counts up as the motor is rotated as shown in Figure 4.2.6. Repeat for each axis.

4. Manually rotate the motor one full revolution. Record how much the motor has counted.

5. From the main menu press **F1-Setup → F3-Config**. The password is **137**. Press **F2-Mach → F2 Motor**. The number you recorded as the number of counts per revolution should approximately match the number you entered for encoder counts per revolution.
5.1 Introduction to Electrical Cabinet Layout

Now that you are finished with the board level test it is time to think about electrical cabinet installation. In this chapter of the manual we will go into detail about how to wire the various systems into your cabinet. During cabinet wiring it is important that you follow the schematic provided by Centroid.

Relevant martysncgarage video: Backpanel part 1, Backpanel Part 2, Backpanel part 3

Below is a suggested layout for the major components on your electrical panel.

For more detailed wiring instructions, please see the schematic that was shipped with your kit, Additional Schematics are found here, http://www.centroidcnc.com/downloads/allin1dc/centroid_allin1dc_schematic_set.zip
**Best Practices**

- **Minimize Noise and Interference**
  
  ◦ **Keep sensitive electronics away from noisy equipment.** Install high voltage transformers, contactors, and other electrically noisy equipment as far away from low voltage circuit boards as practical. For example, it would be a bad practice to mount a contactor block or large transformer directly underneath the ALLIN1DC.

  ◦ **Keep high voltage power lines far away from low voltage signal lines.** Keep the high-voltage AC power lines and motor power lines as far away from low voltage logic signals as practical.

  ◦ **Grounding Principle.** Wire the incoming chassis (earth) ground lug directly to a single ground bus bar. Wire all cabinet doors, power supply chassis grounds, and other equipment chassis ground to one single ground bus bar. What you should **NOT** do is have several different grounding points throughout the cabinet, as this could increase electrical noise and interference.

  ◦ **Leave plenty of space between wire ducts and components.** Keep wire ducts at least 2" away from circuit boards when practical.

  ◦ **Use Snubbers on Contactors.** Contactor blocks and relays need a snubber across the coil. Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise. If you are new to using snubbers more information can be found in **Technical Bulletin #206**, the latest version can be found [here](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/206.pdf).

  ◦ **Keep wires short** Keep all cabinet wiring under 6ft.

- **Keep the cabinet maintainable and easily serviceable.** Centroid can provide electrical cabinet materials such as contactors blocks, time delay contactor blocks, relays, fuse blocks, din rails, overload relay with fuses, din rail end stops, terminal blocks, etc. Call Centroid for details.

  ◦ **Wire management** Use PVC wire ducts (such as Panduit Panduct) to keep your wires neat and organized.

  ◦ **Use DIN Rails** Use DIN rails for mounting relays, contactors, terminal blocks, circuit protection blocks, disconnects, etc.

  ◦ **Leave a little bit of slack in the wire.** Take all corners in the wiring ducts as wide as possible. Always leave a little bit of slack in the wires.

  ◦ **Keep all the wiring in neat horizontal and vertical lines.** Never run wires diagonally.

  ◦ **Label EVERYTHING.** Label everything so that it matches the labels on your schematic. This includes labeling each individual wire at both ends, circuit boards, relays, contactors, etc.

  ◦ **Don’t lose the schematic.** Keep the schematic attached to the cabinet somewhere so it does not get lost.

- **Use the correct AWG** Below is the **minimum** AWG for the ALLIN1DC.

  **Minimum Wire Gauge (AWG)**[^1]

<table>
<thead>
<tr>
<th></th>
<th>VM+</th>
<th>VM-</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low power ALLIN1DC[^2]</td>
<td>16</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>ALLIN1DC with Centroid single phase rectifier (Part number 12726)</td>
<td>14</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>ALLIN1DC with Centroid two phase rectifier (Part number 10767)</td>
<td>12</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

1. **Minimum Wire Gauge:** Recommendations for typical applications – cable lengths, drive current setting, and motor loads may change requirements. Always follow the electrical code. This chart assumes multi-stranded copper wire is used.

2. **Low power ALLIN1DC:** A specialized low power version of the ALLIN1DC is available that supports extremely small motors from 5 to 9 amps.
Common Wiring Problems

The following information is also covered in Technical Bulletin #78 which can be found here. (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/78.pdf)

5.1 Introduction to Electrical Cabinet Layout

- The wire is too small for the spade terminal
- Red = 18-22 ga, Blue = 14-16 ga.
- This wire is too large for the spade terminal
- Do not cut strands away!

Wrong Crimp Tool!

- 22 ga

Wrong Crimp Tool!

- 12 ga

These are for cutting wires, not stripping!

This type of tool is used for stripping wires.

When cutting back the insulation on a cable, do not cut the insulation on the wires inside the cable.

There are cuts in these wires from careless stripping of cable. This is very bad.

A cutter cannot be used to strip wires!

Some strands are cut because a cutter was used to strip.
The inputs of the ALLIN1DC can be configured for either 5, 12, or 24 volts DC. The input voltage is changed by changing the resistance of the SIP (single inline package) resistor.

The SIP resistance is defined by the last three numbers of the manufacturer's part number as shown in Figure 5.2.1. Of the last three numbers, the first two digits signify the value of the resistance. The last digit signifies the number of zeros after the value. For example, if the manufacturer’s part number is “4308R-102 LF – 222”, the values 222 define the resistance. The resistance is 22 plus two zeros, so the final value is 2200 Ohms. The chart next to Figure 5.2.1 defines which resistors are needed for which voltages. Allin1DC Controls ship with the 2.2K Ohm Sips installed for 24VDC operation.

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>Centroid SIP Part #</th>
<th>SIP Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5VDC</td>
<td>3950</td>
<td>470 Ohm(471)</td>
</tr>
<tr>
<td>12VDC</td>
<td>4152</td>
<td>1K Ohm(102)</td>
</tr>
<tr>
<td>24VDC</td>
<td>1548</td>
<td>2.2K Ohm(222)</td>
</tr>
</tbody>
</table>

Looking closely at the ALLIN1DC, the silkscreen is labeled “SIP1, SIP2, SIP3, and SIP4” as shown in Figure 5.2.2. Each SIP controls a group of I/O as demonstrated by the table below.

<table>
<thead>
<tr>
<th>Input Group</th>
<th>SIP Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs 1-4</td>
<td>4</td>
</tr>
<tr>
<td>Inputs 5-8</td>
<td>3</td>
</tr>
<tr>
<td>Inputs 9-12</td>
<td>2</td>
</tr>
<tr>
<td>Inputs 13-16</td>
<td>1</td>
</tr>
</tbody>
</table>
All inputs on the ALLIN1DC can be configured for sourcing or sinking operation using either 5, 12 or 24 volts DC. The inputs are arranged in groups of four with a common shared by each input in a group.

There are two ways to wire I/O on the ALLIN1DC:

- **Sourcing** Connecting the inputs to power is sourcing. The negative lead of the power supply must be connected to common. This is demonstrated on inputs 1-4 in Figure 5.2.3.

- **Sinking** By connecting the inputs to ground is sinking. The positive lead of the power supply must be connected to common. This is demonstrated on inputs 5-8 in Figure 5.2.3.

![Diagram of Sourcing and Sinking](image-url)
5.3 Wiring VM

This information is also contained in Technical Bulletin #286 contained here. (http://www.centroidcnc.com/dealersupport/tech_bullets/uploads/286.pdf)

**DANGER:** It is important that the ALLIN1DC, the rectifier, and all other hardware is powered off before wiring or troubleshooting. The reservoir capacitor must be given adequate time to discharge before wiring or troubleshooting. The DC output of the rectifier will measure less than 10VDC if the reservoir capacitor is adequately discharged.

The ALLIN1DC controls DC (direct current) servo motors. VM, is the voltage coming from the DC rectifier, though the contactor and into the ALLIN1DC. The actual motor output of the ALLIN1DC is a pulse-width modulated, PWM, signal but the VM voltage is what is connected between VM+ and VM- on the ALLIN1DC. Typically, motors will have a nameplate on the motor stating the maximum rated DC voltage of that motor as shown in the photo below. VM Voltage should not exceed the rated motor voltage.

![Image of motor with nameplate](image)

If the motor doesn't have a nameplate, as long as the model number is known, a datasheet of that model motor should contain that information. An AC-to-DC converter known as a rectifier turns AC power into DC power. This rectifier is sometimes called a “Cap board” because it contains an extremely large reservoir capacitor. At the time of this writing there are two rectifier options to choose from:

<table>
<thead>
<tr>
<th>Rectifier Part #</th>
<th>PCB Name</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>12726 &amp; (10537 with transformer)</td>
<td>CAPBRDLO</td>
<td>125 VAC Max, single phase</td>
<td>180 VDC Max</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(155 VDC typical for an 110 VAC input)</td>
</tr>
<tr>
<td>10767 &amp; (10010 with transformer)</td>
<td>CAPBRDHI</td>
<td>240 VAC Max, two phase</td>
<td>180 VDC Max</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(155 VDC typical for a 220 VAC input)</td>
</tr>
</tbody>
</table>

The DC voltage out of the rectifier circuit must **NEVER** exceed the maximum voltage rating of any of the motors that are to be controlled by the ALLIN1DC. The DC voltage generated by the rectifier circuit can be determined using the following formula.

\[
\text{Rectified DC Output Voltage} = 1.414 \times \text{AC Rectifier Input Voltage}
\]

If 110VAC is being connected to the rectifier circuit, it will produce roughly 156VDC. If the motors that are to be controlled by the ALLIN1DC have a maximum rated voltage lower than 156VDC, then a step-down transformer **MUST** be used in order to lower the rectified DC output voltage. The transformers mentioned above take the incoming AC voltage and step it down to approximately 83VAC which produces a rectified DC output voltage of approximately 117VDC. To determine the maximum AC input voltage that is needed to connect to the rectifier circuit for the motors that are installed onto the ALLIN1DC, the following formula is to be used.

\[
\text{AC Rectifier Input Voltage} = \frac{\text{Rectified DC Output Voltage}}{1.414}
\]
**Centroid recommends** using a Schneider Electric/Telemecanique LC1DT40B7A or similar device for the E-stop contactor (Centroid PART# 14374). This Contactor includes snubber assembly and uses 24VAC to control it. **Both** the VM- and VM+ go through the E-stop contactor.

A snubber needs to be placed across the contactor(s). Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise when the servo motor power is cycled on and off.

The E-stop wiring is covered in-depth during section 5.6.

---

**Figure 5.3.1**
Simple Illustration depicting Allin1DC VM and Estop Circuit
5.4 Wiring Servo Motors

The ALLIN1DC supports a wide variety of DC motors. Information on supported motors is provided in Appendix D. The ALLIN1DC must be powered off before attempting to wire motors. DO NOT PROVIDE POWER TO THE MOTORS UNTIL INSTRUCTED TO DO SO. Do not mechanically connect the motors to the machine until told to do so. Check Servo motors before connecting to ALLIn1DC. A bad servo motor will damage the ALLIn1DC. Follow Tech Bulletin 155 – Quick Checks for Servo Motors.

Relevant martysncngarage video: Backpanel part 4 & Motor/Encoder hookup & Servo motor current setting

Motor Installation Procedure

1. With the servo motor disconnected from the ALLIN1DC, check for >100 MΩ between the motor chassis, and the motor power terminals.

2. With the servo motor disconnected from the ALLIN1DC, check for >100 MΩ between the ALLIN1DC chassis and the ALLIN1DC motor power terminals.

3. Wire the servo motors to the servo drive.
   1. Connect the motor power to the ALLIN1DC as shown below in Figure 5.4.1.
   2. Connect the shield ground from the motor cable to either of the two shield terminals on the ALLIN1DC.

4. With the servo motors connected, confirm continuity between motor chassis and the ALLIN1DC chassis using a DVM/multimeter.
   1. DANGER An ungrounded servo motor is an electrocution hazard. Always confirm continuity with a multimeter!

5. NOTICE: Never remove the brushes from a DC motor. They do not wear out and more costly damage may result by removing them unnecessarily.

6. Connect each encoder cable to the proper ALLIN1DC encoder input. The “Encoder 1” input corresponds with Axis 1, Encoder 2 corresponds with Axis 2, etc.
   1. NOTE: Encoders 4, 5, and 6 are for accessories. They can be used to connect additional servo drives to the ALLIN1DC (such as a DC1), add extra encoders to reduce error, custom MPG's, etc. These advanced uses will not be covered in this manual.
5.5 Setting Current Limiting

The ALLIN1DC has a switch that limits that maximum amount of current to the servo motor. The purpose of this feature is to prevent the ALLIN1DC from burning up the servo motor. A hole in the cover is provided to allow users to adjust the maximum current without having to remove the servo drive cover as shown in Figure 5.5.1. For your reference, a close up picture of the current selector switch is shown in 5.5.2. If the switch is black, ON is away from the PCB while OFF is towards the PCB. If the switch is blue, ON is towards the PCB while OFF is away from the PCB. Use the tables below to set the current correctly.

Use Appendix D to determine the correct current settings for your motor. For optimal performance, the current settings on the ALLIN1DC need to be set at a higher value than the current rating on the motor.

NOTICE: When adjust the current, push carefully on the switch! The switch levers are plastic and can easily brake off if too much force is used.

![Figure 5.5.1 Location of Current Switches](image)

![Figure 5.5.2 Old Style Black Current Switches](image)

![Figure 5.5.3 New Style Blue Current Switches](image)
### Current Setting

<table>
<thead>
<tr>
<th>Current Setting</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>Switch 4</th>
<th>Switch 5</th>
<th>Switch 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Amps</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>9 Amps</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>12 Amps</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>15 Amps</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

### Low Power ALLIN1DC Drive Current Settings

<table>
<thead>
<tr>
<th>Current Setting</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>Switch 4</th>
<th>Switch 5</th>
<th>Switch 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Amps</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>6 Amps</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>7 Amps</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>9 Amps</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

### Common Current Settings for Stock Centroid Motors

<table>
<thead>
<tr>
<th>Motor Size</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 in-lb motors</td>
<td>6 Amps</td>
</tr>
<tr>
<td>16 / 17 in-lb motors</td>
<td>9 Amps</td>
</tr>
<tr>
<td>29 in-lb motors</td>
<td>12 Amps</td>
</tr>
<tr>
<td>40 in-lb motors</td>
<td>15 amps</td>
</tr>
</tbody>
</table>

**Notice:** Additional information for 3rd party motors available in Appendix D and Tech Bulletin 288.
5.6 Wiring E-Stop
(refer to the picture on the next page and the picture in 5.3.1)

A general guide to E-stop wiring and motor power troubleshooting is contained in Technical Bulletin #286 which is located here. (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/286.pdf)

Relevant martyscncgarage video: PID, Estop, Limit Switch, Lube & Final Encoder Testing

1. E-Stop Wiring
   The emergency-stop (or E-stop) is a safety mechanism used to shut off the machine during an emergency. The switch should be closed when the machine is in its operational state. Wiring E-stop in a normally open configuration is dangerous as it will not stop the machine in the event that a wire breaks. It also prevents noise from causing spurious faults because the signal is being electrically held at the operational level. For additional safety, multiple E-stops can be added to a machine but they all must be wired in series.

1. E-Stop Switch – Use a double pole single throw (DPST), normal closed, twist to release, emergency stop switch. Such as Centroid part number #1009 used with #5934.

2. ALLIN1DC E-Stop - There are two E-stop signals, one input and one output.

   1. Input 11 Input 11 on header H1 needs to be routed in series with any E-stop switches (such as a jog panel or pendant), so that if any of the E-stop switches are tripped the PLC knows the E-stop is engaged as seen in Figure 5.5.1. Please note that SIP1 sets the E-stop input voltage to either 5V, 12V, or 24V. Failure to install the proper SIPS to match the voltage levels being used will damage the ALLIN1DC. Setting SIP1 correctly is outlined in Section 5.2.

   2. Output 1 (AKA drive fault relay) The E-stop contactor must be routed in series with output 1 and any E-stop switches, so that if any of the E-stop switches are tripped the power is removed from the contactor block as seen in Figure 5.5.2. The ALLIN1DC's output 1 relay is rated for up to 10 amps at 125 VAC or up to 5 amps at 30 VDC. Please use the lowest voltage practical, as a high voltage can result in excessive noise that will create undesirable effects. Centroid recommends using 24 VAC.

      1. NOTE: If additional servo drives axis are added using a the Centroid DC1, all drive fault relays need to be wired in series with the ALLIN1DC output1. This makes it so that if one drive throws a drive fault, ALL the servo drives are stopped simultaneously.

3. Contactor – Centroid recommends using a Scheneider Electric/Telemecanique LC1DT40B7A or similar device for the E-stop contactor (Centroid PART# 14374). This Contactor includes snubber assembly and uses 24VAC to control it. A snubber needs to be placed across the contactor(s). Centroid recommends using Quencharc snubber networks (Centroid PART# 1819). This reduces electrical noise when the servo motor power is cycled on and off. It is best practice to run both the VM- and VM+ through the E-stop contactor

2. Testing E-Stop Wiring

   1. Power up your system.

   2. Start CNC12 and press F10 to continue to the main screen

   3. Enable the E-stop (which was inverted during board level testing). In the main menu press alt + I to bring up the real time I/O display. Click on input 11. Press the ctrl-alt-i keys simultaneously to remove the bar over the input in the display, enabling your E-stop.

   4. Provide AC power to the E-stop contactor.

   5. Toggle the E-stop. Confirm that there is not bar over input 11. Check that input11 is green when the E-stop is released (not tripped), and red when E-stop is pressed. Refer to Technical Bulletin #286 for troubleshooting if necessary.
5.6 Wiring E-Stop

**Figure 5.6.1**
Example of E-Stop Input Wiring

**Figure 5.6.2**
Example of E-Stop output Wiring
5.7 Wiring Limit Switches

All inputs used for Limit switches must be wired in normally closed configuration. The switch should be closed when the machine is in its operational state. Wiring any of these inputs in a normally open configuration is dangerous as the machine will not stop in the event that a wire breaks. It also prevents noise from causing spurious faults because the signal is being electrically held at the operational level.

The I/O configuration on every machine is different. While the examples below assume dry contact type switches and utilize 24VDC, your machine may utilize different voltage levels and different type devices such as NPN or PNP proximity sensors. If your devices are proximity sensors, they MUST be 3-wire sensors, **2-wire sensors will not work reliably**. Make sure the SIPS you installed in section 5.2 match the voltage levels for your devices.

The limit switch defeaters (SW4) on the ALLIN1DC need to be pointed **DOWN** if SW4 is black and **UP** if SW4 is blue to be able to use the limit switches.

Failure to install the proper SIPS to match the voltage levels being used will **damage** the ALLIN1DC.

Connect your limit switches as shown below in Figure 5.7.2.

**Testing Limit Switch Wiring**

1. Power up your system.
2. Start CNC12.
3. Invert the limit switches (which were inverted during board level testing). In the main menu press alt + I to bring up the real time I/O display.
4. Select the appropriate limit switch input (input 1 – 8), and press the ctrl-alt-i keys simultaneously to remove the bar over the input in the display. This will enable that limit switch.
5. Confirm that all limit switches are are green when nothing is tripped. Confirm that the correct input turns red when the switch is tripped.
5.8 Wiring Lube Pump
(refer to the picture on the next page)

The typical lube pump circuit consists of two parts: The first part is the control of the lube pump itself which is controlled by output 2 sending 110VAC to the lube pump. The second part is the low lube alarm signal which gets wired to input 9. The low lube signal tells the control to produce a "405 Low lube" alarm which inhibits the control from starting a new job until the lube pump is refilled and the alarm is cleared.

Failure to install the proper SIPS to match the voltage levels being used on Inputs 9-12 will damage the ALLIN1DC. Spindle Fault, E-Stop Input, and Lube Fault all have to be wired to run off the same input voltage using the default PLC program.

Keep in mind that the ALLIN1DC output relay is rated for up to 5 amps DC or 10 Amps AC. If your lube pump draws more current you will need to install a contactor.

When wiring your lube pump it is important to know which type of lube pump you have so that you configure it correctly. Typically lube pumps come in one of 3 types:

- **Mechanical Cam Actuated Lube Pump:** This pump is based on a simple mechanical plunger riding on a clock motor driven cam. The advantage of this type of lube pump is that it is reliable and it remembers where it was and how much run time has been accumulated even between power cycles. So that you actually get lube for 5 seconds every 10 minutes of machine use.

- **Electronic Lube Pumps:** These pumps try to imitate the mechanical cam pumps but often forget where in sequence they were when powered off. There are two types of Electronic lube pumps, “lube first” which pumps lube immediately after power on. This typically results in too much lube. The second type is “lube last”, this type waits a set amount of time before lubing the machine. The problem with this type is on small jobs your machine may never get any lube, possibly damaging the machine. To avoid this some people wire the lube last type to get power all the time which results in too much lube.

- **Direct controlled lube pumps:** These pumps are controlled by the control via the PLC program and the software. With this type the lube pump is not responsible for the timing of the pump actuation. **This method is the best for reliable and even lubing of your machine.**


**Enabling Lube Inputs**

1. Power up your system.
2. Start CNC12 software.
3. Invert the lube fault input (which was inverted during board level testing). In the main menu press alt + I to bring up the real time I/O display.
4. Click on input 9, and press the ctrl-alt-i keys simultaneously to remove the bar over the input in the display. This will enable your lube fault input.
5. Confirm that input 9 is green while the pump has lube. If the pump has a low lube alarm, confirm that the correct 9 turns red when the pump is low on lube.
+24VDC CONNECTED TO THE INPUT COMMONS WITH THE INPUTS PULLED DOWN TO 24VDC COMMON IS STANDARD (SEE NOTE 1)
5.9 Wiring Coolant Pump

By default ALLIN1DC output 3 is the coolant flood pump output and output 4 is the default output for a coolant mist pump. If you have a custom PLC program your I/O may be different.

This sub-circuit shows how to hook up a 3 phase Flood Pump. Because the pump in this example draws more power than the ALLIN1DC is rated for, a Flood Contactor (Centroid PART# 3959) is needed.

All contactors need snubbers! Centroid recommends using the Quencharc snubber network (Centroid PART# 1819) on the coil of the contactor. This reduces electrical noise when flood coolant is cycled on and off. A thermal overload is also shown, this part protects the pump motor by opening the circuit if it stalls for any reason, such as metal chips in the pump.

Centroid recommends a thermal overload protector. The example below diagram depicts the 24VAC wired through the NC contacts on the overload section of the contactor. The overload protection circuit on your existing contactor may be labeled differently or there may be no overload protection.

Figure 5.9.1
Sample Flood Pump Circuit
5.10 Wiring Spindle

**STOP:** Before wiring up the spindle make sure that you already tested the spindle as directed during the board level tests.

There are two methods of wiring a spindle:

1. Connect three phase directly to an induction spindle motor (shown on the next page in Figure 5.10.1). Hooking the three phase directly saves costs, but prevents the Centroid CNC software from being able to control the speed of the spindle. The spindle speed will have to be controlled by mechanical methods such as pulleys.

2. Use a spindle controller. (A sample using a GS2 inverter is shown on the following pages in Figure 5.10.2). The terms “inverter” (short for power inverter), “AC Drive”, and “VFD” (Variable Frequency Drive) can all refer to the spindle controller. Centroid does not provide spindle controllers and recommends using Delta Products VFDs, Automation Direct GS2 and GS3 AC drives, as well as Yaskawa VS (Varispeed) Inverters. It is the responsibility of the technician installing to consult their spindle controller manufacturer for support.

With the default PLC program, several of the I/O are decided for use with a spindle. Input 10 is the spindle fault input. Output 7 is the spindle fault output. Output 5 is the inverter fault reset. Output 8 is the inverter direction. Output 10 is for a spindle cooling fan. Always refer to your schematic.

Failure to install the proper SIPS to match the voltage levels being used on Input 9-12 will damage the ALLIN1DC. Spindle Fault, E-Stop Input, and Lube Fault all have to be wired to run off the same input voltage using the default PLC program.

A thermal overload protector is recommended. It should be wired in series with the spindle enable as shown below in Figure 5.10.1, so that both the ALLIN1DC and the overload protector can stop the spindle.

All contactors need snubbers! Centroid recommends using the Quencharc snubber network (Centroid PART# 1819) on the coil of the contactor. This reduces electrical noise when the spindle is turned off and on.

For spindle slaved movements such as rigid tapping, the spindle encoder needs to be connected to the ALLIN1DC. The spindle encoder must meet the prerequisites listed in section 2.3. Rigid tapping should be enabled last, after the spindle is functioning. A multitude of software parameters need to be set up for rigid tapping, which is beyond the scope of this document. More information on how to set up rigid tapping is contained in your CNC12 operators manual and Technical Bulletins.

Figure 5.10.1
Sample Spindle Wiring
### ALLIN1DC Wiring For Inverter

<table>
<thead>
<tr>
<th>ALLIN1DC I/O</th>
<th>Function</th>
<th>ALLIN1DC I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT 5</td>
<td>Spindle Fault Reset</td>
<td>OUT 8 NO (Normally Open)</td>
<td>Spindle Reverse</td>
</tr>
<tr>
<td>OUT 7</td>
<td>Spindle Enable</td>
<td>IN 10</td>
<td>Spindle Fault</td>
</tr>
<tr>
<td>OUT 8 NC (Normally Closed)</td>
<td>Spindle Forward</td>
<td>DAC OUT</td>
<td>Spindle Speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ADC IN</td>
<td>Spindle Load</td>
</tr>
</tbody>
</table>

### Sample Inverter Spindle Wiring

Figure 5.10.2
Sample Inverter Spindle Wiring
6.1 Introduction To Software Configuration

This chapter assumes that you have completed the board level test, and have built up a level of confidence with the hardware and software. The PID settings and appropriate CNC12 parameters for the ALLIN1DC need to be entered into the software as described during the board level test before continuing with chapter 6.

Clear Any Existing Faults Before Continuing. To confirm that all faults have been cleared before continuing, press F3 MDI from the main menu. If all faults have been cleared correctly, the screen should look like Figure 4.1.10. See Appendix C for troubleshooting.

Figure 6.1.1
MDI mode, indicating that all faults have been cleared.

6.2 Confirm Encoder Communication

This section assumes encoders are already set up, which was done during section 4.1.

1. **DANGER: MECHANICALLY DISCONNECT THE SERVO MOTORS FROM THE MACHINE.** The servo motors need be able to move freely. Failure to disconnect the motors from the machine could result in personal injury or damage to the machine.

2. **Confirm Encoder Feedback on all axes**

   1. From the main menu, press **F1-Setup → F3-Config**. Password is **137**. Press **F4 PID**

   2. Manually rotate each motor while watching the abs pos field (circled below) for that axis as seen in Figure 6.2.1. Confirm that you have smooth feedback on all axes and that X updates the X DRO, Y updates Y DRO etc.

   3. Confirm that the absolute position increases for while rotating the shaft counter clockwise as shown below in Figures 6.2.1 and 6.2.2.

Figure 6.2.1
Confirm encoder rotation

Figure 6.2.2
Encoder counting up when the motor shaft is rotated counter clockwise.
6.3 Motor Software Setup

1. CNC12 supports velocity, torque, and precision mode. The ALLIN1DC is designed to run only in torque mode. Make sure the ALLIN1DC is set to torque mode pressing Setup (F1) → Config (F3) (Password 137) → Parms (F3). Repeatedly hit Next Table (F8) to bring up parameter 256. Parameter 256 should be set to 0.

2. In the PID menu, enter the servo motor parameters menu as shown below in Figure 6.3.1. Press Setup (F1) → Config (F3) (Password 137) → PID (F4) → PID Config (F1). Consult Appendix D for the proper PID settings.

3. Enter in Kp, Ki, Kd and Limit. Kg, Kv1, Ka and Accel will be automatically filled out by autotune performed later in this chapter.

4. Press Save & Exit (F10). Return to the main menu.

1. Do not have stall detection disabled for the rest of this manual. (Section 4.1)

5. Release E-stop to clear all errors and provide VM power to the servo motors.

6. Set the feedrate to around 10%

7. Jog each servo motor while it is disconnected from the machine if you have not already done so. Use the arrow keys on the jog panel or MDI commands to confirm that the motors are moving correctly. While jogging, disable increment mode by making sure the button on your jog panel labeled 'Incr Cont' is not lit up.

1. DANGER: The first time jogging the servo motor, best practice is to have it disconnected from the machine. (Either by physically removing the motor, or removing a gear or drive belt.) This way if something goes wrong, there is a minimal risk of mechanical damage to the machine. If one of the parameters or settings was entered incorrectly during the setup, the motor may oscillate violently or move out of control.

2. NOTE: After jogging, when the motor stops moving a little bit of “rumbing” noise from the motors is considered normal. This is just the sound of the motors trying to hold position.

3. TROUBLESHOOTING TIP #1: If movement does not occur, check for errors in the “status” window.

4. TROUBLESHOOTING TIP #2: If during jogging or while holding position the motors are visibly oscillations during, there is most likely a problem with your PID settings. Manual tune the motor. Use Technical Bulletin #260 which can be found here. (http://www.centroidcnc.com/dealersupport/ttech_bulletins/uploads/260.pdf)

5. TROUBLESHOOTING TIP #3: During the troubleshooting process if you want the motors to stop holding position issue a M93 command using the MDI terminal.

6. TROUBLESHOOTING TIP #4: If the motors “take off” or “run away” or start spinning and then fault out with “SV_ Stall Error”, this is due to the control not seeing the proper encoder signals. Check to see that the encoders are configured correctly. This would also occur if the motor power leads were reversed. The control would be commanding
8. After successful servo motor movement, power down the system.

9. Manually move all axes to the center of their travel to provide safe clearance when the motors are connected to the machine.

10. Mechanically connect the servo motors to the machine, allowing the motors to control the movement of the machine.

**Manual Tuning** – Manual tuning of the Kp, Ki, and Kd can be performed to reduce motor movement errors. In most cases this is unnecessary. Users experiencing excessive servo motor “whine” or “singing”, difficulty with motors holding position, or motor oscillations should manually tune their values. Additionally, in some cases users may get a very small accuracy increase by manual tuning. Manual tuning is covered in **Technical Bulletin #260** which can be found [here](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/260.pdf). Further instructions can be found in the following video: **Centroid CNC control DC Servo Motor PID Tuning Procedure**

Settings for 3rd party Servo manuals can be found in **TR288 – Allin1DC Settings for 3rd Party Servo Motors**

11. Power up the machine. Release E-stop to provide power to the servo motors.

12. **Check home configuration** During the board level test in Section 4.1 we changed the machine home at power up to jog. Double check to make sure it is still set to jog as demonstrated in figure 6.3.2.

   1. **DANGER**: Since your limit switches have not been configured correctly yet, homing to limit switches right now could cause physical damage to your machine.

   ![Figure 6.3.2](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/260.pdf)

   **Figure 6.3.2**
   Checking home configuration

13. Make sure the feedrate is turned down to around 10%

14. Press the Start button on the jog panel, or Alt+S from the keyboard. This will cause the machine to set home right where it is.

15. Slow jog each of the servo motors, checking that each axis of the machine can move.
16. **Configure servo motors to move in the correct direction** Mechanically connect the motors to the machine. It is important to understand that correct servo motor direction is determined by the motion of the tool relative to the part. This is not necessarily the same as the motion of the table. More information on this procedure is also covered in Technical Bulletin #137, which can be found [here](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/137.pdf).

Relevant martyscncgarage videos: Checking Axis Direction Movement on the Knee Mill and Properly Reversing an Axis with Centroid CNC All in One DC

For axes that move the table while the tool remains stationary such as the X & Y axes on a typical Bridgeport type knee mill, the table motion is the opposite of the “tool motion”. For axes that move the tool, such as the quill on a knee mill, axis motion is the same as the tool motion. The Figures 6.3.3 and 6.3.4 below describe this concept.

Figure 6.3.3
Difference between table motion and tool on a knee mill.

Figure 6.3.4
Table verses tool movement

In the above illustration 6.3.4, the tool is moving in the X+ direction relative to the part while the table moves to the left.
Configuring motors to move in the correct direction (continued)

Use MDI to move each axis and determine if the axis is moving in the correct direction. To determine this, observe that the DRO counts more positive while moving an axis in the positive direction and that it counts more negative while moving in the negative direction. To correct for an axis that is moving in the wrong direction, from the main menu press **F1 -Setup → F3 Config.** The password is **137**, Press enter. Press **F2 Mach → F2 Motor.** Use the arrow keys to select the “Dir Rev” field for the axis that needs to be corrected and press the space bar to toggle it's current state as seen in Figure 6.3.5.

![Figure 6.3.5](image)

**Direction reversal**
6.4 Spindle Setup

From Main Screen Setup (F1) → Config (F3) (Default Password = 137) → Ctrl (F1)

The Control Configuration screen provides you with a method of changing controller dependent data. If you wish to change a field, use the up and down arrow keys to move the cursor to the desired field. Type the new value and press <ENTER>. When you are done editing, press <F10> to save any changes you have made. If you wish to discard your changes and restore the previous values, press <ESC>.

### Maximum Spindle Speed (High Range)

This field sets the high range maximum spindle speed for those machines that have a variable frequency spindle drive (VFD). All spindle speeds entered in a CNC program are output to the PLC as percentages of this maximum value. If your machine is equipped with a dual range spindle, see the Parameters 65-67 section below.

### Minimum Spindle Speed (High Range)

This parameter sets the minimum spindle speed when in high range. If minimum spindle speed is set to a value greater than zero, the spindle voltage will output the minimum voltage equivalent until the commanded spindle speed is greater than the minimum spindle speed. The values stored can range from 0 to 500000.0 RPM.
Enabling The Spindle Fault Inputs

If the spindle fault circuitry is used, invert the spindle fault input (which was inverted during board level testing). In the main menu press alt + I to bring up the real time I/O display. Press the ctrl + alt + I keys simultaneously to remove any bars over the input in the display. This will enable the spindle inputs.

Enable Spindle Encoder Parameters

If a spindle encoder is being connected to the ALLIN1DC, modify the following parameters as specified in the CNC12 Operator's Manual.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Spindle Encoder Counts/Rev</td>
<td>Dependent on Line Count of Spindle Encoder (Line x 4)</td>
</tr>
<tr>
<td>35</td>
<td>Spindle Encoder Axis Number</td>
<td>6</td>
</tr>
<tr>
<td>78</td>
<td>Spindle Speed Display and Operations</td>
<td>1</td>
</tr>
</tbody>
</table>

If the spindle is counting in the wrong direction, invert parameter 34. Example: Change Pr 34 = 4000 to Pr 34 = -4000

Parameters 65-67 – Spindle Gear Ratios

These parameters tell the control the gear ratios for a multi-range spindle. Up to four speed ranges are supported; high range is the default. Parameters 65-67 specify the gear ratio for each lower range, relative to high range. For example, if the machine is a mill with a dual range spindle, and the spindle in low range turns 1/10 the speed it turns in high range, then parameter 65 should be set to 0.1.

Parameter 65 is the low range gear ratio.

*Note: Some machines use a Back Gear, if one is in use then the low range gear ratio will need to be a negative value.*

Parameter 66 is the medium-low range gear ratio.

Parameter 67 is the medium-high range gear ratio.

These parameters work in conjunction with the PLC program, which uses the states of INP63 and INP64 to signal to the CNC10 software which range is in effect, according to the table below.

<table>
<thead>
<tr>
<th></th>
<th>High Range</th>
<th>Medium High Range</th>
<th>Medium Low Range</th>
<th>Low Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>INP63</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>INP64</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
NOTE: An alternative method is to use math to get a course estimation. This is described in the first part of Technical Bulletin #36, which can be found here. ([http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/36.pdf](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/36.pdf))

The value being displayed by the DRO screen is calculated from knowing how much the servo motor moved, and the motor revolutions per inch/mm (usually controlled by the ball screw). Before we can fine tune the DRO to an exact number, we need a course estimate to get us close.

Later in this chapter after tuning the servo motor, we will perform a fine adjustment on the motor revs/in (mm/rev for metric systems) to calculate an exact value.

1. **Jog the machine** Jog the machine so that the spindle is in the center of the table.

2. **Zero the software** From the main menu, press F1 – Setup → F1 Part → F10 Set Zero as shown below in Figure 6.4.1.

![Figure 6.4.1 Setting Part Zero](image)

3. **Set Up a Tape Measure on the Table** Set up a tape measure on the table so that 0” is lined up under the center of the spindle.

4. **Command the machine to move.** The longer the move the more accurate your final calculation will be. It is recommended that you move the machine at least 1 foot. Use the MDI command. From the main menu, press F3 MDI. If we were testing the X axis for example we could type “X 12”.

   1. **WARNING**: Turn the feed rate down and be prepared to hit E-stop. Since your limit switches have not been completely configured it is possible to crash the machine if it moves too far.
5. **Calculate the value** Enter into the servo motor parameters menu. From the main menu press **F1 -Setup → F3 Config**. The password is **137**, Press enter. Press **F2 Mach → F2 Motor**.

6. **Repeat the test as needed until the DRO matches the measuring tape.**

7. **Repeat the test for each axis.**
6.6 Homing the Machine

This same procedure is outline in Technical Bulletin #22, the latest version can be found here. (http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/22.pdf)

1. Creating and Editing the Homing File

Your software comes with a default homing file that will work for most cases. If you have a machine with an unusual number of axes (such as a rotary table, CNC controlled grinder, CNC controlled drill press, extra lathe axes, etc..) or an unconventional limit switch configuration editing the home file will be necessary. If you do not need to edit your home file, skip to the next page.

1. Exit CNC12.

2. Right click on your CNC12 desktop shortcut.

3. Select properties as shown in Figure 6.5.1.

4. In the shortcut tab, click on “Open File Location” as shown in Figure 6.5.2.

5. Windows explorer will open up in a new window showing the contents of your CNC12 directory (The directory will be called “CNCM” or “CNCT” depending on weather you have a mill or a lathe).

6. If “cncm.hom” (“cnct.hom” for lathes) is present, double click on it. If not the file present, it will have to be created. To create this file, right click on cncm folder in the Windows File Explorer. (cnct for lathes). Select “new”, then select “text document”. A file will be created named “New Text Document.txt”. Rename this file “cncm.hom” (“cnct.hom” for lathes).

1. TIP Centroid recommends using Notepad++ as your default text editor. Notepad++ can be downloaded here. (http://notepad-plus-plus.org/)

7. Edit the file as needed as seen in Figure 6.5.3. There should be the correct number of axes defined in this file, and they should be listed in the correct order.

1. Centroid recommends that the Z positive axis is always homed first to prevent damage to the machine!

8. Make sure to save any changes that you make.
2. Start CNC12

3. Configure Limit Switches


2. **Prerequisite:** The servo motor movement direction (discussed in Section 6.3) must be configured correctly before testing the limit switches! Move the machine so that the spindle is in the center of the table.

3. **Enter the motor parameters menu.** From the main menu press F1 -Setup → F3 Config. The password is 137, Press enter. Press F2 Mach → F2 Motor.

4. Manually trip the minus limit switch for the X axis by physically pressing it / blocking it. Try to jog the machine. It should only move in the plus direction. If it does not, change the limit switch in software as shown below in Figure 6.5.4.

   1. **NOTE:** If you disabled the limit switches earlier by using ctrl+alt+l on inputs 1-6 (limit switches), you will need to re-enable them by pressing alt + l to bring up the I/O screen and ctrl + alt + l to “undo” and limit switch inputs with a bar above them.

5. Repeat the previous setup for each of the home switches.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Label</th>
<th>Motor revs/in</th>
<th>Encoder counts/rev</th>
<th>Lash Comp. (Inches)</th>
<th>Limit</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>2.0000000000</td>
<td>8000</td>
<td>0.000000</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>2.0000000000</td>
<td>8000</td>
<td>0.000000</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Figure 6.5.4
Reversing limit switches in software

4. **Change the home type** From the main screen press F1-Setup → F3 -Config. The password is 137. Then press F1 Control. Using the keyboard space bar change "Machine home at power up" to "Limit Switch" as shown in 6.5.5.

5. **Restart the Machine**

6. **Home the Machine:** From the main menu. When the machine asks you to home, press “start” on the jog panel or “Alt+S” to home the machine. The machine should move slowly towards each jog switch.

   1. **DANGER:** Adjust the feedrate as needed so that the machine moves slowly. Be prepared to press E-stop if anything unexpected occurs.

   2. **NOTE:** If the machine stops homing and the main menu says "Warning: Machine not homed" a limit switch was pressed in the wrong order and the machine faulted out. Please check the order of your limit switches as shown above.
Exit to the main menu. Enter the maximum feed rate in the Jog Parameters menu (F1 – Setup, F3 – Config, Password 137, F2 – Mach., and then F1-Jog.)

Use the following equation to get an estimation: \( \text{maximum motor rpm} / \text{motor revolutions per inch} \times 0.85 = \text{maximum feed rate} \).

The calculated maximum feedrate may be too high due to variations in supply voltage and load. Use MDI commands to test the calculated machine maximum feed rate. Gradually issue faster feed commands until the maximum is determined. If the machine is displaying the following symptoms the maximum feed rate is too fast and should be decreased:

- The load bar graph in the DRO display of the main menu is red, indicating excessive load on the motors
- The software is giving errors such as position errors.
- Motors are overheating.

**Troubleshooting TIP:** The autotune tool can automatically adjust the maximum feed rate and acceleration for the servo motors. The autotune tool will set the servo motors to the maximum performance that they are capable of. In many cases, the machine cannot handle the mechanical stress of running at such high speeds and acceleration rates. Therefore it is recommended that you do not use autotune, but manually tune the maximum feed rate and acceleration for best performance.

If you desire to go the autotune route, from the main menu autotune can be found at F1- Setup → F3 – Config. The password is 137. F4 – PID → F5 – Tune.)

---

6.6.1 Adjusting maximum feed rate
6.8 MANUALLY TUNE THE ACCELERATION

Acceleration is the time for the axis to reach maximum velocity. An acceleration rate of 0.1 second is very fast, where an acceleration rate of 1.0 will be considered very slow. CNC12 defaults to an acceleration of 0.5. We are going to create a “worst case scenario” test program and manually decrease the acceleration until the machine starts to approach its limits.

Acceleration tuning is a fairly subjective process. What is might be acceptable for one person might be unacceptable for another person. Often the limiting factors are the amount of mechanical stress that the machine can handle and the amount of current that can be provided to the motors.

Using the jog panel, move the machine so that the axes are in the middle of their travel. Make sure the real time I/O display is not showing in the main menu (press alt + I to toggle the real time I/O display). Check to make sure the machine feed rate override on the job panel/pendant is set to it’s maximum value (typically 120%).

Creating a the Test Program From the main menu press F1 – Setup → F3 – Config. The password is 137. Press F4 – PID → F1 – PID CONFIG → F1-Edit Program. We are going to adjust PID_Collection_Moves.txt to test our acceleration values.

Adjust the Feedrate First, we need to adjust the feed rate of PID_Collection_Moves.txt so that it reflects the maximum feed rate calculated in the previous step. For example, if the maximum feedrate was calculated to be 500 inches per minute we would change the default program from “F100” to “F500.

Adjust the Movement Second, we need to adjust the movements of the test program. A “good” test program should generally move the machine as follows:

1. Wait stopped for 0.1 to 1 seconds
2. Accelerate the machine up to it's maximum speed
3. Run at maximum feed rate for 0.5 to 1 seconds
4. Decelerate from maximum feed rate to a compete stop
5. Wait stopped for 0.1 to 1 seconds
6. Accelerate to maximum speed again, but this time going the opposite direction
7. Run at maximum feed rate (going the opposite direction) going back to where the program started
8. Decelerate from maximum feed rate to a compete stop
9. Repeat at step 1

A sample mill program is below:...

G20; Inch mode
G90; Absolute positioning mode
F500; Set the feedrate to the maximum feedrate
G4 P0.5; Delay for 0.1 second
G1 X0.0; Move to our starting position
G4 P0.5; Delay for 0.1 second
G1 X3; Execute a short move. We want this move to allow the machine to reach maximum speed for 0.5 -1 seconds.
G4 P0.5; Delay for 0.1 second
M102; Rerun the program, repeating infinitely

Save your changes to the program when you are finished editing it. Press F2-Run Program to test out your changes. Press F7 – Zoom All to get a clearer graph on the right side of the screen. If done correctly, your program will look similar to the Figure 6.7.1 on the next page.

Troubleshooting Tip: The program is suppose to run infinitely. If the screen says “Finished Running Program” or if no motors are moving exit to the main menu. There is likely an error on the status menu.
What's going on here?

"VAbs" and "ErrAbs" are the only values we care about while adjusting acceleration.

Vabs: (graphed in green on Figure 6.7.1) is the velocity of the motor. The Y axis indicates how fast the motor is going. A large positive number corresponding to a fast movement in the positive direction, a large negative number corresponding to a fast moment in the negative direction, and a zero value indicates that the axis is not moving. A “slope” indicates that the motor is accelerating, whereas a straight line indicates no acceleration. If your program is adjusted correctly, the Vabs graph should look similar to this:

ErrAbs: (orange in Figure 6.7.1). The Y axis indicates the amount of error position of the servo motor measured in encoder counts. The “Value” column next to ErrAbs indicates the error in inches or mm. In the figure below the error is 0.00003”. It is impossible to have an error of zero. The error should be acceptable (15 encoder counts is typical) before continuing with acceleration tuning. If the error is excessive, manually tuning of the PID loop will have to be performed.

How To Tune

1. Run the test program

   1. Check that:
      1. The ErrAbs is showing an acceptable amount of error (typically over 15 encoder counts).
      2. The acceleration rate is not causing shock or vibration as the machine moves.
      3. The machine movement is not becoming becomes bumpy, rough, or jerky.
      4. The machine is not creating unusual or loud noises such as thunks or rapping noises.
      5. The software is not giving errors such as position errors.

2. If any of these problems are showing acceleration rate is too fast, stop the test program. Slightly decrease the acceleration rate (by increasing the accel value). Run the test program again. If the problem goes away you are at your maximum acceleration value.

3. If no problems are found, stop the test program. Increase the acceleration rate (by decreasing the acceleration time). Repeat process.

4. Repeat the process for each axis by editing PID_Collection_Moves.txt
6.9 **Fine Adjustment of DRO Position**  
( Fine Adjustment of Machine Rev's Per Inch / MM )

This method is also described in Method 2 of *Technical Bulletin #36*, the latest version can be found [here](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/36.pdf).


For **imperial** machine configurations the number of motor revolutions required to move 1” must be calculated.

For **metric** machine configurations the number of mm's traveled during one revolution of the motor must be calculated.

3. **Attach a dial indicator**: Attach a dial test indicator (also known as a lever arm test indicator or a finger indicator) to the spindle.

   1. **NOTE**: If you purchased a probe from Centroid, there is an easier method of adjusting the DRO position. Use of the probe will not be covered in this document.

4. **Create a Test Fixture**: Create an “L” shaped block of material to act as a reference for measurement as seen in Figure 6.8.1. The material should be appropriately 6 inches to 12 inches in length. A longer material will give you better accuracy. The **exact** length of the “long” part of the “L” needs to be known. A gauge block attached to another gauge block is recommended. An example test fixture is shown below.

   The long part of the “L” is from is guage block measuring 12.000”

5. **Secure the test fixture** Attach the test fixture to your machine so that it runs parallel to the axis being tested.

6. **Move the dial indicator into position**: Start from away from the block and jog towards the top of the “L”. Set jog panel mode to incremental when you get close. Move the spindle so that the dial indicator is reading as close to “0” as possible as demonstrated in Figure 6.8.2.

   1. **NOTE**: Only jog towards the block. If you jog too close and have to back up slightly, backlash will be introduced into your measurement. In that case you will have to start the test again.
7. **Zero the software** From the main menu, press F1 – Setup → F1 Part → F10 Set Zero as shown below in Figure 6.8.3.

![Figure 6.8.3 Setting part zero](image)

8. **Raise the spindle**: Move the spindle so that it is away from the text fixture. If we are configuring the X or Y axes we need to raise the Z-axis.

9. **Move to the base of the “L”**: Jog towards the base of the “L”. Set jog panel mode to incremental when you get close. Move the spindle so that the dial indicator is reading as close to “0” as possible as shown in Figure 6.8.4.

   1. **NOTE**: Only jog towards the block. If you jog too close and have to back up slightly, backlash will be introduced into your measurement. In that case you will have to start the test again.

![Figure 6.8.4 Zeroing the dial indicator again](image)
10. **Calculate Values:** Go into the motor parameters menu. From the main menu press **F1 -Setup → F3 Config.** The password is 137, Press enter. Press **F2 Mach → F2 Motor.**

![Image of motor parameters menu](image)

**Figure 6.8.5**

Fine adjustment of motor revs/in or mm/rev

1. **Imperial Units:** To calculate the value to be entered in the revs/inch field. Divide the distance moved (DRO value) by the distance that the axis actually moved. Multiply this result by the current value in the rev/inch field. This the new value that you will enter in the revs/inch field. If the axis traveled 6", but the command was 7.5" 7.5/6 = 1.25, if the current revs/inch is 5.000 * 1.25 = 6.25 is the new value to enter in the revs/inch field.

2. **Metric Units:** To calculate the value to be entered in the mm's/revs field. Divide the distance that the axis actually moved by the distance commanded (DRO value). Multiply this result by the current value in the mm's/rev field. This the new value that you will enter in the mm's/rev field. If the axis traveled 150mm", but the command was 175mm, 150/175 = 0.85714285, if the current mm's/rev is 5.08 * 0.85714 = 4.35428 is the new value to enter in the mm's/rev field.

11. Repeat the test as needed until the DRO measures the same as the gauge block.

12. Repeat the test for each axis.
6.10 Backlash Compensation

This same procedure is outlined in Technical Bulletin #37, the latest version can be found here. (http://www.centroidcnc.com/dealersupport/tech_bullets/272kb/uploads/37.pdf)

1. Adjust Mechanical Lash: Before configuring the “electronic” backlash compensation in the control, every effort should be made to reduce the mechanical lash in your machine to less than 0.001”. (Use the test below to verify your backlash is less than 0.001). The electronic backlash compensation provided by the control will help, especially in point to point moves, but the overall accuracy of your machine is determined purely by the amount mechanical lash in the machine.

2. Attach a dial indicator: Attach a dial test indicator (also known as a lever arm test indicator or a finger indicator) to the spindle.

   1. NOTE: If you purchased a probe from Centroid, there is an easier method of performing this test. Use of the probe to perform software backlash compensation will not be covered in this document.

3. Zero Previous Backlash Values: Enter into the motor parameters menu. (From the main menu press F1 Setup → F3 Config. The password is 137, Press enter. Press F2 Mach → F2 Motor.) Zero out any backlash that was previously entered into the control.

4. Secure a Test Fixture: Mount a piece of metal to the machine to act as a reference. A gauge block recommended. You may re-use the test fixture you created for configuring your motors to move the correct distance.

5. Move the dial indicator into position: Start from away from the block and jog towards it. Set jog panel mode to incremental when you get close. Move the spindle so that the dial indicator is reading as close to “0” as possible as demonstrated in Figure 6.9.1.

   1. NOTE: Only jog towards the block. If you jog too close and have to back up slightly, backlash will be introduced into your measurement. In that case you will have to back way up and start again.
6. **Zero the software** From the main menu, press F1 – Setup → F1 Part → F10 Set Zero as shown below in Figure 6.9.2.

![Figure 6.9.2 Setting part zero](image1)

7. Back the spindle 0.025 away from the gauge block at a feedrate of 0.5 inches per minute. This can be done by using the MDI menu (F3 from the main menu) and typing “G1 X- 0.025 F0.5” for the X axis.

1. **NOTE:** It is important that you use extremely slow feedrates. Faster feedrates will introduce inconsistencies due to the inertia of the table.

8. Move the axis back to the zero position. Type “G1 X0 F.5” in the MDI screen.

9. If the number is less that 0.001”, enter the value shown into the “Lash Compensation” section of the motor parameters menu as shown below in Figure 6.9.3. (from the main menu press F1 Setup → F3 Config. The password is 137. Press F2 Mach. → F2 Motor.) If the number is greater than 0.001”, there is a mechanical accuracy problem with your system. Reduce the mechanical lash before adjusting the backlash compensation.

![Figure 6.9.3 Adjusting backlash compensation](image2)

---

**Page 70 of 81**

6.10 Backlash Compensation
6.11 Software Travel Limits

This information is also contained in Technical Bulletin # 289, the latest version can be found here.

Relevant martyscncgarage video: Setting Software Travel Limits

NOTICE: Without software travel limits the machine can go maximum speed until a limit is tripped as shown in Figure 6.10.1. Often times, there is not enough time to decelerate the axis after the limit switch is tripped causing the machine to crash into the hard stop. This collision may cause serious damage to the damage to both the mechanical and electrical system.

Setting software travel limit will automatically decelerate the axis right before it reaches the limit switch, preventing possible damage to the machine as shown in Figure 6.10.2. Additionally, the CNC12 software will throw an error and stop the machine if a G code requests the machine to move past the software travel limit.

1. Prerequisites: Before starting machine revs per inch / mm (DRO) needs to be calibrated correctly, the limit switches need to be functioning, and the maximum feed rate and acceleration should be correctly set up. Restart the machine and home it before continuing with this procedure.

2. Make sure your looking at the machine position and not the part position. From any menu, press the “alt” key and “D” key simultaneously until “machine” is displayed in the top left corner of the DRO as shown in Figure 6.10.3.

3. Put the machine into “Slow jog” mode and turn the feed rate down. Slowly moves the axis away from home toward the limit switch on the opposite end of the axis until the limit switch trips. The status screen will display message such as “407 ## limit (#50004) tripped”.

4. Put the jog panel into incremental mode. Slowly increment to away from the limit switch until the limit switch is cleared. The status screen will display a message such as “340 ## limit (#5003) cleared”.

5. From the main menu, press F3 MDI and issue a command to move another 0.1 inches (2.5 millimeters) away from the limit switch. This DRO position will be our software travel limit.

6. From the main menu, press F1 – Setup → F3 - config. The password is 137. Press F2- Mach. → F1-Jog. In the jog parameters menu. Enter the position for the software travel limit into the appropriate “Travel (-)” or “Travel (+)” box.

1. NOTE: When both the Travel(-) limit and the Travel(+) limit are set to zero, software travel limits are disabled. As soon as one of the two values change to a non-zero value, both limits are enabled. This can be seen in figure 6.10.3. Since everything is referenced to machine position, the side of each axis that you “home to” should be left at zero.

7. Repeat for each axis.
8. Test by manually jogging each axis toward the limit switch. Watch that the software automatically stops the axis at the software travel limit before the limit switch is tripped. Use the F3 – MDI menu to issue a G-code that asks the software to move just beyond the software travel limit, if set up correctly the CNC12 status window will throw an error such as “907 # axis travel exceeded, 325 Limit: job canceled”.

“alt” + “D” to toggle the DRO mode to display the machine coordinates.

Set up software travel limits here.

Figure 6.10.3
Setting Software Travel Limits

6.12 DEADSTART

Deadstart is located in the jog parameters menu and has to do with direction reversal of an axis. The deadstart usually doesn't have to be changed from the default value on a Milling machine. Sometimes very light wood routing tables with very low friction and low inertia can benefit from a deadstart change along with other "hand tuning." Call in if you have this case.

6.13 PERFORMING A SYSTEM TEST

In some versions of CNC12 software, when finished, the main menu will display a message saying “Machine Setup Not Completed. Machine Is Not Ready To Run. Contact Your Dealer” as shown below.

At this point you will need to run the System Test to clear this message. Documentation on how to perform a system test is located here. (http://centroidcnc.com/usersupport/support_files/tbs/Systemtest.pdf)

The following video by martyscncgarage is also a useful reference Centroid CNC System Test

If the instructions outlined in system test do not apply to your system, contact technical support.

Figure 6.12.1
Machine Requiring a System Test
This procedure is outlined in Technical Bulletin #309. The latest version can be found here:

martyscncgarage: Centroid Acorn CNC Basics - Win 10 PC Setup and benchtest

Centroid CNC Technical Support: Windows 10 configuration for use with Centroid CNC software and hardware
# Status LED Troubleshooting

(See Section 4.2 for a description of the LEDs and where they are located)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>All status LEDs are out</td>
<td>Logic power not applied</td>
<td>Measure the AC power coming into the logic supply. Measure the DC power going out of the logic supply. Check the logic power wiring.</td>
</tr>
<tr>
<td>Some (but not all) of the status power LEDs are out. (+3.3V, +5.0V, +12.0V, or -12.0V LED are out.)</td>
<td>Power supply failure or wiring problem.</td>
<td>If the other LEDs are lit (+3.3V, +5.0V, +12.0V, and -12.0V), the analog section is most likely damaged. Return for repair.</td>
</tr>
<tr>
<td>Analog +12.0V or Analog -12.0V LEDs out.</td>
<td>Loss of power to the analog section of the ALLIN1DC.</td>
<td>If the other LEDs are lit (+3.3V, +5.0V, +12.0V, and -12.0V), the analog section is most likely damaged. Return for repair.</td>
</tr>
<tr>
<td>FPGA OK LED not lit</td>
<td>ALLIN1DC not ready or internal fault</td>
<td>Wait for ALLIN1DC to start and enter run mode. If after 1 minute the ALLIN1DC does not enter run mode, then a hardware failure is likely. Return for repair.</td>
</tr>
<tr>
<td>DSP OK LED not lit</td>
<td>ALLIN1DC is booting up.</td>
<td>Wait for the ALLIN1DC to detect hardware and start run mode.</td>
</tr>
<tr>
<td>DSP Debug LED is flashing fast</td>
<td>ALLIN1DC is detecting hardware</td>
<td>Waiting for the ALLIN1DC to finish detecting hardware and enter run mode.</td>
</tr>
<tr>
<td>DSP Debug LED is flashing one time per second.</td>
<td>Using MPU11 drive protocols</td>
<td>None.</td>
</tr>
<tr>
<td>Drive Fault LED is out</td>
<td>The drive fault relay is open (see section 4.1, 5.3, and 5.6 for details). The ALLIN1DC is not able to communicate with the PC or a drive fault was detected.</td>
<td>Confirm that the ALLIN1DC can communicate with the PC by toggling an input (such as E-stop). If the input was not detected by the PC, then it is a communication error. If input was detected correctly, press MDI and check the status menu of the software for errors.</td>
</tr>
<tr>
<td>PLC OK LED is out</td>
<td>The motion control procession has not booted.</td>
<td>Restart the CNC12 software and wait for the main screen to load.</td>
</tr>
<tr>
<td>LED1 is displaying a flashing number with a decimal point.</td>
<td>See the table below.</td>
<td>See table below</td>
</tr>
</tbody>
</table>
### LED1 (Seven Segment Display) Troubleshooting

(See Section 4.2 for a description of the LEDs and where they are located)

<table>
<thead>
<tr>
<th>Error Number</th>
<th>Meaning</th>
<th>Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power Failure (Revision 100315 and earlier only)</td>
<td>The logic power supply is indicating to the ALLIN1DC that is operation out of specification.</td>
<td>Check power supply wiring. Replace power supply.</td>
</tr>
<tr>
<td>2</td>
<td>15A Not Available</td>
<td>The current select switches on any axis are set to 15A, but the drive is not equipped with the appropriate FETs for long term use at 15A, so the drive will drop back to 12A</td>
<td>Select 12A or lower current settings or use a normal ALLIN1DC.</td>
</tr>
<tr>
<td>3</td>
<td>Null Error</td>
<td>The self adjustment routine has detected too large an offset on the current feedback. Usually indicates a failure of the ALLIN1DC’s current sensors.</td>
<td>Send the drive back for repair.</td>
</tr>
<tr>
<td>4</td>
<td>Limit Tripped</td>
<td>Any limit switch is tripped.</td>
<td>Move away from the limit, check limit switch wiring, or use limit defeat switch if a limit switch is not required.</td>
</tr>
</tbody>
</table>

### Misc Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input does not work with a 3-wire sensor</td>
<td>Voltage drop across sensor is too high.</td>
<td>Voltage drop across sensor is too high.</td>
</tr>
</tbody>
</table>

When attempting to move the motor getting “Full Power Without Motion” error.

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC12 is unable to see the encoder move when the software orders the motor to move.</td>
<td>Make sure the correct encoder is plugged into the correct axis. Make sure the axis and encoders are assigned correctly in software (Parameters 300-315). Check for blown fuses. Check for the motor polarity being reversed or the encoders counting the wrong direction. Check encoder wiring.</td>
</tr>
</tbody>
</table>
Additional ALLIN1DC Problems and Common Solutions

Troubleshooting General Problems

Motor doesn’t move and there is no error or fault. See Technical Bulletin #285

No power to the drive VM terminals when E-Stop is released. See Technical Bulletin #286.

Encoders not counting or DRO not updating. See Technical Bulletin #281

Troubleshooting Software Errors

“Jog Panel Communication Fault” errors. See Technical Bulletin #282

“Quadrature errors” or “Differential Encoder errors”. See Technical Bulletin #280

“Error Initializing MPU 11”. See Technical Bulletin #279

“PC Data Receive Errors”. See Technical Bulletin #270

Accuracy Problems

Accuracy problems with the DRO display of the machine. See sections 6.7 and 6.8.
### ALLIN1DC Settings for 3rd Party Servo Motors

This information is also contained in Technical Bulletin #288 contained [here](http://www.centroidcnc.com/dealersupport/tech_bulletins/uploads/288.pdf)

#### Current Settings for 3rd Party Motors

<table>
<thead>
<tr>
<th>Motor Constant Current Rating or Motor Constant Stall Rating</th>
<th>Recommended ALLIN1DC Current Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3 Amps</td>
<td>Recommended</td>
</tr>
<tr>
<td>4 Amps</td>
<td>Required</td>
</tr>
<tr>
<td>5 Amps</td>
<td>Required</td>
</tr>
<tr>
<td>6 Amps</td>
<td>Good Performance</td>
</tr>
<tr>
<td>7 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>8 Amps</td>
<td>Good Performance</td>
</tr>
<tr>
<td>9 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>10 Amps</td>
<td>Good Performance</td>
</tr>
<tr>
<td>11 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>12 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>13 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>14 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>15 Amps</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>16 Amps or more</td>
<td>Not Recommended</td>
</tr>
</tbody>
</table>

- **Current setting limited by swtich1 as described in section 5.5**
- **Not Recommended** – The ALLIN1DC will provide too much or too little power to the motor.
- **Good Performance** – The ALLIN1DC will provide good acceleration and good peak torque to the motors.
- **Recommended** – Centroid recommended settings. Most likely to provide the best a balance between performance and motor heating.
- **Maximum Current** – The ALLIN1DC will provide maximum acceleration and maximum peak torque to the motors. Motor could overheat!

**Motor tuning:** CNC12 software supports velocity, torque, and precision mode. The ALLIN1DC is designed to run only in torque mode. Make sure the ALLIN1DC is set to torque mode pressing Setup (F1) → Config (F3) (Password 137) →Parms (F3). Repeatedly hit Next Table (F8) to bring up parameter 256. Parameter 256 should be set to 0.

Enter PID parameters into the PID menu by pressing Setup (F1) → Config (F3) (Password 137) → PID (F4) → PID Config (F1). This is explained in section 6.3. Parameter 256 should be set to 0. Kp = 1.00, Ki = 0.004, Kd = 3.0. This is subject covered in more detail in section 6.3.
### Stock Centroid Servo Motors

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>ALLIN1DC Current Setting (Switch1)</th>
<th>Torque Mode PID Parameters</th>
<th>Maximum RPM</th>
<th>Maximum Bus Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glentek 10 in-lb</td>
<td>GM3320-22</td>
<td>6 Amps</td>
<td>Kp 0.50, Ki 0.004, Kd 0.5, Limit 32,000</td>
<td>4,650</td>
<td>180 VDC</td>
</tr>
<tr>
<td>Glentek 16 in-lb</td>
<td>GM3340-30</td>
<td>9 Amps</td>
<td>Kp 1.00, Ki 0.004, Kd 2.0, Limit 32,000</td>
<td>3,200</td>
<td>180 VDC</td>
</tr>
<tr>
<td>Redcom 17 in-lb</td>
<td>82SYXB-17</td>
<td>9 Amps</td>
<td>Kp 0.50, Ki 0.004, Kd 1.0, Limit 32,000</td>
<td>2,300</td>
<td>120 VDC</td>
</tr>
<tr>
<td>Glentek 29 in-lb</td>
<td>GM4030-41</td>
<td>12 Amps</td>
<td>Kp 1.00, Ki 0.004, Kd 3.0, Limit 32,000</td>
<td>3,500</td>
<td>180 VDC</td>
</tr>
<tr>
<td>Glentek 40 in-lb</td>
<td>GM4050-60</td>
<td>15 Amps</td>
<td>Kp 1.00, Ki 0.004, Kd 3.0, Limit 32,000</td>
<td>2,200</td>
<td>180 VDC</td>
</tr>
</tbody>
</table>

### Fanuc Retrofit Servo Motors

<table>
<thead>
<tr>
<th>Family</th>
<th>Name</th>
<th>Model</th>
<th>ALLIN1DC Current Setting (Switch1)</th>
<th>Maximum Bus Voltage</th>
<th>Torque Mode PID Parameters</th>
<th>Maximum RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black End Caps</td>
<td>Black Cap 00</td>
<td>A06B-0631-B0xx</td>
<td>12 Amps</td>
<td>See motor nameplate</td>
<td>1 0.004 3.0 32,000</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>Black Cap 0</td>
<td>A06B-0613-B0xx</td>
<td>15 Amps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow End Caps</td>
<td>Yellow Cap 00M</td>
<td>A06B-0632-Bxxx</td>
<td>9 Amps</td>
<td>50 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow Cap 0M</td>
<td>A06B-0641-Bxxx</td>
<td>12 Amps</td>
<td>90 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow Cap 5M</td>
<td>A06B-0642-Bxxx</td>
<td>15 Amps</td>
<td>150 VDC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Fanuc Retrofit Servo Motors** – See the Fanuc Retrofits Installation Manual for more details. Using an AC/DC30 guarantees maximum acceleration and maximum peak torque with the Fanuc Black Cap 0 and Yellow Cap 5M. Fanuc motors larger than a Fanuc Black Cap 0 and Yellow Cap 5M are compatible with the ALLIN1DC, but would have a very noticeable decrease in the acceleration rate and peak torque. Keep in mind that if different types of Fanuc motors are used, they will all have to run at the same bus voltage.

**Definition of terms used in the above tables**

- **Switch1** – Referring to the current limiting switch SW1. Explained in more detail in section 5.5.
- **Torque Mode** – CNC12 supports velocity, torque, and precision mode. The ALLIN1DC is designed to run only in torque mode. Make sure the ALLIN1DC is set to torque mode pressing Setup (F1) → Config (F3) (Password 137) → Parms (F3). Repeatedly hit Next Table (F8) to bring up parameter 256. Parameter 256 should be set to 0.
- **PID Parameters** – Enter PID parameters into the PID menu by pressing Setup (F1) → Config (F3) (Password 137) → PID (F4) → PID Config (F1). This is subject covered in more detail in section 6.3.
- **Maximum RPM** – This information is provided for reference only. Do not use the maximum RPM parameters (357-364) to limit the speed of your drive. Use the maximum jog rate to limit the speed of your drive. Set the maximum jog rate by pressing Setup (F1) → Config (F3) (Password 137) → Mach. (F2) → Jog (F1). Enter the maximum rate under "Max Rate".
Heating and Cooling Parameters for Servo Motors

Fanuc and 3rd Party Servo Motors

Heating and cooling parameters are not available for third party motors. The table below contains suggested values used for Centroid motors. Find the motor that is closest to your motor. Set the parameters as described below.

Since the temperature coefficients we used are the “best guess” based on your torque rating, it is necessary to run the machine at maximum feed rate and acceleration using a test program then physically measure the surface temperature of the servo motors. Make sure the servo motors do not overheat. Adjust the heating and cooling coefficients if needed to get an accurate temperature estimation.

If the motor occasionally overheats, adjust the values for feedrate and acceleration as needed to prevent the motor from overheating. If the motor consistently overheats, turn the current limit down one setting using Switch1.

Centroid Servo Motors

Centroid servo motors have heating and cooling temperature coefficients that allow CNC12 to estimate the temperature of the motor. Enter the suggested values into the indicated parameters.

<table>
<thead>
<tr>
<th>Servo Drive Model</th>
<th>16 / 17 in-lb Switch1 set to 9</th>
<th>29 in-lb Switch1 set to 12</th>
<th>29 in-lb Switch1 set to 15</th>
<th>40 in-lb Switch1 set to 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Axes</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
</tr>
<tr>
<td>21-24 [1]</td>
<td>1-4</td>
<td>0.028</td>
<td>0.02</td>
<td>0.027</td>
</tr>
<tr>
<td>25-28 [2]</td>
<td>1-4</td>
<td>0.68</td>
<td>0.68</td>
<td>0.68</td>
</tr>
<tr>
<td>20 [3]</td>
<td>Applies to all axes</td>
<td>72 / 22</td>
<td>72 / 22</td>
<td>72 / 22</td>
</tr>
<tr>
<td>29 [4]</td>
<td></td>
<td>150 / 65</td>
<td>150 / 65</td>
<td>150 / 65</td>
</tr>
<tr>
<td>30 [5]</td>
<td></td>
<td>180 / 82</td>
<td>180 / 82</td>
<td>180 / 82</td>
</tr>
</tbody>
</table>

1. Parameters 21-24 – These are the servo motor heating coefficients. A higher number will cause the CNC12 software to “estimate” the motors temperature to be a higher temperature while the motor is under load.

2. Parameter 25-28 – These are the motor cooling coefficients. A higher number will cause the CNC12 software to “estimate” that the motor has cooled off quicker while not under load.

3. Parameter 20 – Set to the “average” ambient temperature of the machine shop during a hot day. On system using inches as the default units, this defaults to 72ºF. On systems using millimeters as the default units, this defaults to 22ºC.

4. Parameter 29 – Set to the temperature at which the CNC12 software should display the “motor overheat warning” software message. Using Centroid motors with inches as the default units, this setting defaults to 150ºF. Using Centroid motors with millimeters as the default units, this setting defaults to 65ºC.

5. Parameter 30 – Set to the temperature which the CNC12 software should stop the machine from running due to motor overheating. Using Centroid motors with inches as the default units, this setting defaults to 180ºF. Using Centroid motors with millimeters as the default units, this setting defaults to 82ºC.
Appendix D  http://www.centroidcnc.com/downloads/allin1dc/centroid_allin1dc_schematic_set.zip

ALLIN1DC Individual Circuit Schematic Set

INDEX

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SHEET</th>
<th>TITLE</th>
<th>SHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE PAGE</td>
<td>1</td>
<td>2ND E-STOP</td>
<td>11</td>
</tr>
<tr>
<td>110VAC DIRECT RECTIFICATION</td>
<td>2</td>
<td>CABLES</td>
<td>12</td>
</tr>
<tr>
<td>110VAC STEPDOWN</td>
<td>3</td>
<td>OPERATORS PANEL</td>
<td>13</td>
</tr>
<tr>
<td>220VAC STEPDOWN</td>
<td>4</td>
<td>LIMIT SWITCH</td>
<td>14</td>
</tr>
<tr>
<td>110VAC POWER RECTIFICATION</td>
<td>5</td>
<td>LUBE PUMP</td>
<td>15</td>
</tr>
<tr>
<td>220/440VAC POWER RECTIFICATION</td>
<td>6</td>
<td>MISTER</td>
<td>16</td>
</tr>
<tr>
<td>INVERTER</td>
<td>7</td>
<td>PLCADD1616</td>
<td>17</td>
</tr>
<tr>
<td>1 PHASE FLOOD</td>
<td>8</td>
<td>SPINDLE CONTACTOR</td>
<td>18</td>
</tr>
<tr>
<td>3 PHASE FLOOD</td>
<td>9</td>
<td>BRAKING MOTOR</td>
<td>19</td>
</tr>
<tr>
<td>1 TO 3 PHASE FLOOD</td>
<td>10</td>
<td>4TH AXIS DC1</td>
<td>20</td>
</tr>
</tbody>
</table>

(814) 353-9256 www.centroidcnc.com

Copyright © 2016 Centroid
DC SERVO POWER RECTIFIER WITH 110V STEP DOWN TRANSFORMER

INCOMING 110VAC

DC SERVO POWER RECTIFIER WITHOUT STEP DOWN TRANSFORMER,
DIRECT RECTIFICATION OF 110 VAC

BRIDGE RECTIFIED DC MOTOR VOLTAGE
(INPUT)VAC X 1.414 = (OUTPUT)VDC

110VAC = 156VDC
117VAC = 165VDC
120VAC = 170VDC
125VAC = 177VDC

RECTIFIED DC MOTOR VOLTAGE MUST
NOT EXCEED SERVO MOTOR VOLTAGE RATING

SUGGESTED WIRE CURRENT CAPACITY
STRANDED MTW OR EQUIVALENT

18 AWG - UP TO 6A
16 AWG - UP TO 8A
14 AWG - UP TO 15A
12 AWG - UP TO 20A

REV  DATE  DESCRIPTION  BY
1  3-14-2016  INITIAL RELEASE  DRS
2  4-15-2016  UPDATED PER GUIDELINES  SPM

(814) 353-9256  www.centroidinc.com
Copyright © 2016 Centroid

Title  DC SERVO POWER RECTIFICATION
FROM INCOMING 110VAC

Size  A  Serial Number  Drawn by  Rev
Date  100715  Drawn by  spw
Filename  ALLIN1DC.SET.dwg  Sheet 5 of 20
NOTE 1
INPUTS REQUIRE 5, 12, OR 24VDC EXTERNAL POWER SUPPLY. POWER SUPPLY FOR ALLIN1DC DRIVE CAN BE USED. SIP RESISTOR VALUE MUST BE APPROPRIATE FOR INPUT VOLTAGE USED FOR EACH BANK OF 4 INPUTS. (SEE CHART)
+24VDC CONNECTED TO THE INPUT COMMONS WITH THE INPUTS PULLED DOWN TO 24VDC COMMON IS STANDARD (SEE NOTE 1)

24VDC POWER FOR LIMIT SWITCH INPUTS

24C-589 BLK (24VDC COM) 18 AWG
(+24VDC) 18 AWG
+24-803 YEL

(24VDC) 18 AWG

3RD AXIS + 24C-922 GRN
3RD AXIS - 24C-920 BLK

2ND AXIS + 24C-918 GRN
2ND AXIS - 24C-916 BLK

1ST AXIS + 24C-914 GRN
1ST AXIS - 24C-912 BLK

22 AWG MIN.

LIMIT SWITCHES NORMALLY CLOSED

RELAYS RATED FOR 5A (NO) / 3A (NC) AT 30VDC/277VAC

ALLIN1DC
REV 140527
PN: 11144

EGND AXIS 3+
AXIS 3 -
EGND
AXIS 2 FUSE
DRIVE COM OUT

NOTE 1

INPUTS REQUIRE 5, 12, OR 24VDC EXTERNAL POWER SUPPLY. POWER SUPPLY FOR ALLIN1DC DRIVE CAN BE USED. SIP RESISTOR VALUE MUST BE APPROPRIATE FOR INPUT VOLTAGE USED FOR EACH BANK OF 4 INPUTS. (SEE CHART)

<table>
<thead>
<tr>
<th>RESISTOR PACK (SIP) CHART</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT VOLTAGE</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REV</th>
<th>DATE</th>
<th>DESCRIPTION</th>
<th>BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9-16-2015</td>
<td>INITIAL RELEASE</td>
<td>DRS</td>
</tr>
<tr>
<td>2</td>
<td>4-25-2015</td>
<td>UPDATED PER GUIDELINES</td>
<td>SPM</td>
</tr>
<tr>
<td>3</td>
<td>8-8-2018</td>
<td>CHANGES TO BOARD DEPICTION, SWITCH ALIGNMENT</td>
<td>SPM</td>
</tr>
</tbody>
</table>

Title
ALLIN1DC LIMIT SWITCH CIRCUIT

Size A NUMBER Rev 3

Date 160916 Drawn by des
Filename ALLIN1DC SET.dwg Sheet 14 of 20

Copyright © 2016 Centroid
+24VDC CONNECTED TO THE INPUT COMMONS WITH THE INPUTS PULLED DOWN TO 24VDC COMMON IS STANDARD (SEE NOTE 1)

NOTE 1
INPUTS REQUIRE 5, 12, OR 24VDC EXTERNAL POWER SUPPLY. POWER SUPPLY FOR ALLIN1DC DRIVE CAN BE USED. SIP RESISTOR VALUE MUST BE APPROPRIATE FOR INPUT VOLTAGE USED FOR EACH BANK OF 4 INPUTS. (SEE CHART)
ALLIN1DC
REV 140537
PN:11144

RELAYS RATED FOR 5A (NO) / 3A (NC)
AT 30 VDC/277VAC

POWER FOR MIST
SOLENOID
18 AWG

MIST COOLANT SOLENOID

H10
13 - 16 COM

16 IN
15 IN
14 IN
13 IN
9 - 12 COM

12 IN
11 IN
10 IN
9 IN

DAC COM
DAC OUT

ADC COM
ADC IN

GND

-VM
+VM

AXIS 3 FUSE

DRIVE
COM OUT

REV | DATE | DESCRIPTION | BY
--- | --- | --- | ---
1 | 9-16-2015 | INITIAL RELEASE | DRS
2 | 4-20-2016 | UPDATED PER GUIDELINES | SPM
3 | 6-6-2016 | CHANGES TO BOARD DEPICTION | SPM

Title
ALLIN1DC 110VAC MIST COOLANT CIRCUIT

Size | NUMBER | Rev
--- | --- | ---
A | 3 | 3

Date | 100916 | Drawn by | des
- | | | -
Filename | ALLIN1DC SET.dwg | Sheet | 16 of 20
Brake Release Power Supply

Incoming 110VAC
10 AWG

(110VACH) 110H-139 BLK
(110VACN) 110N-140 WHT
GND 7 GRN

(24VDC COM) 24C-855 BLK
18 AWG

(24VDC) +24-810 RED
18 AWG

Output: +24VDC 1.1A

Axis Brake Connector

Axis Brake Cable

Relays rated for 5A (NO) / 3A (NC)
At 30 VDC / 277VAC

Allin1DC

Rev 1.0527
PN: 11144

Drive
Com Out

Axis 3 Fuse
NOTE 1

Inputs require 5, 12, or 24VDC external power supply. Power supply for ALLIN1DC drive can be used. SIP resistor value must be appropriate for input voltage used for each bank of 4 inputs. (See chart)
Overview

The ALLIN1DC is a three axis DC brush motor drive with an integrated PLC and motion control processing. Centroid’s DC3IOB and MPU11 technology have been integrated into one unit to provide a highly functional, yet compact motion control product. Communication with a host PC is performed over Ethernet. Six encoder inputs are available for motor control or scale input. A range of motor drive currents are selectable with jumper blocks. The integrated PLC includes 16 digital inputs, 9 relay outputs, one analog input, and one analog output for general purpose use (see “PLC Section” for details).

Features

<table>
<thead>
<tr>
<th>Function</th>
<th>Motion Control Processor, PLC, and Servo Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of Axes:</td>
<td>8</td>
</tr>
<tr>
<td>Encoder and Scale Inputs:</td>
<td>6 Incremental Encoders (A, B, and Z channels)</td>
</tr>
<tr>
<td>PLC Protocol Support</td>
<td>PLCbus protocol up to 768in / 768 out</td>
</tr>
<tr>
<td></td>
<td>miniPLC protocol with 4 expansion ports</td>
</tr>
<tr>
<td>Drive Protocol Support</td>
<td>DriveBus Protocol</td>
</tr>
<tr>
<td>MPG Support</td>
<td>Differential encoder and discrete inputs (no serial MPG support)</td>
</tr>
<tr>
<td>Control Interface:</td>
<td>100 Mb/s Ethernet to PC</td>
</tr>
<tr>
<td>Drive Application:</td>
<td>DC Brush Motors</td>
</tr>
<tr>
<td>Number of Axes:</td>
<td>3</td>
</tr>
<tr>
<td>Current rating per axis:</td>
<td>6 to 15 Amps</td>
</tr>
<tr>
<td>Motor Voltage:</td>
<td>20 to 180 Volts</td>
</tr>
<tr>
<td>Digital PLC Inputs:</td>
<td>34</td>
</tr>
<tr>
<td>Digital PLC Outputs:</td>
<td>12</td>
</tr>
<tr>
<td>Analog Output resolution:</td>
<td>12 bits</td>
</tr>
<tr>
<td>Analog Input resolution:</td>
<td>12 bits</td>
</tr>
<tr>
<td>Dimensions (W<em>D</em>H):</td>
<td>16 * 8 * 5.25 inches</td>
</tr>
</tbody>
</table>
Typical Connections

Logic Power Connection for Revision 100316 and Older

An ATX style PC power supply provides voltage for ALLIN1DC logic circuits. The power supply connector may have 20 pins or 24 pins on units equipped with an ATX 2.2 compatible supply. The -5V and +5VSB pins are not used by the ALLIN1DC, but all other pins should be checked if troubleshooting a supply problem.

ATX 2.0 Power Connector (H14)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3.3V</td>
</tr>
<tr>
<td>2</td>
<td>-12V</td>
</tr>
<tr>
<td>3</td>
<td>COMMON</td>
</tr>
<tr>
<td>4</td>
<td>POWER ON</td>
</tr>
<tr>
<td>5</td>
<td>COMMON</td>
</tr>
<tr>
<td>6</td>
<td>+5V</td>
</tr>
<tr>
<td>7</td>
<td>COMMON</td>
</tr>
<tr>
<td>8</td>
<td>+5V</td>
</tr>
<tr>
<td>9</td>
<td>+5VSB</td>
</tr>
<tr>
<td>10</td>
<td>+12V</td>
</tr>
</tbody>
</table>

Optional ATX 2.2 Power Connector (H14)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+3.3V</td>
</tr>
<tr>
<td>2</td>
<td>-12V</td>
</tr>
<tr>
<td>3</td>
<td>COMMON</td>
</tr>
<tr>
<td>4</td>
<td>POWER ON</td>
</tr>
<tr>
<td>5</td>
<td>COMMON</td>
</tr>
<tr>
<td>6</td>
<td>+5V</td>
</tr>
<tr>
<td>7</td>
<td>COMMON</td>
</tr>
<tr>
<td>8</td>
<td>+5V</td>
</tr>
<tr>
<td>9</td>
<td>+5VSB</td>
</tr>
<tr>
<td>10</td>
<td>POWER OK</td>
</tr>
<tr>
<td>11</td>
<td>-12V</td>
</tr>
<tr>
<td>12</td>
<td>COMMON</td>
</tr>
<tr>
<td>13</td>
<td>+3.3V</td>
</tr>
<tr>
<td>14</td>
<td>-12V</td>
</tr>
<tr>
<td>15</td>
<td>COMMON</td>
</tr>
<tr>
<td>16</td>
<td>POWER ON</td>
</tr>
<tr>
<td>17</td>
<td>COMMON</td>
</tr>
<tr>
<td>18</td>
<td>+5V</td>
</tr>
<tr>
<td>19</td>
<td>COMMON</td>
</tr>
<tr>
<td>20</td>
<td>+5V</td>
</tr>
<tr>
<td>21</td>
<td>+5VSB</td>
</tr>
<tr>
<td>22</td>
<td>-12V</td>
</tr>
<tr>
<td>23</td>
<td>+5V</td>
</tr>
<tr>
<td>24</td>
<td>COMMON</td>
</tr>
</tbody>
</table>
Logic Power Connection for Revision 140317 and Newer

Newer ALLIN1DC units regulate +3.3 VDC on board, allowing for a different power supply. The power connector has been simplified as part of the upgrade.

Revision 140317 Power Connector (H1)

+5V ☐ ☐ ☐ ☐ ☐ +12V
COMMON ☐ ☐ ☐ ☐ ☐ COMMON
CHASSIS GROUND ☐ ☐ ☐ ☐ ☐ -12V

Servo Drive Section

The ALLIN1DC drive section is based on Centroid’s proven DC brush motor drive technology. Several built-in features allow for easy integration with a variety of hardware.

Each axis can be built with a range of current ratings determined by DIP switch settings and drive hardware. Current ratings of 6, 9, 12, and 15 amps can be provided on the ALLIN1DC. The following chart shows the various current settings available by changing settings on DIP switch block SW1.

<table>
<thead>
<tr>
<th>Drive Current Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Axis 0</strong></td>
</tr>
<tr>
<td>Current Setting</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>15</td>
</tr>
</tbody>
</table>
Additional axis drives may be connected to the ALLIN1DC through the “Drive Communication Out” connector. LED1 status display will show the base or first axis number for the drive. For example, an ALLIN1DC that is running as axes 2, 3, and 4 will display 2 on LED1 as long as no error codes are present. The axis farthest from the ALLIN1DC in the communication chain will always be axis 1. Axis numbers increase along the chain toward the ALLIN1DC. To find the axis number of a particular motor connector on ALLIN1DC, add the base axis number to the labeling for the motor connector. If LED1 displays 2, “0+” and “0-” motor terminals are for motor 2, “1+” and “1-” go to motor 3, and “2+” and “2-” go to axis 4. These axis numbers correspond to software parameters that can be used to rearrange the order of display on the DRO.

If error codes exist, the decimal point on LED1 will light and an error number will flash. See the “LED1 Error Codes” chart for information on error codes.

Drive Communication Connection for ALLIN1DC and DC1
PLC Section

The ALLIN1DC has 34 digital inputs, 12 digital outputs, one analog input, and one analog output. Some I/O is dedicated to a particular function. Inputs 1 through 6 are axis limit switch inputs that inhibit motion at the hardware level. Four inputs are dedicated to supporting the digitizing probe, and 11 inputs and 3 outputs are used for MPG support. The remaining 10 configurable, optically isolated inputs and 9 fused relay outputs are available for general purpose use. Check the “ALLIN1DC I/O Map” and “ALLIN1DC Specifications” sections to determine I/O type and capability. Accessory boards can be connected to increase I/O capacity. See the “PLC Expansion” section for details.

Digital Outputs

Two SPDT and 7 SPST fused outputs are available on board, as well as 3 open collector outputs designed to connect to the MPG.

Configurable Inputs

Configurable inputs are used for general purpose inputs. These inputs can be used with 5, 12, or 24 VDC sensors or switches. Compare the specifications of sensors to the “ALLIN1DC Specifications” chart to ensure reliable operation. Inputs are arranged into banks of 4 that can be individually configured for voltage and polarity. Resistor packs SIP1, SIP2, SIP3, and SIP4 must be changed to match the input voltage for each bank of inputs. Sinking or sourcing operation is determined by the wiring configuration.
Configurable Input Connection Examples

Sinking (NPN) Sensor Wiring Example

External Power Supply

+24 VDC

+24 COM

Sensor

+24 COM

+24 VDC

Sourcing (PNP) Sensor Wiring Example

External Power Supply

+24 VDC

+24 COM

Sensor

+24 COM

+24 VDC

SIP Identification – XXX Indicates Value

SIP Internal Wiring / Pinout

SIP Input Reference

<table>
<thead>
<tr>
<th>SIP Designator</th>
<th>Related Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIP1</td>
<td>13,14,15,16</td>
</tr>
<tr>
<td>SIP2</td>
<td>9,10,11,12</td>
</tr>
<tr>
<td>SIP3</td>
<td>5,6,7,8</td>
</tr>
<tr>
<td>SIP4</td>
<td>1,2,3,4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIP Resistor Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIP Value Marking</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>471</td>
</tr>
<tr>
<td>102</td>
</tr>
<tr>
<td>222</td>
</tr>
</tbody>
</table>

Dedicated I/O

Several inputs and outputs are dedicated to particular functions and route directly into the MPU11 processor section of the ALLIN1DC. As can be seen in the “ALLIN1DC I/O Map” section, these I/Os are mapped after normal PLC space, and start at location 769. Probing and MPG functions use the dedicated I/O.
Analog Output

Four voltage output ranges are available on the analog output. A block of five DIP switches (SW3) must be set according to the following chart to get the desired output range.

Analog Output Range Selection

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Switch Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0 TO 5</td>
<td>OFF</td>
</tr>
<tr>
<td>0 TO 10</td>
<td>OFF</td>
</tr>
<tr>
<td>-5 TO 5</td>
<td>ON</td>
</tr>
<tr>
<td>-10 TO 10</td>
<td>ON</td>
</tr>
</tbody>
</table>

Analog Output Calculations

Analog outputs use a 12 bit digital to analog converter (DAC) to generate analog from the DAC request sent from the PLC program. The 12 bit value allows a DAC request of 0 to 4095, which corresponds to 0 to 9.998 volts in the 0 to 10V range.

Analog Output Wiring

Analog outputs should be wired using a shielded twisted pair for best results. The analog output terminal is paired with a common terminal for direct wiring of the signal, common, and shield. In most cases, it is best to connect the shield to the common only at the ALLIN1DC. Routing analog cables away from power wires and other noise sources is also critical for good performance. See “ALLIN1DC Connections” section for terminal locations.
Analog Output Trim

The analog output is factory trimmed for the 0 to 10V scale. If a different output range is used, it will be necessary to trim the output for best results. The following procedure is used to trim the analog output:

1. Request 0V
2. Adjust offset POT until 0V is output
3. Request maximum output
4. Adjust gain POT until maximum is output (depends on range)
5. Repeat steps 1-4 until readings are consistent and correct

Analog Input

Like the analog output, the input has four ranges available. Set the corresponding block of five DIP switches (SW2) according to the following chart to accept the required input range.

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Switch Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 TO 5</td>
<td>OFF OFF OFF X X</td>
</tr>
<tr>
<td>0 TO 10</td>
<td>OFF ON OFF X X</td>
</tr>
<tr>
<td>-5 TO 5</td>
<td>ON ON OFF X X</td>
</tr>
<tr>
<td>-10 TO 10</td>
<td>ON ON X X</td>
</tr>
</tbody>
</table>

X = don’t care
Analog Input Calculations

The analog input uses a 12 bit analog to digital converter (ADC) to generate a digital ADC result from an analog signal. The 12 bit result allows an ADC result of 0 to 4095, which corresponds to 0 to 9.998 volts in the 0 to 10V range.

\[
\begin{align*}
0 \text{ to } 5V \text{ Range} & \quad \text{ADC result} = \frac{4096 \times \text{Input Voltage}}{5} \\
-5 \text{ to } 5V \text{ Range} & \quad \text{ADC result} = \left( \frac{4096 \times \text{Input Voltage}}{10} \right) + 2048 \\
0 \text{ to } 10V \text{ Range} & \quad \text{ADC result} = \frac{4096 \times \text{Input Voltage}}{10} \\
-10 \text{ to } 10V \text{ Range} & \quad \text{ADC result} = \left( \frac{4096 \times \text{Input Voltage}}{20} \right) + 2048
\end{align*}
\]

Analog Input Wiring

The analog input should be wired using a shielded twisted pair for best results. The analog input terminal is paired with a common terminal for direct wiring of the signal, common, and shield. In most cases, it is best to connect the shield to the common only at the ALLIN1DC. Routing analog cables away from power wires and other noise sources is also critical for good performance. See “ALLIN1DC Connections” section for terminal locations.

Analog Input Trim

The analog input is factory trimmed for the 0 to 10V scale. If a different input range is used, it will be necessary to trim the input for best results. The following procedure is used to trim the analog input:

1. Input 0V in bipolar modes, or slightly above 0V in unipolar modes
2. Adjust offset POT until the reported voltage matches the actual voltage
3. Input a voltage slightly below the maximum (depends on range)
4. Adjust gain POT until the reported voltage matches the actual voltage
5. Repeat steps 1-4 until readings are consistent and correct
PLC Expansion

PLC I/O expansion is possible through the four “PLC ADD” connectors. Each PLC expansion port can accept 16 – 128 inputs, outputs, or inputs and outputs in 16 bit increments. This allows for digital I/O, DACs, ADCs, or other devices to be added to the system as needed.

PLC ADD 1 – 4 Connector Pinouts

<table>
<thead>
<tr>
<th>Pinout Description</th>
<th>Pin 1</th>
<th>Pin 2</th>
<th>Pin 3</th>
<th>Pin 4</th>
<th>Pin 5</th>
<th>Pin 6</th>
<th>Pin 7</th>
<th>Pin 8</th>
<th>Pin 9</th>
<th>Pin 10</th>
<th>Pin 11</th>
<th>Pin 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>+12V AND -12V RET</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-12V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA TO EXPANSION CARD +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+12V AND -12V RETURN *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5V RETURN *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pinout Description</strong></td>
<td><strong>Pin 1</strong></td>
<td><strong>Pin 2</strong></td>
<td><strong>Pin 3</strong></td>
<td><strong>Pin 4</strong></td>
<td><strong>Pin 5</strong></td>
<td><strong>Pin 6</strong></td>
<td><strong>Pin 7</strong></td>
<td><strong>Pin 8</strong></td>
<td><strong>Pin 9</strong></td>
<td><strong>Pin 10</strong></td>
<td><strong>Pin 11</strong></td>
<td><strong>Pin 12</strong></td>
</tr>
<tr>
<td>+12V AND -12V RETURN and 5V RETURN are connected on the ALLIN1DC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PLC Expansion Memory Assignments

PLC I/O is arranged in 16 bit groups or slots. As a general rule, slots 0-14 are used for individual I/Os such as switches and have a programmable debounce time for the inputs. Slots 15-47 are reserved for ADCs, DACs, or other devices that do not require debounce. Every device using I/O space must use space in 16 bit multiples by reserving slots. An ALLIN1DC uses 2 slots for its inputs and 2 slots for outputs.

Assignment of I/O slots occurs in a linear fashion starting at the ALLIN1DC, then “PLC ADD” port 1, “PLC ADD” port 2, etc. In the following general example, the ALLIN1DC I/O is shown in its fixed location, which can not be changed. Devices plugged into the “PLC ADD” ports that require debounce will be assigned starting at the slots marked “A”, while devices that do not require debounce will start being assigned at the slots marked “B”.

PLC Expansion Location Assignment General Example

![PLC Expansion Location Assignment General Example](image)

The remaining examples show how specific devices will map into the PLC under certain conditions. PLC Expansion devices have a variety of memory requirements, which are summarized in the following chart for devices used in the examples.

PLC I/O Slot Requirements

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Function</th>
<th>Input Debounce Slots Used</th>
<th>Input Non-Debounce Slots Used</th>
<th>Output Debounce Slots Used</th>
<th>Output Non-Debounce Slots Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALLIN1DC</td>
<td>Digital and Analog I/O</td>
<td>15</td>
<td>33</td>
<td>15</td>
<td>33</td>
</tr>
<tr>
<td>DC3IOB as expansion</td>
<td>Digital and Analog I/O</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PLCADD1616</td>
<td>Digital I/O</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Example 2 illustrates I/O assignments on a system that has an ALLIN1DC main PLC, a DC3IOB plugged into “PLC ADD 1”, a PLCADD1616 to “PLC ADD 2”, and an ADD4AD4DA expansion card plugged into PLC ADD 3. Note that the ADD4AD4DA is an ADC/DAC expansion card and is assigned starting at slot 16 since it does not require debounce.

**PLC Expansion Example 2**

![Input Space Diagram](image1)

Example 3 shows the results of plugging an ADD4AD4DA into “PLC ADD 1”, a PLCADD1616 into “PLC ADD 2”, and a DC3IOB into “PLC ADD 3”. The location of the ADD4AD4DA expansion card I/O is unaffected since it is the only expansion device in the example that does not require debounce. The PLCADD1616 and DC3IOB have changed locations since the PLCADD1616 is plugged into a lower number “PLC ADD” port and is therefore assigned I/O locations before the ALLIN1DC.

**PLC Expansion Example 3**

![Input Space Diagram](image2)
### ALLIN1DC I/O Map

#### Input Specification

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Axis Limit 0-</td>
<td>Configurable</td>
<td>H11</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Axis Limit 0+</td>
<td>Configurable</td>
<td>H11</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Axis Limit 1-</td>
<td>Configurable</td>
<td>H11</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Axis Limit 1+</td>
<td>Configurable</td>
<td>H11</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Axis Limit 2-</td>
<td>Configurable</td>
<td>H11</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Axis Limit 2+</td>
<td>Configurable</td>
<td>H11</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H11</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H11</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>6</td>
</tr>
<tr>
<td>14</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>7</td>
</tr>
<tr>
<td>15</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>8</td>
</tr>
<tr>
<td>16</td>
<td>General Purpose</td>
<td>Configurable</td>
<td>H10</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Output Specification

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>1,2</td>
</tr>
<tr>
<td>2</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>3,4</td>
</tr>
<tr>
<td>3</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>5,6</td>
</tr>
<tr>
<td>4</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>7,8</td>
</tr>
<tr>
<td>5</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>9,10</td>
</tr>
<tr>
<td>6</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>11,12</td>
</tr>
<tr>
<td>7</td>
<td>General Purpose</td>
<td>Relay SPST</td>
<td>H6</td>
<td>13,14</td>
</tr>
<tr>
<td>8</td>
<td>General Purpose</td>
<td>Relay SPDT</td>
<td>H6</td>
<td>15,16,17</td>
</tr>
<tr>
<td>9</td>
<td>General Purpose</td>
<td>Relay SPDT</td>
<td>H6</td>
<td>18,19,20</td>
</tr>
</tbody>
</table>

#### Analog in

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>241-252</td>
<td>Analog in</td>
<td>12 bit ADC</td>
<td>H9</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Forced to 0

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>233-256</td>
<td>Forced to 0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Mechanical Probe

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>769</td>
<td>Mechanical Probe</td>
<td>12VDC Opto</td>
<td>H13</td>
<td>6</td>
</tr>
</tbody>
</table>

#### DSP Probe

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>770</td>
<td>DSP Probe</td>
<td>12VDC Opto</td>
<td>H13</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Probe Detect

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>771</td>
<td>Probe Detect</td>
<td>12VDC Opto</td>
<td>H13</td>
<td>8</td>
</tr>
</tbody>
</table>

#### Probe Auxiliary

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>772</td>
<td>Probe Auxiliary</td>
<td>12VDC Opto</td>
<td>H13</td>
<td>10</td>
</tr>
</tbody>
</table>

#### MPG x1

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>773</td>
<td>MPG x1</td>
<td>5VDC</td>
<td>H19</td>
<td>9</td>
</tr>
</tbody>
</table>

#### MPG x10

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>774</td>
<td>MPG x10</td>
<td>5VDC</td>
<td>H19</td>
<td>11</td>
</tr>
</tbody>
</table>

#### MPG x100

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>775</td>
<td>MPG x100</td>
<td>5VDC</td>
<td>H19</td>
<td>13</td>
</tr>
</tbody>
</table>

#### MPG Axis 1

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>776</td>
<td>MPG Axis 1</td>
<td>5VDC</td>
<td>H19</td>
<td>4</td>
</tr>
</tbody>
</table>

#### MPG Axis 2

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>777</td>
<td>MPG Axis 2</td>
<td>5VDC</td>
<td>H19</td>
<td>6</td>
</tr>
</tbody>
</table>

#### MPG Axis 3

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>778</td>
<td>MPG Axis 3</td>
<td>5VDC</td>
<td>H19</td>
<td>8</td>
</tr>
</tbody>
</table>

#### MPG Axis 4

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>779</td>
<td>MPG Axis 4</td>
<td>5VDC</td>
<td>H19</td>
<td>10</td>
</tr>
</tbody>
</table>

#### MPG Axis 5

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>780</td>
<td>MPG Axis 5</td>
<td>5VDC</td>
<td>H19</td>
<td>12</td>
</tr>
</tbody>
</table>

#### MPG Axis 6

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>781</td>
<td>MPG Axis 6</td>
<td>5VDC</td>
<td>H19</td>
<td>14</td>
</tr>
</tbody>
</table>

#### MPG Axis 7

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>782</td>
<td>MPG Axis 7</td>
<td>5VDC</td>
<td>H19</td>
<td>16</td>
</tr>
</tbody>
</table>

#### MPG Axis 8

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>783</td>
<td>MPG Axis 8</td>
<td>5VDC</td>
<td>H19</td>
<td>18</td>
</tr>
</tbody>
</table>

#### MPG Aux 1

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>784</td>
<td>MPG Aux 1</td>
<td>5VDC</td>
<td>H19</td>
<td>15</td>
</tr>
</tbody>
</table>

#### MPG Aux 2

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>785</td>
<td>MPG Aux 2</td>
<td>5VDC</td>
<td>H19</td>
<td>20</td>
</tr>
</tbody>
</table>

#### MPG Aux 3

<table>
<thead>
<tr>
<th>Number</th>
<th>Function</th>
<th>Type</th>
<th>Connector</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>786</td>
<td>MPG Aux 3</td>
<td>5VDC</td>
<td>H19</td>
<td>22</td>
</tr>
</tbody>
</table>

*Open Collector outputs are pulled up to 5V

*5 VDC inputs are not isolated
### ALLIN1DC Specifications

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 Volt Supply Current</td>
<td>1.9</td>
<td>-</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>5 Volt Supply Current</td>
<td>2.4</td>
<td>-</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>12 Volt Supply Current</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>-12 Volt Supply Current</td>
<td>0.1</td>
<td>-</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>Input Pullup Voltage (Vinp)</td>
<td>4</td>
<td>-</td>
<td>30</td>
<td>VDC</td>
</tr>
<tr>
<td>Input On Voltage</td>
<td>Vinp-1.25</td>
<td>-</td>
<td>-</td>
<td>VDC</td>
</tr>
<tr>
<td>Input Off Voltage</td>
<td>-</td>
<td>-</td>
<td>1.25</td>
<td>VDC</td>
</tr>
<tr>
<td>Relay Output Current</td>
<td>0.1</td>
<td>-</td>
<td>10</td>
<td>A @ 125VAC</td>
</tr>
<tr>
<td>Relay Current</td>
<td>0.1</td>
<td>-</td>
<td>5</td>
<td>A @ 30VDC</td>
</tr>
<tr>
<td>Open Collector Output Current</td>
<td>-</td>
<td>10</td>
<td>90</td>
<td>mA</td>
</tr>
<tr>
<td>Open Collector Output Voltage</td>
<td>-</td>
<td>5</td>
<td>5</td>
<td>VDC</td>
</tr>
<tr>
<td>Input Operating current</td>
<td>9</td>
<td>11</td>
<td>15</td>
<td>mA</td>
</tr>
<tr>
<td>Motor Output Current Settings</td>
<td>6</td>
<td>12</td>
<td>15</td>
<td>A</td>
</tr>
<tr>
<td>Motor Supply Voltage</td>
<td>20</td>
<td>115</td>
<td>180</td>
<td>VDC</td>
</tr>
<tr>
<td>Analog Output Current</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>Analog Output Voltage</td>
<td>-10</td>
<td>-</td>
<td>10</td>
<td>V</td>
</tr>
<tr>
<td>Analog Output Resolution</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>bits</td>
</tr>
<tr>
<td>Analog Output Error</td>
<td>-</td>
<td>&lt; 0.2</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Analog Input Current</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>mA</td>
</tr>
<tr>
<td>Analog Input Voltage</td>
<td>-10</td>
<td>-</td>
<td>10</td>
<td>V</td>
</tr>
<tr>
<td>Analog Input Resolution</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>bits</td>
</tr>
<tr>
<td>Analog Input Error</td>
<td>-</td>
<td>&lt; 0.1</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>PLC ADD Port 5V Current Output*</td>
<td>0</td>
<td>-</td>
<td>0.5</td>
<td>A</td>
</tr>
<tr>
<td>PLC ADD Port 12V Current Output*</td>
<td>0</td>
<td>-</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>PLC ADD Port -12V Current Output*</td>
<td>0</td>
<td>-</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>Encoder channel input low</td>
<td>0</td>
<td>-</td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>Encoder channel input high</td>
<td>3.5</td>
<td>-</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Encoder input frequency low (per channel)**</td>
<td>0</td>
<td>-</td>
<td>1200</td>
<td>kHz</td>
</tr>
<tr>
<td>Encoder input frequency high (per channel)**</td>
<td>0</td>
<td>-</td>
<td>6000</td>
<td>kHz</td>
</tr>
<tr>
<td>Size: 16 * 8 * 5.25 (W<em>D</em>H)</td>
<td></td>
<td></td>
<td></td>
<td>Inches</td>
</tr>
</tbody>
</table>

*PLC ADD Port Current is a total for all 4 ports in any combination. Voltage drop may increase too much beyond this rating, requiring external power wiring to the expansion boards.

**FPGA Firmware versions below 0.56 limited encoder input frequency to 800khz.

**See parameter 323 for switching to low speed filter on MPU11 FPGA versions 0.59 and newer.
<table>
<thead>
<tr>
<th>Error Number</th>
<th>Meaning</th>
<th>Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power Failure (revision 100316 and earlier)</td>
<td>the logic power supply is indicating to the ALLIN1DC that it is operating out of specification</td>
<td>Check power supply wiring (the grey wire and AC input in particular), replace power supply</td>
</tr>
<tr>
<td>2</td>
<td>15A Not Available</td>
<td>current selection switches on any axis are set to 15A, but the drive is not equipped with the appropriate FETs for long term use at 15A, so the drive will drop back to 12A</td>
<td>Select 12A or lower current settings or use a high power ALLIN1DC</td>
</tr>
<tr>
<td>3</td>
<td>Null Error</td>
<td>the self adjust routine has detected too large an offset on the current feedback</td>
<td>Send the drive back for repair. There is likely an internal failure causing the large offset</td>
</tr>
<tr>
<td>4</td>
<td>Limit Tripped</td>
<td>any limit switch is tripped</td>
<td>move away from the limit, check limit switch wiring, or use the limit defeat switches if a limit switch is not required</td>
</tr>
</tbody>
</table>
## ALLIN1DC Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>All status LEDs out</td>
<td>Logic power not applied</td>
<td>Measure AC coming into power supply, correct wiring or supply problems</td>
</tr>
<tr>
<td>5, 3.3, 12, or -12 LED out</td>
<td>Power supply or connection problem</td>
<td>Measure AC coming into power supply, correct wiring or supply problems</td>
</tr>
<tr>
<td>AN +12V or AN -12V LED out</td>
<td>Analog section power loss</td>
<td>If other power LEDs are lit, the analog section has probably been damaged by incorrect connection, return for repair</td>
</tr>
<tr>
<td>FPGA LED not lit</td>
<td>MPU11 not ready</td>
<td>Wait for MPU11 to start and enter run mode</td>
</tr>
<tr>
<td>DSP LED not lit</td>
<td>MPU11 is booting up</td>
<td>Wait for MPU11 to detect hardware and start run mode</td>
</tr>
<tr>
<td>DSP DEBUG LED flashing fast</td>
<td>MPU11 is detecting hardware</td>
<td>Wait for MPU11 to detect hardware and start run mode</td>
</tr>
<tr>
<td>DSP DEBUG LED flashing one time per second</td>
<td>New drive protocols active</td>
<td>None</td>
</tr>
<tr>
<td>DSP DEBUG LED flashing two times per second</td>
<td>Legacy drive protocols active</td>
<td>Internal fault, only new protocols should be in use, return for repair</td>
</tr>
<tr>
<td>Encoder connection bad</td>
<td>Bad encoder or wiring</td>
<td>Check or replace encoder and cable</td>
</tr>
<tr>
<td></td>
<td>Return not connected</td>
<td>Connect return line. If the encoder is not powered by ALLIN1DC’s +5V, this is sometimes overlooked.</td>
</tr>
<tr>
<td>DF LED out</td>
<td>Motion control processor section hasn't booted up</td>
<td>Start software, wait for the main screen to load</td>
</tr>
<tr>
<td></td>
<td>&quot;Servo Power Removed&quot; due to fault</td>
<td>Restart system to reset runaway or other serious fault condition</td>
</tr>
<tr>
<td>PLC OK LED out</td>
<td>Motion control processor section hasn't booted up</td>
<td>Start software, wait for the main screen to load</td>
</tr>
<tr>
<td>LED1 display flashing with decimal point lit</td>
<td>An error condition has been detected</td>
<td>See the &quot;LED1 Error Codes&quot; section for details on the error</td>
</tr>
<tr>
<td>LEDs on, but motor doesn't run</td>
<td>Axis Fuse blown</td>
<td>Check fuses with a meter, replace as necessary</td>
</tr>
<tr>
<td></td>
<td>Limits tripped</td>
<td>Check limit switch wiring or pull up the limit defeat switches</td>
</tr>
<tr>
<td>Input doesn't work with sensor</td>
<td>Incorrect wiring</td>
<td>Correct wiring for sensor type (sinking or sourcing), check that SIP values are appropriate for the input voltage</td>
</tr>
<tr>
<td></td>
<td>Voltage drop across sensor is too high</td>
<td>Use 3-wire sensors with lower voltage drop spec.</td>
</tr>
<tr>
<td>9023 PLC Communication Out Fault (Fiber 1)</td>
<td>Revision 100316 and older: The power supply may have lowered &quot;Power OK&quot; (grey wire) momentarily.</td>
<td>Change power supply.</td>
</tr>
</tbody>
</table>
ALLIN1DC Connections

Note: Revision 140317 and newer will have a 6 pin connector in place of the ATX power connector, but is otherwise equivalent.