

XMOD

The “X” Gets an Upgrade

User Guide rev. 0.6
(for XMOD BETA 1.6.1 and later)

By: Paul Niedfeldt

Special Thanks To:

Development

David McClanahan
Ty McNeer
Brian “Miscue” Workman
David “Bit-wizard” Smith
Kayle “KayleAGD” Malcom
Lee “sig11” Helpingstine

Testing

Ty McNeer
Ian “Majinebz” Zeigle
Scott “BigEvil” Feritta
Zak “Z-man” Vetter
Martin “cabldawg” Jeffers

Table of Contents:

<i>Section Title</i>	<i>Page</i>
Disclaimer	3
Preface	5
Donations	6
Price List/Payment Options	6
Customization	7
Installation	8
Hardware Setup	12
Quick Jumper	14
Menu Navigation	15
Firing Modes	16
Menu Item Descriptions and Use	18
Other Features	20
Recommended Settings	22
Adjusting DWEL	22
Adjusting FIX	23
Solenoid Wiring Test	24
Troubleshooting	25

Disclaimer

THIS IS A LEGAL AGREEMENT BETWEEN YOU, THE END USER, AND PAUL NIEDFELDT, ABOUT THE XMOD SOFTWARE ("THE SOFTWARE") FOR AGD PAINTBALL GUNS. PAUL NIEDFELDT WROTE THIS SOFTWARE INDEPENDENTLY WITH NO INPUT, HELP, OR DIRECTION FROM AIRGUN DESIGNS INC.

BE SURE TO READ AND UNDERSTAND ALL OF THE RIGHTS AND RESTRICTIONS DESCRIBED IN THE FOLLOWING AGREEMENT BEFORE USING THE SOFTWARE. BY INSTALING THE SOFTWARE YOU ARE AGREEING TO BE BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DELETE ALL COPIES OF THE SOFTWARE AND ALL ACCOMPANYING FILES FROM ANY STORAGE DEVICES UPON WHICH YOU HAVE PLACED IT.

1. LICENSE

THIS AGREEMENT ALLOWS YOU TO:

INSTALL AND USE THE SOFTWARE ON YOUR PERSONAL GUN OR GUNS.

2. LICENSE RESTRICTIONS

(A) YOU MAY NOT REVERSE ENGINEER, DECOMPILE, DISASSEMBLE, OR OTHERWISE REDUCE THE SOFTWARE TO A HUMAN-PERCEIVABLE FORM.

(B) YOU MAY NOT RENT, LEASE, LEND OR SUBLICENCE THE SOFTWARE.

(C) YOU MAY NOT MODIFY THE SOFTWARE OR CREATE DERIVATIVE WORKS BASED UPON THE SOFTWARE.

3. UPGRADES

IF THIS COPY OF THE SOFTWARE IS AN UPGRADE FROM AN EARLIER VERSION OF THE SOFTWARE, IT IS PROVIDED TO YOU ON A LICENSE EXCHANGE BASIS. YOU AGREE BY YOUR INSTALLATION AND USE OF THIS COPY OF THE SOFTWARE TO VOLUNTARILY TERMINATE YOUR EARLIER END USER LICENSE AND THAT YOU WILL NOT CONTINUE TO USE THE EARLIER VERSION OF THE SOFTWARE NOR TRANSFER IT TO ANOTHER INDIVIDUAL OR ORGANIZATION.

4. OWNERSHIP

THE FORGOING LICENSE GIVES YOU LIMITED RIGHTS TO USE THE SOFTWARE. ALTHOUGH YOU OWN THE MEDIA ON WHICH THE SOFTWARE IS RECORDED, YOU DO NOT BECOME THE OWNER OF, AND PAUL NIEDFELDT RETAINS TITLE TO, THE SOFTWARE, AND ALL COPIES THEREOF. ALL RIGHTS NEW SPECIFICALLY GRANTED IN THIS AGREEMENT ARE RESERVED BY PAUL NIEDFELDT.

5. COPYRIGHT

ALL TITLE AND COPYRIGHTS IN AND TO THE SOFTWARE (INCLUDING BUT NOT LIMITED TO AND IMAGES, PHOTOGRAPHS, ANIMATIONS, VIDEO, AUDIO, MUSIC TEXT AND "APPLETS," INCORPORATED INTO THE SOFTWARE), THE ACCOMPANYING PRINTED MATERIALS, AND ANY COPIES OF THE SOFTWARE, ARE OWNED BY PAUL NIEDFELDT OR ASSOCIATED SUPPLIERS.

6. TERMINATION

THIS LICENSE IS EFFECTIVE UNTIL TERMINATED. YOU MAY TERMINATE THIS LICENSE AT ANY TIME BY DESTROYING THE SOFTWARE, RELATED DOCUMENTATION AND ALL COPIES THEREOF. THIS LICENSE WILL TERMINATE IMMEDIATELY WITHOUT NOTICE IF YOU FAIL TO COMPLY WITH ANY PROVISION OF THIS LICENSE. UPON TERMINATION YOU MUST DESTROY THE SOFTWARE, RELATED DOCUMENTATION AND ALL COPIES THEREOF. THIS LICENSE MAY BE TERMINATED BY OFFERING YOU A SUPERCEDING DISCLAIMER/EULA FOR THE SOFTWARE OR ANY REPLACEMENT OR MODIFIED VERSION OF OR UPGRADE TO THE SOFTWARE.

7. DISCLAIMER OF WARRANTIES

PAUL NIEDFELDT PROVIDES THE SOFTWARE "AS IS" AND WITH ALL FAULTS, AND HEREBY DISCLAIM ALL OTHER WARRANTIES AND CONDITIONS, EITHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING BUT NOT LIMITED TO ANY (IF ANY) IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, OF FITNESS FOR A PARTICULAR PURPOSE, OF LACK OF VIRUSES, AND OF LACK OF NEGLIGENCE OR LACK OF WORKMANLIKE EFFORT. ALSO, THERE IS NO WARRANTY OR CONDITION OF TITLE, OF QUIET ENJOYMENT, OR OF NON INFRINGEMENT. THE ENTIRE RISK ARISING OUT OF THE USE OR PERFORMANCE OF THE SOFTWARE IS WITH YOU.

8. EXCLUSION OF ALL DAMAGES

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL PAUL NIEDFELDT OR ASSOCIATED SUPPLIERS BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, DIRECT, INDIRECT, SPECIAL, PUNITIVE, OR OTHER DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR ANY INJURY TO PERSON OR PROPERTY, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, FOR LOSS OF PRIVACY FOR FAILURE TO MEET ANY DUTY INCLUDING OF GOOD FAITH OR OF REASONABLE CARE, FOR NEGLIGENCE, AND FOR ANY PECUNIARY OR OTHER LOSS WHATSOEVER) ARISING OUT OF OR IN ANY WAY RELATED TO THE USE OF OR INABILITY TO USE THE SOFTWARE, WHETHER BASED ON CONTRACT, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, EVEN IF PAUL NIEDFELDT OR ANY SUPPLIER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THIS EXCLUSION OF DAMAGES SHALL BE EFFECTIVE EVEN IF ANY REMEDY FAILS OF ITS ESSENTIAL PURPOSE.

9. LIMITATION AND RELEASE OF LIABILITY

THE SOFTWARE WAS PROVIDED TO YOU AT NO CHARGE AND PAUL NIEDFELDT HAS INCLUDED IN THIS DISCLAIMER/EULA TERMS THAT DISCLAIM ALL WARRANTIES AND LIABILITY FOR THE SOFTWARE. TO THE FULL EXTENT ALLOWED BY LAW, YOU HEREBY RELEASE PAUL NIEDFELDT AND ASSOCIATED SUPPLIERS FROM ANY AND ALL LIABILITY ARISING FROM OR RELATED TO ALL CLAIMS CONCERNING THE SOFTWARE OR ITS USE. IF YOU DO NOT WISH TO ACCEPT THE SOFTWARE UNDER THE TERMS OF THIS DISCLAIMER/EULA, DO NOT INSTALL THE SOFTWARE. NO REFUND WILL BE MADE BECAUSE THE SOFTWARE WAS PROVIDED TO YOU AT NO CHARGE.

THIS DISCLAIMER/EULA IS VALID FOR ALL SOFTWARE, PROGRAMS, DOCUMENTATION AND ANYTHING RELATED TO US. THIS DOCUMENT IS NOT INCLUDED WITH EVERY INSTALATION OR ON EVERY PAGE, ETC. BUT THE SAME APPLIES AS IF IT WAS. THANKS FOR YOUR COOPERATION!

Preface

I started this project as a three credit independent study for my Mechatronics professor during my last semester at the University of Wisconsin Milwaukee. I have since graduated with a Bachelors of Science in Mechanical Engineering and a Minor in Computer Science. During that final semester I, many times, spent over thirty hours per week to complete the software in time for the final demonstration. At the end of the semester I was not finished but I had a working beta version I called “XMOD BETA 1.0”. My professor was so impressed he asked me to present a demonstration to his regular Mechatronics students and gave me an “A” hands down. Since then I have spent countless additional hours tweaking, testing, optimizing, and debugging every possible aspect. I’ve also added as many features and I could possibly fit in the processors 2k of memory. There’s actually a few that had to cut out due to lack of space, but don’t worry all the necessary stuff is there. And for the extras, just read...

Donations

This software took a lot of time and effort to develop. And I am distributing it free of charge to anyone who asks for it. If you like what I have done and received it without purchasing a programmer please send a donation. If you're wondering how much to donate, just ask yourself, how much would I be willing to pay to buy it.

Price List

(\$10 shipping to continental US and \$25 world wide)

XMOD BETA Software	FREE
Programmer and Cable Combo	\$100 (Everything you need to load the software)
Programmer Only	\$50 (ICProg-AVR, cable not included)
Programming Cable Only	\$60 (you buy the programmer and send me the cable)
Quick Jumper	\$20 (See <i>Quick Jumper</i>)
Custom Messages	\$20 (See <i>Customizations</i>)
Custom Characters	\$5ea (See <i>Customizations</i>)
Custom Default Settings	\$5 (See <i>Customizations</i>)
Development Tools	contact me (all documents and diagrams I have created/found)
Source Code (commented)	\$2,000 (Limited rights, contact me for details)
Tested Programmers:	
ICprog-AVR	(Recommended)
Atmel AVRISP	(Compatible)
Atmel AVRISP mkII	(Not compatible)
Atmel STK500	(Compatible)

Payment Options:

PayPal:
pniedfeldt@wi.rr.com

Other:
Paul Niedfeldt
3844 E. Van Eimeren Ave.
Cudahy WI 53110
USA

Customizations

(See Price List for Costs)

Custom Characters

Custom Boot and/or Low Battery messages are available. Email me the exact text you want and I will email the new .hex file (software) to the email address that I received the money from. Custom characters are also available. Once it's made you can use it as many times as you want.



Here are some examples of but the possibilities are endless. Click the Attachments Tab to view attachments and open *Custom Chars.xls* to create your own custom characters. Just email me the form with the custom characters and custom messages you want and note where you want the special characters in your messages. I can also use a special character for the Calibration mode "On" symbol. See Calibration mode for more details.



Custom Default Settings

If your gun has a problem with the EEPROM being corrupted and keeps resetting to the default values, I can make your default settings anything you want. Here are the default settings:

Mode	SEMI
BRST	2
ROF	8
ACE	OFF
DLAY	0
FIX	95
DWEL	13
Brightness	20%

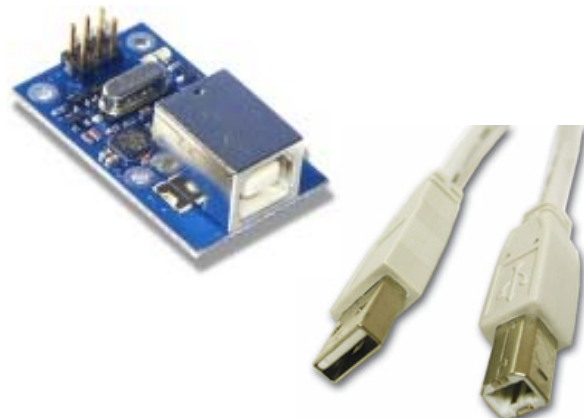
Installation (ICProg-AVR ONLY)

If you are using a programmer other than the ICProg-AVR please contact me for a previous version of the manual that included installation instructions for the AVRISP and STK500.

Below is a picture of the flash cable that will connect to the ICProg-AVR programmer. The left end will connect to the programmer and the right end to the gun as shown in Step 4. The connector on the left end may be a different color (Grey) or look slightly different. Be careful when connecting the cable to the programmer that the red stripe gets connected to the pin designated pin 1 on the circuit board of the programmer.



On the right is a picture of the ICProg-AVR and the USB cable required (Not Included). As you can see the USB port on the programmer is a USB-B female. A USB-A male to USB-B male cable is necessary to connect it to your computer. If you do not have one for your printer or some other device they can be purchased online or at any computer retail store.



Step 1: Installing AVR Studio

Download and install AVR Studio (45MB). The program is available FREE from www.atmel.com. In the search box type studio then pick AVR Studio 4. Download AVR Studio by clicking on the CD icon. Make sure the version of AVR Studio that you are installing is 4.12 build 460. There is no need to download the Service Pack since it only affects developers and not people who are just flashing an existing program.

Step 2: PreInstalling the USB Driver

Download and install the drivers for the ICProg-AVR. The drivers must be downloaded from www.ic-board.de the web page is in German but don't worry. On the right hand side of the page there is a box titled "Bestseller". Click on ICprog-AVR_1.0, then scroll down until you see...

[Win32 USB-Treiber](#)



Right click on the link and pick Save Target As... Extract the zip file to your desktop and then open the unzipped folder. Double click on **PreInstaller.exe**, this will create a second folder in the same location. Both these folders can be deleted as soon as you verify everything has worked correctly.

Step 3: Installing the USB Driver

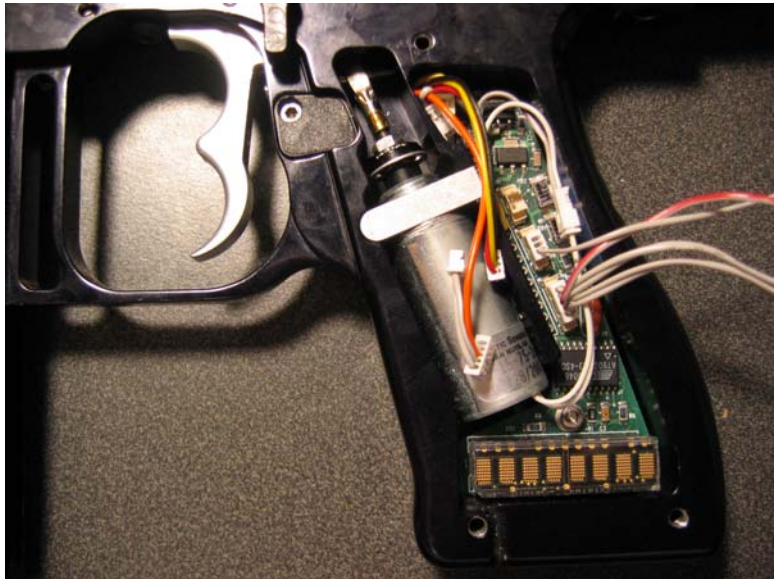
Connect the ICProg-AVR to the computer with a standard USB cable. A red light should come on, on the programmer, as you do this. Make sure the USB cable is fully seated into the programmer. Some of them have really tight fits. You may be prompted with the “New Hardware Found” dialog box. If so, there will be 2 of them one followed by the other. It will prompt you to install software for an ICmega Module and then a USB to COM Bridge for ICmega Module. If you are prompted for new hardware click on the advanced option and then specify the folder you unzipped the USB drivers and click OK for both devices. Once the devices have finished installing it will recognize them as a CP210x USB Composite Device and a CP210x USB to UART Bridge Controller.

Step 4: Connect to Gun

Unscrew the left grip and connect the flash cable to your E/X-Mag as shown. If you want the boot message to scroll immediately upon success turn your gun on now. In addition, the battery must be connected and have a sufficient charge for the text to scroll.

Note:

I have modified the wires to my solenoid to have an extra connector. This connector makes it easy to quickly disconnect and reverse my solenoid. I did this so that I could test the reliability of my software whether the solenoid was wired correctly or incorrectly.



Step 5: Using AVR Studio

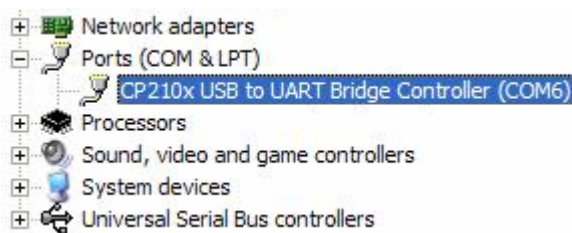
Open AVR Studio and click *Tools*→ *AVR Prog...*
If you do not get this error proceed to step 6. If you do get this error you must restart your computer and then change the COM port number.



Changing the COM Port Number

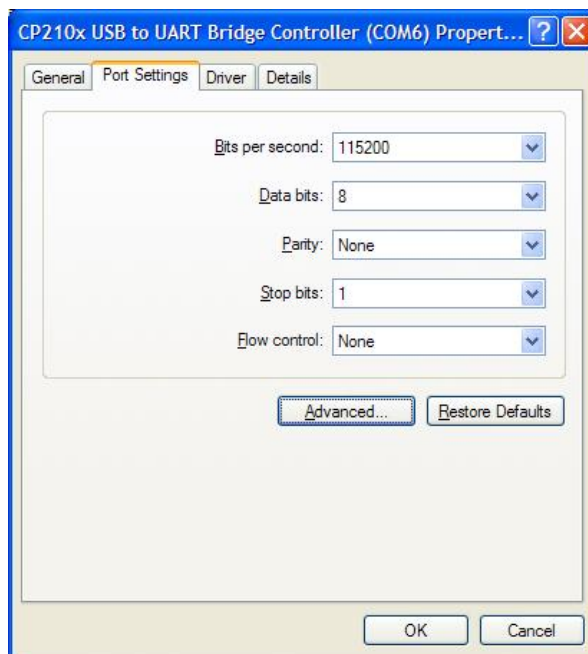
Part 1: Show Properties

Right click on *My Computer* and select *Properties*. Click on the *Hardware* tab and then click the *Device Manager* button. Open Ports (COM & LPT) by clicking the plus next to it. Right click on CP210x USB to UART Bridge Controller and select Properties.



Part 2: Port Settings

Select the Port Settings tab and click the advanced button. Double check the settings shown in the picture on the right but they should all be the default values.

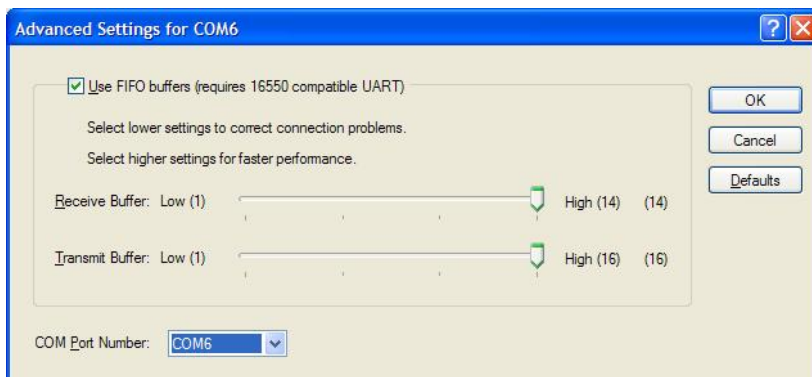


Part 3: Change COM Port Number

The Port must be COM1 to COM4. If all the ports 1- 4 are in use, you can tell because they will say "in use" in parenthesis in the selection box, you must select one of them anyways and ignore the error message that you get. If you don't know which one to select, I recommend COM1 or COM2 because those are the physical ports and as long as you are not trying to use a serial device at the same time it shouldn't be a problem.

Part 4: Finish

Restart the installation process at Step 5, hopefully with no errors this time. If errors persist please email me your phone number and I will call you to make sure you get it.

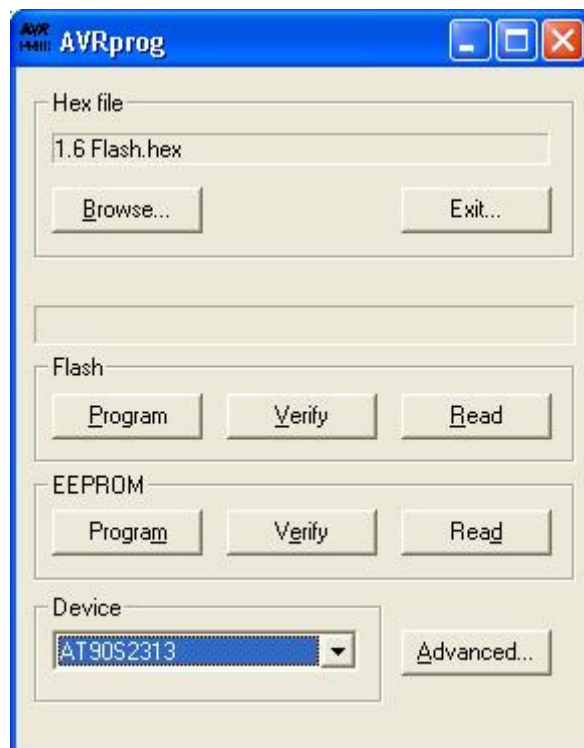


Step 6: Setting the device

Set Device to **AT90S2313**.

Step 7: Saving the Old Software

Please save your old AGD software just in case you need or want to restore it later. To do this press the Browse button and type the name of the file you will be saving (AGD3.2). The .hex will be added automatically. Once you have selected a name press the Open button. Even though the file does not yet exist this is the necessary process. The file is not created until you press the Read Button. At that point it is saved to the location you selected. It is only necessary to do this for the flash if you want your settings, such as the shot counter, ROF, and SHBF saved as well then do it for the EEPROM also. Remember to choose a different file name such as AGD3.2EEPROM.



Step 7: Flashing the New Software

Press the **Browse** button and select the .hex file for the flash you wish to load. Then, press the **Program** button inside the frame labeled Flash to load the software. If you did it correctly and your power is on, in about seven seconds you will see the boot message start to scroll across the screen. If you did not have the power on simply turn it on once the process has completed. There is no need to disconnect the cables before you turn the gun on, just be aware that the trigger will not work until you plug it back in and the programmer is unplugged.

Step 8: Remove/Cut Burst Jumper

Some guns may have the AGD burst jumper installed and although this jumper has no affect on the functionality of AGD 3.2 it must be removed or cut for XMOD to be adjustable. In XMOD this jumper is used as the tournament lock jumper and functionally locks everything except your ACE and your display brightness settings. See *Hardware Setup* for pictures and more details.

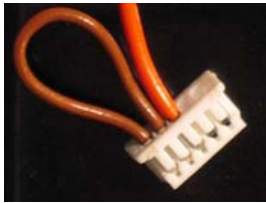
Hardware Setup

ACE

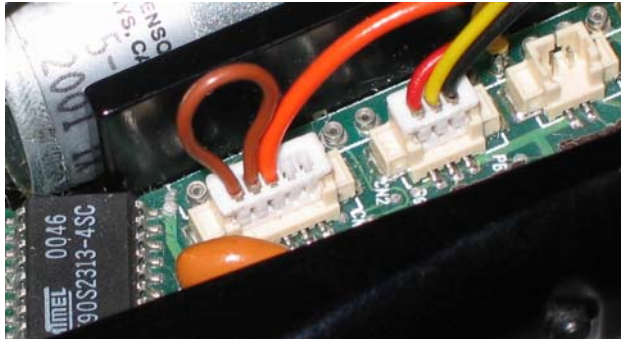
In order for the ACE to function the ACE wire has to be plugged into the 3rd pin from the top (middle position) of the 5-pin connector. (see pictures below)

Tournament Lock

The tournament lock jumper must be placed on the bottom two pins in the 5-pin connector to lock the gun. (see pictures below)



AGD Jumper and ACE



AGD Jumper and ACE Installed

Plunger Friction

If your gun is to perform its best it is extremely important that the solenoid plunger move with the absolute least amount of friction possible. This means that your Solenoid plunger should move freely up and down by only tipping your gun approximately 45° past horizontal in either direction to get it to move. If you have to tip your gun vertical to get the plunger to drop you need to get your gun tuned. You can send your gun to AGD or also to Tunaman as he is known on the Automags.org forums. Either one will do an excellent job of making sure your gun is in tip top shape.

Plunger length

If your solenoid plunger is moving freely but you still can't seem to shoot very fast you may need your solenoid plunger length adjusted. The plunger is loctightened in and it needs to be heated in order to adjust it. Shown in the picture on the right is a digital caliper from www.harborfreight.com that can be purchased for \$16.00. The length of the plunger should be set at 3.005in, but if you are not getting enough force to fire the gun reliably it may be possible to fix it by increasing the plunger length. It is also possible that the solenoid just isn't as strong as it once was and may need to be replaced. AGD will not sell sears to just anyone because the plunger length is not an adjustment that should be done by anyone but an AGD certified tech. However, if you do choose to take things into your own hands you could try to increase the length of your plunger in increments of 0.005in up to about 3.020 to see if that helps.



Sear Length

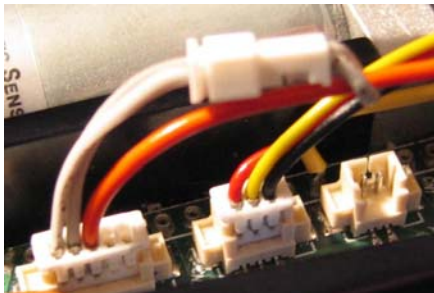
The sear length according to AGD should be 2.125 but to see if this works for you I recommend setting your gun to E-Mode and Full auto and pulling the trigger all the way back fairly hard. If you can feel any bounce against the trigger you should make it shorter in 0.005in increments and do the test again. You don't want it too short because that will affect your ability to shoot in mechanical mode. Again you will have to use a lighter to loosen the loctight and you may need to reapply it if it is loose after it has cooled.



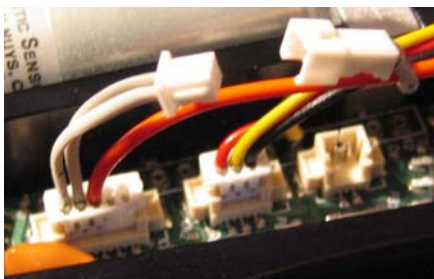
Quick Jumper

(Recommended for Tournament Players)

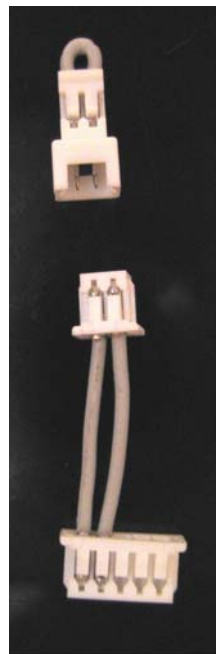
I have also created a quick jumper that can be easily applied and removed in seconds. Here are some pictures. When installed on my gun I put the ACE wire through the loop in the disconnectable top portion. This is simply to ensure I don't lose it. The picture on the far right shows the quick jumper exactly as it will be sold.



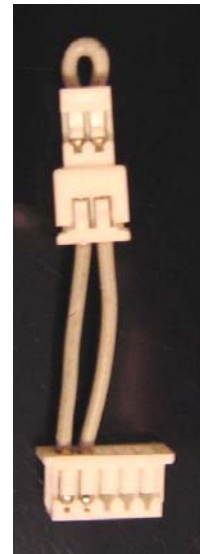
**Installed Quick Jumper
Connected**



**Installed Quick Jumper
Disconnected**



Disconnected



**Quick Jumper
Connected**

Menu Navigation

Here is a quick list of everything in menu system:

- **MOD**
 - SEMI
 - RELS
 - BRST
 - 2RND
 - ...
 - 9RND
 - FULL
 - NXL
 - PSP
 - MIL
 - HYPR
 - PR-T
 - SOL OFF
 - SOL ON
- **ROF**
 - 8
 - ...
 - 31
- **ACE**
 - OFF
 - ON
 - DLAY 0
 - ...
 - DLAY 8
- **FIX**
 - 0
 - ...
 - 95
- **DWEL**
 - 5
 - ...
 - 30
- **TRG ACE**
- **DSP BRIT**

Navigation:

- Pressing the top button at any time will jump to the next main menu item. (Level 1 - solid round bullets)
- Pressing the bottom button will jump to the next item inside the selected menu or submenu. (Level 2 – hollow round bullets)
- Pulling the trigger will either save all changes and exit the menu or jump to a submenu if it is available. (Level 3 – solid square bullets)

Note:

1. If the gun is turned off before the menus are exited all changes will be lost.
2. Exiting the menus and powering down at the same time may corrupt the guns memory causing it to reset to defaults.
3. Multiple items may be modified in one menu call, and all changes are saved when exiting menus.

Firing Modes

MOD SEMI

Semi auto mode – A true semi auto mode that can be used for all semi auto recreational and tournament play

MOD RELS

Release mode – Also a true semi auto mode where the gun will not fire until the trigger is released. Before using this mode at an event please check with officials to verify it is legal.

MOD BRST

Burst mode – A standard burst mode that may be used for recreational or scenario play. Before using this mode at an event please check with officials to verify it is legal. When the trigger is released the burst will stop even if all of the shots in the burst have not been fired. Then next shot may not be fired until the rate of fire timer has expired. With this mode selected on the display a trigger pull will jump to a submenu allowing you to choose how many shots you would like in your burst.

2RND . . . 9RND

The number of shots in the burst may be selected from 2 to 9 rounds.

MOD FULL

Full auto mode – The gun fires at the rate of fire setting as long as the trigger is held.

MOD NXL

NXL mode – Standard NXL ramping is three shots semi auto and the fourth if held is full auto. If there is more than 250ms (1/4 second) between shots the gun will continue to shoot semi auto. In other words the minimum rate of fire for ramping to start and/or be maintained is 4 bps. Technically the maximum time between shots is 1 second but that would have taken significantly more code. Note that the rate of fire must be set to 15 or below for this mode to be legal according to the NXL rules.

MOD PSP

PSP mode – Standard PSP ramping is three shots semi auto and the fourth if held is a three round burst. If there is more than 250ms (1/4 second) between shots the gun will continue to shoot semi auto. In other words the minimum rate of fire for ramping to start and/or be maintained is 4 bps. Technically the maximum time between shots is 1 second but that would have taken significantly more code. Note that the rate of fire must be set to 15 or below for this mode to be legal according to the PSP rules.

MOD MIL

Millennium mode – Standard Millennium ramping is one shot semi auto and ramping may only start and/or be maintained if at least 8 bps is achieved. Once the trigger is released only a single additional shot may be discharged thereafter. Note that the rate of fire must be set to 15 or below for this mode to be legal according to the Millennium rules.

The image shows a digital display with the text "MOD HYPR" in a bright orange, pixelated font against a black background.

Hyper mode – The gun fires on pull and release of the trigger. This mode is sick, allowing even a 3 year old to shoot 20 balls per second. Warning, using HYPR in hybrid mode may cause uncontrollable wet dreams for an extended period of time and possibly life.

The image shows a digital display with the text "MOD PR-T" in a bright orange, pixelated font against a black background.

Practice trigger mode – This mode uses Semi auto and will count how many shots per second you shoot. The Dynamic rate of fire is shown on the display as long as the trigger is being pulled. It is updated 4 times per second and the minimum value is 4. If the trigger has not been pulled the last value displayed stays on the screen for bragging rights. With this mode selected on the display a trigger pull will jump to the SOL submenu.

The image shows a digital display with the text "SOL OFF" in a bright orange, pixelated font against a black background.

The solenoid is disabled in PR-T mode only. This will reduce the power consumption to almost nothing for those of you who sit in your basement and practice fingering your trigger. This mode is still accurate because the rate of fire timer is still being used. The solenoid is actually still pulled it is just turned off in less than one millisecond not allowing the gun to actually fire.

The image shows a digital display with the text "SOL ON" in a bright orange, pixelated font against a black background.

The solenoid is enabled in PR-T mode. If the gun is gassed up it will function as if semi auto was selected.

Menu Item Descriptions and Use



This is the rate of fire setting. It is a global setting that applies to all firing modes. It may be incremented from 8 to 31. The ROF is not an exact number but an approximation rounded to the nearest millisecond. For a list of the exact values see the table in *Adjusting FIX*. Note that shooting the gun with a high rate of fire and a high dwell may overheat your solenoid and cause both your solenoid and your board to become nonfunctional.



For those of you who don't have an ACE this must be left off in order for your gun to work.



If you are lucky enough to have an ACE this will turn it on. With the ACE on the gun will only fire if the ACE detects a ball in the breech. With this option selected on the display a trigger pull will jump to the DLAY submenu. If there is no ACE cable connected the gun will fire regardless of what this setting is.



The Delay submenu adjusts the minimum time in milliseconds between the time the ACE first senses the ball and the time it is allowed to fire. The intended use is for people who use either multicolored balls of more than one type of paint. Here's the logic behind it:

The formula for an objects free fall distance as a function of time is: $d = \frac{gt^2}{2}$

Where:

d = distance

g = acceleration due to gravity
(386.09 in/sec²)

t = time

Assumptions:

There is no friction or wind resistance
affecting your ball as it falls into the breech

The ball is being accelerated only by gravity

If there are two balls your gun, one in the chamber and one on top of it in the feed neck. It will take the ball on top 59.3ms to fall completely into the chamber. Assuming the ball's diameter is exactly .680 in. If the ball is sensed by the ACE when it is 75% of the way into your gun ($d = .680 \cdot .75$) the time elapsed is 51.4ms. An additional 7.9ms (8ms) is required for the ball to fall completely into the breech. That is why the maximum delay value is 8ms. If you think the weight of the ball or the weight of the balls above it has anything to do with the speed that it drops at you need to go review your 5th grade science book. With any type of force feed such as a Halo, Warp feed, or Q-Loader this calculation becomes invalid and should be adjusted by experimentation.



FIX is included for guns that have full auto or bouncing problems. Any full auto problem is a hardware problem and FIX is a software fix for that hardware problem. This problem is caused by the magnetic field from the solenoid interfering with the field from the magnet in the trigger and tripping the Hall Effect sensor (Senses a change in magnetic fields). FIX can be used for guns that have a full auto or bouncing problem regardless of whether they are wired correctly or incorrectly. All guns will not require this fix but if needed it is fully adjustable. For more information on setting the FIX value see *Troubleshooting*.



Dwell adjusts the amount of time the solenoid is pulled for. Changing the dwell will not affect the velocity. It will only affect whether the gun fires consistently or not. It takes the solenoid time to increase the magnetic field enough strong enough to move the sear and build force enough to push the On/Off pin. This is unlike other guns that use air solenoids that control how long the valve is open.



Calibration mode is included so that the ACE and trigger can be fine tuned. The display will change when a trigger pull is detected or an object is detected by the ACE. This is the only mode that can not be exited by a trigger pull. You must switch to a different mode and then pull the trigger to exit the menus. For trigger calibration instructions visit www.havoc-online.com and click on “Emag and Xmag” on the left hand side. Havoc-online is arguably the best resource for fixing Mag problems. To calibrate your ACE place a ball in your breech and roll the ball with your finger. If you see the light blink adjust the ACE by turning the small screw on the left hand side of the gun just in front of the trigger. Turn it clockwise to make it more sensitive counter-clockwise for less sensitive.



The display brightness can be adjusted by pressing the bottom button. The actual text on the display doesn't change, only the brightness changes. There are 4 levels of brightness available 100%, 80%, 50%, and 20%.

Other Features

Shot Buffer

There is a one shot buffer for those who can pull the trigger faster than the gun can shoot. See FIX for additional information.

Tournament Lock

When a tournament lock jumper is in place, the menu will display the mode and rate of fire but neither can be changed. DWEL and FIX are locked in their last state and are not displayed until jumper is removed. The jumper should be applied between the bottom two pins in the 5 pin connector.

Automatic Warp Advance

When the trigger is pulled the warp feed will advance even if the ACE has disabled the gun from firing. Intellifeed cable must be connected, to purchase one contact AGD.

Manual Warp Advance

Pressing the bottom button for less than one second will manually advance the warp feed. Intellifeed cable must be connected, to purchase one contact AGD.

Quick ACE Toggling

Holding the bottom button for more than 1 sec will cause the ACE to toggle. If you have a warp feed with an Intellifeed cable the warp will continuously attempt to feed until the ace has toggled letting you know the instant it is done.

Electronic Power on Safety

If the gun is powered on while the trigger is pulled, the gun will not fire in any mode. It will only fire after the trigger is released and pulled again (and released for RELS mode).

Menu Safety

The trigger must be pulled to exit the menus, but firing the gun will not be enabled until after the exit pull has been released.

Visual Low Battery Alert

When powered on with a low battery the gun will display a low battery alert before the boot message. A second trigger pull is required to clear this message.

Fried Board Test (requested by AGD Techs)

If the trigger is pulled and the top button is then pushed, the menu will display but can not be modified until the trigger is released.

Power Conservation

Unnecessary components of processor are shut down when not in use to conserve power. This is an extremely minor gain but it's only a couple lines of code so why not add it.

Scrolling Custom Boot Message

The boot message scrolls and can be easily customized in the source code. Boot personalization is available for an additional fee. Boot message does not have to scroll. Please see *Price List* and *Customizations* for additional information

Scrolling Low Battery Message Available

The low battery message does not scroll by default but can be edited and customized to scroll easily in the source code. Low Battery personalization is available for an additional fee. Please see *Price List* and *Customizations* for additional information

Custom Scrolling Speed

If you feel that the scrolling speed is too fast or slow it can be modified for your custom messages. If both messages scroll, they must both scroll at the same speed.

Full Alpha Numeric Character Set Available (upper case only)

Messages can be customized to say anything, A-Z and 0-9 with room for up to five custom characters or more if all of the standard characters are not used.

Self Correcting EEPROM values

If any one saved setting becomes corrupted for any reason, that value in the EEPROM will be automatically reset so that the gun can continue to be used. This feature was first available in XMOD BETA 1.6, prior to that if the EEPROM was corrupted the gun would have to be reflashed to make it work again. Here are the default settings:

MOD	SEMI
BRST	2
ROF	8
ACE	OFF
DLAY	0
FIX	95
DWEL	13
Brightness	20%

Recommended Settings

These are the default settings and have been thoroughly tested to be safe. DLAY can always be adjusted without ever taxing the gun.

MOD SEMI
ROF 15 (or less)
ACE OFF (should be ON for X-Mags or E-Mags with an eye)
DLAY 1 (Irrelevant unless ACE is on)
DWEL 15
FIX 46 (or as high as it can go)

DWEL should not be set above 15 if ROF is greater than 15. ROF should not be set above 20. Rates of fire above 20 are for testing and demonstration purposes. It is safe to set the ROF to 31 when in PR-T mode if the solenoid is turned off. This will allow you to practice higher rates of fire without being capped by the ROF. When doing this, make sure to set FIX to 0 so that you will be able to buffer shots.

Full Auto should be used for testing purposes only. Using full auto excessively may damage the guns electronics. The solenoid will also be damaged if it overheats.

Input pressure will have a drastic affect on actual max rate of fire that may be achieved. 850psi should be used as a minimum. 1000psi is recommended and to achieve rates of fire above 20bps more pressure is required. Setting the ROF to faster than the gun can actually cycle at due to its input pressure will cause damage to the sear and may damage other components also.

Adjusting DWEL

Start your gun with DWEL set to 15 and decrease it 1 until the gun does not fire consistently. If the gun ever does not fire consistently, increase DWEL by 1 and test it extensively. The exact value required varies per gun but should always be between 9 and 15. This value is dependent on the internal friction and pressures inside the valve. It will also take more dwell to fire the gun when the battery is low. You will probably want to adjust the DWEL to a level that will work the longest for you. This may be higher than the minimum DWEL setting when the battery is full.

Adjusting FIX

Increasing the FIX actually adjusts the number of milliseconds the gun pauses after the solenoid is released and before it will look for another shot to fire or buffer. If the FIX is set to 0 a shot can be buffered immediately after the solenoid is pulled (less than 0.25ms). If the FIX is set to 1 a shot can be buffered 1ms after the solenoid has been released. To calculate this time add the DWEL value to the FIX value. This summation is the number of milliseconds before the next shot can be buffered. Setting the FIX to the max value, if that value is not 46 will completely eliminate shot buffering. Both the DWEL and the ROF affect what the max FIX can be. The table illustrates what the FIX can be with DWEL set to 15.

If the max FIX setting does not cure the bouncing problem there are 2 things you can do. The first is to decrease the ROF so the FIX can be set to a higher value. The recommended setting for no bounce is 46. One other option is to change from using SEMI to RELS or vice versa. For some reason if the gun bounces in one mode it will not bounce in the other. Which will bounce is dependent on whether you have your solenoid wired correctly or not. For more information see *Solenoid Wiring Test*.

Click the Attachments Tab to view attachments and open Bounce.xls to be able to change the dwell and see the color ranges dynamically update.

Desired BPS	Desired Time (ms)	BPS (Actual)	Time (ms) (Actual)		DWELL	MAX FIX
8	125.000	8.00	125		15	46
9	111.111	9.01	111		15	46
10	100.000	10.00	100		15	46
11	90.909	11.11	90		15	46
12	83.333	12.05	83		15	46
13	76.923	13.16	76		15	46
14	71.429	14.08	71		15	46
15	66.667	15.15	66		15	46
16	62.500	16.13	62		15	46
17	58.824	17.24	58		15	43
18	55.556	18.18	55		15	40
19	52.632	19.23	52		15	37
20	50.000	20.00	50		15	35
21	47.619	21.28	47		15	32
22	45.455	22.22	45		15	30
23	43.478	23.26	43		15	28
24	41.667	24.39	41		15	26
25	40.000	25.00	40		15	25
26	38.462	26.32	38		15	23
27	37.037	27.03	37		15	22
28	35.714	28.57	35		15	20
29	34.483	29.41	34		15	19
30	33.333	30.30	33		15	18
31	32.258	31.25	32		15	17

KEY:	
	All Guns are 99% bounce free
	Guns with correctly wired solenoids are 99% bounce free
	Many guns will illegally bounce

Solenoid Wiring Test

If you have XMOD loaded make sure you have the FIX set to 0 then set the mode to RELS try pulling the trigger and releasing it extremely slowly. If the gun bounces it is wired incorrectly. If you can't get it to bounce in RELS mode change the mode to SEMI and pull the trigger extremely slowly. If the gun bounces in SEMI mode while the trigger is being pulled it is wired correctly.

Here's another easy way to test if the Solenoid is wired correctly with any version of software loaded. A compass is needed for this test.

Step 1:

Lay your gun on a flat surface. Take a compass and lay it at the bottom of your grip, so that the center of the compass is on the axis of pull for the solenoid.

Step 2:

Orient both the compass and the gun so that the needle of the compass is perpendicular to the axis of solenoid (the needle of the compass points north/south and the solenoid points east/west)

Step 3:

Pull the trigger rapidly since the solenoid is only on for a few milliseconds and will require several quick pulls to give the magnetic needle in the compass time to respond.

Solution:

If the South end of the needle turns and points toward the solenoid while you are pulling the trigger it is correct

If the North end of the needle is pointing toward the solenoid it is wired incorrectly and NEEDS to be fixed (Trust me and either fix it or get it fixed. If you are having problems it will in most cases solve them all.)



Step 2 - Oriented Correctly



Solution – Solenoid is Wired Correctly

Troubleshooting

All Troubleshooting assumes the gun works perfectly in mechanical mode and AGD 3.2 functions as it should in electronic and hybrid mode. If you are having a mechanical problem please visit www.havoc-online.com. Havoc-online is arguably the best resource for fixing Mag problems.

1. *In SEMI mode the gun fires more than one shot if the trigger is pulled slowly.*
Increase FIX. See *Adjusting FIX* for more information.
2. *In RELS mode the gun fires more than one shot if the trigger is released slowly.*
Increase FIX. See *Adjusting FIX* for more information.
3. *In semi auto mode the gun continues to shoot after the trigger has been released.*
Increase FIX. See *Adjusting FIX* for more information.
4. *The gun fires more shots than expected (at any time)*
Check what mode you have selected.
Increase FIX. See *Adjusting FIX* for more information.
5. *In BRST mode with the ACE on the gun does not fire the full number of shots in the burst.*
Disable the shot buffer by increasing the FIX and/or reduce the ROF
6. *When the trigger is pulled the gun will click with no air but does not fire a ball.*
Increase DWEL
7. *It takes multiple trigger pulls to get the gun to fire.*
Recharge the battery
Increase DWEL. See *Adjusting DWEL* for more information
8. *After the gun has sat a while it will not fire in electronic-mode until after a shot has been fired in mechanical mode.*
It is possible to fix this by increasing the DWEL but it is not recommended unless it happens frequently. By leaving you dwell low, it will save battery power. If increasing the dwell does not help please visit www.automags.org/forums/ and click on Deep Blue. I have created a thread specifically for BETA Testers and this subject has been discussed in detail there.
9. *When installing the quick jumper or ACE the wires don't stay in place anymore.*
Sometime the tabs on the connector just need to be bent down before the wire is inserted. If however you have damaged any part contact me (see *Price List* for contact information) and I can send you any new connector for a minimal charge if no crimping is required.
10. *The firing mode and ROF can be changed, also FIX and DWEL are not in the menu at all.*
Remove the tournament lock jumper. See *Hardware Setup* for more information.