



AMC-AASD15A servo controller

Manual v2.4

for 4DOF+TL+Surge Servo Kit

AMC-AASD15A servo controller Manual

<https://www.thanos-motion.com/>

This manual is written for firmware **v2.11 fix6**



AMC-AASD15A Interface information

The AMC-AASD15A servo controller allows seamless and fast interface between the PC and the AASD-15A servo drives. Using the AMC-AASD15A controller you can interface your linear servomotors to [Sim Racing Studio](#), [Simtools](#), [X-sim](#) and [Ian's 6DOF BFF motion software](#). The connection to PC is a simple USB connection and the connection to the AASD-15A drives is via straight male-male DB25 cables (1:1 with all 25 wires), one for each drive.

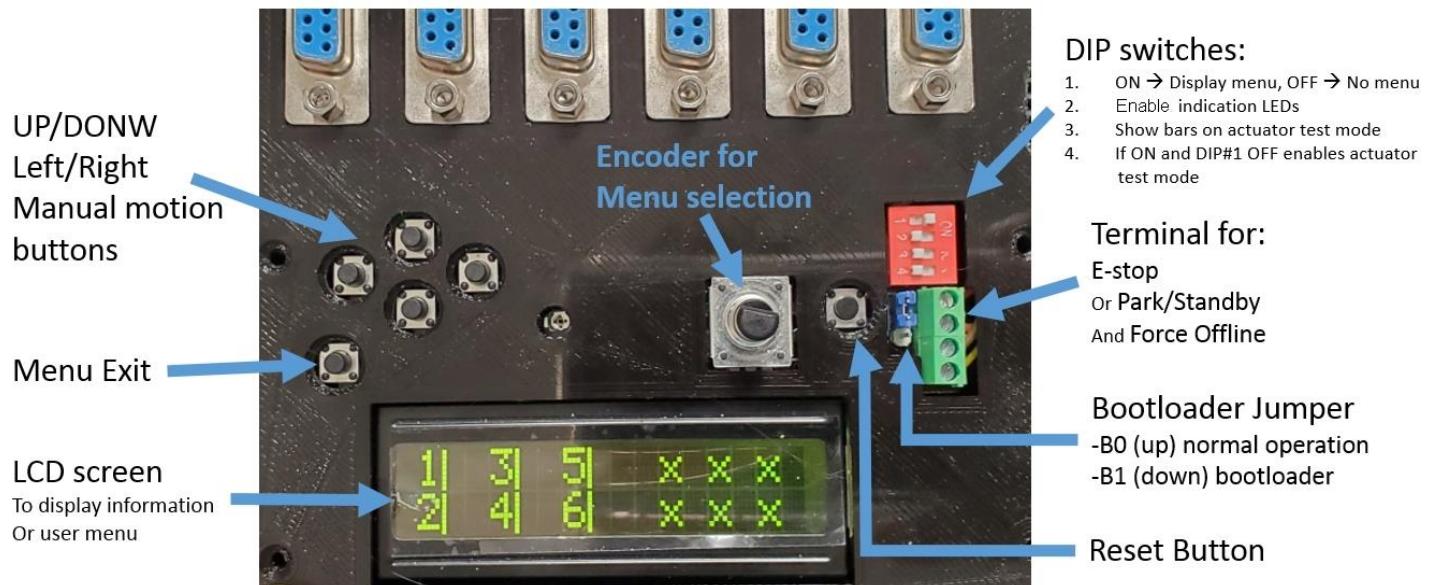
In the LCD menu of the AMC-AASD15A, you can set the following to match your simulator platform (Other settings are not so much important):

- Number of motors → **4act** (for 3DOF using 4 vertical actuators) or **5act or 6act or 7act** (additional actuator for Surge or Front/Back Traction loss)
- Auto-Park function → **4act +TL +Surge** (to disable park on TL axis or other horizontally placed actuators)
- Actuator Stroke → set to **100mm** (for SFX100 DIY actuators) or **150mm** (for PT-ACTUATOR Scorpion or other)
- Lead screw → set to **5mm/rev** for 250mm/s speed with 1605 or 2005 leadscrew (SFX100 and PT-ACTUATOR Scorpion actuators) or 10mm/rev for 500mm/s with 1610 or 2010 leadscrew actuators
- Motor Direction → Set to **Inline** (for SFX100 DIY actuators) or **Foldback** if the motors are mounted via belt.
- Gear reduction ration → Used mostly foldback actuators that may have different ratio belt drive.
- Platform Check → Blocks the use of the platform with motion data if any of the actuators is not in ready state.
- Pulse Frequency → by default is 200kHz, but some servo drives may require less like the Syntron HS that need 100Khz frequency for the pulses.
- Pulse Filter → smooths out high frequency motion data received to create smooth curve pulse signals.
- Spike Filter and Spike Filter TL → if enabled, it can limit motor speed when new position cues are above the defined stroke distance.



Panel and buttons info

For detailed guide on setting up the parameters and options for 4DOF+TL on the AMC-AASD15A controller see this video:
https://www.youtube.com/watch?v=RG3atym_IKo



When an AASD-15A servo is connected and powered on the AMC-AASD15A servo controller, it will perform calibration seeking for the home position (usually hard stop against the end of travel of the actuator).



Once the calibration is complete, the motor will head to home position...



...or standby position if motion data from the PC are already present.



If there is no motion data from the PC, the controller will timeout and automatically park the actuator showing a P symbol for the actuator.

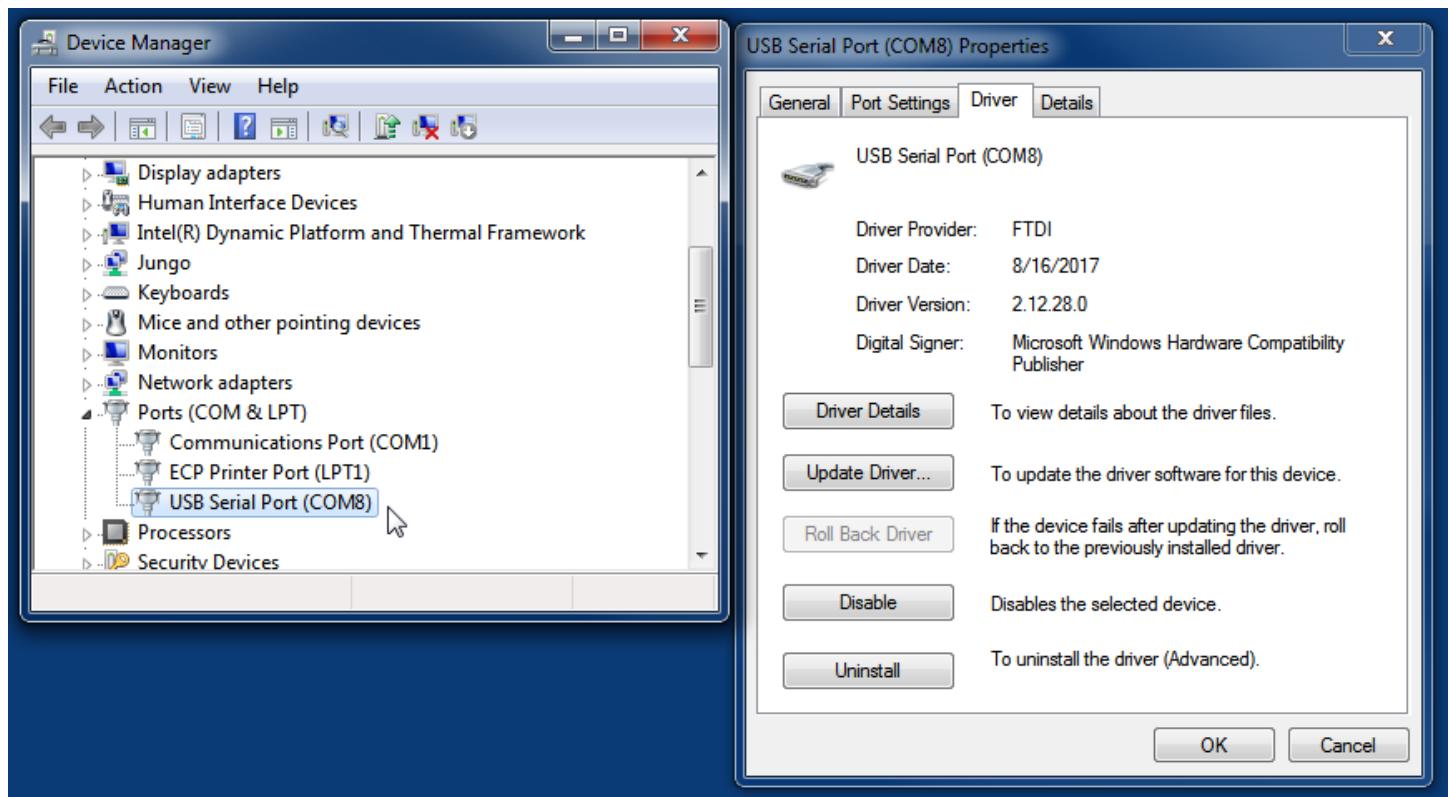


At any point you can **restore default parameters** by holding the "Menu Exit" button and pressing Reset. Keep holding the "Menu Exit" button until you see the message "**Restoring Defaults**" appear on the LCD. Watch this video to see how:
<https://www.youtube.com/watch?v=g12Grq-1LBQ>

The USB Data connection requires FTDI driver that can be downloaded from the FTDI website:

<http://www.ftdichip.com/Drivers/VCP.htm>

The device appears in the PC Device manager as COM Serial interface device that then can be defined for use with Simtools or any other motion software that provides interface support for the AMC-AASD15A.



If your controller has older firmware you can visit the Github and get the latest firmware to update the controller.

<https://github.com/tronicgr/AMC-AASD15A-Firmware>

https://github.com/tronicgr/AMC-AASD15A-Firmware/tree/master/Latest_firmware

Make sure to download the bootloader utility:

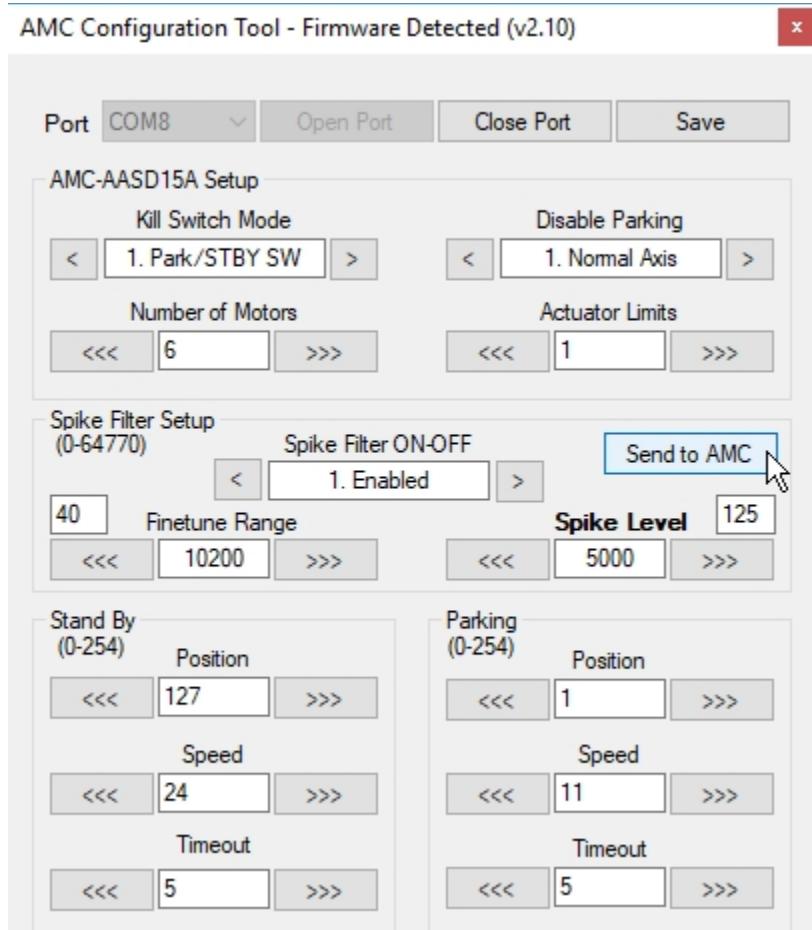
https://github.com/tronicgr/AMC-AASD15A-Firmware/blob/master/Latest_firmware/Firmware%20bootloader%20Utility%2052.zip

Firmware Update procedure video

<https://www.youtube.com/watch?v=WkAm-MI0xbo>

You can use the AMC config tool to access and modify the parameters in the AMC-AASD15A:

https://github.com/tronicgr/AMC-AASD15A-Firmware/blob/master/Latest_firmware/AMC_Config_tool_1_2.zip



The AMC config tool can be used to remotely set some parameter temporary, like the Spike Filter values before you are about to use Simtools and don't want to reach to the LCD panel to adjust the value there. This is not needed with SRS motion software as it automatically adjusts spike filter values directly from the SRS app.

Filtering

The Pulse Filter smooths out high frequency motion data received to create smooth curve pulse signals for the servomotors. It acts like a high-pass filter which amplitude depends on the frequency, so fast frequency “noise” with high amplitude gets filtered, while lower frequency “noise” will be allowed to pass through.

The Pulse Filter uses a Rolling Average Filter on the servomotor, to decrease the motor step performance, remove small vibrations (noise) that exist from the use of electronic gearing pulse method and add s-curve smoother accelerations and decelerations. On the other side the Spike filter is used to replace any large spikes in motion (non-linear motion cues) with temporary artificial slower motion until the motion levels relax. The Spike Filter is especially useful to protect the motion platform from large amplitude fast vibrations that translate to full speed swings to the expend of the whole stroke, that are usually generated from the motion software in case of a crash (maxing out force levels). It will also slow down the motors speed in case you run off road to minimize the effects of violent vibration if set to lower level.

The Rolling Average filter is located under the Pulse Frequency submenu. A good value for minimal vibration and good response is “2-Semi-Hard-Filter”. You can disable the Pulse Filter by setting it to “0”.



The Spike filter is located in a separate menu, where you can set the Level of the spike parameter (distance between two positions, in the scale of 0-65535 values), the Range parameter, which can increase the selection resolution “step” of the values in lower Spike Level values and the option to Enable-Disable the filter. A good level for the Spike filter for normal racing is around “1800”.

The spike filter level, represents a stroke travel. Say you use value 1800... then in mm for 150mm total stroke it would be about 4mm free travel for fast vibrations, if a motion cue instructed the actuator to go instantly to say 5mm it would activate the spike filter...

The calculation is as:

$$150\text{mm} / 65535 = 0.0022888533$$
$$1800 * 0.0022888533 = 4.11993594 \text{ mm}$$



You can select the TL spike filter setting (for horizontal actuators) using the Left-Right buttons on the AMC Panel. You can define which actuators are horizontal by selecting the **Auto-Park** menu parameter and selecting **4act +TL +Surge** to indicate you have 4 vertical actuators and the rest (5,6 and 7) are horizontal placed.



There are some parameters available to adjust for the recovery of the spike filter: ESC and FINE...

Under Spike Filter speed menu:



ESC sets the "Escape" speed that the actuators move during the spike filter trying to reach the real time target.

FINE sets how close to real time motion data targets the actuators need to be to jump to live data. It defines the smaller distance before that actuator "locks" into the target position and jumps only if ALL the rest axis are also in locked distances...

The servomotor speed is proportional to the rate of the pulses it receives. So the AMC sends the pulses with max rate possible to be able to synchronize the motion to all actuators and keep the positions as close to real time with the game motion cues.

Less pulse rate is used when spike filter is active for example where the controller is not reacting real time but "following" slowly the real time positions, to create artificial motion instead the huge spike jump. But the slower motion is lagging behind, so its temporary until it catches up with real time positions again.

So anything less than full speed pulses, will be lagging behind in normal use and will clip out vibration details of the road etc... you could use the pulse filter parameter in the AMC, which adds some ramping in the accelerations, to make motion a bit more smooth, but as I said will filter out some of the details.

LCD navigation information

The following menus use the LEFT/RIGHT buttons on the AMC Panel to select values or actuator number on the displayed parameter: **Stroke Act**, **Leadscrew Act**, **Direction Act**, **Ratio Act**, **Spike Filter**, **RGB color** menu.

To be able to select actuator number for the above parameters, please adjust one first and when it asks to "Merge Act values" select "No, individual". The LCD menu parameters displays different values when rotating the encoder knob i.e:

6 axis: 1 ■ 3 ■ 5 ■ x x x 2 ■ 4 ■ 6 ■ x x x 7axis: 1 ■ 3 ■ 5 ■ x x xx 2 ■ 4 ■ 6 ■ x x x■ Number of Motors <1-7axis>: 6axis --> 1 axis --> 2 axis --> 3 axis --> 4 axis --> 5 axis --> 6 axis --> 7 axis	Actuator Type --> Linear --> Rotary Platform Check OFF – Normal ON – Park all Park Position <0-100%>:0/4 Position ____ %0 Park move speed Speed ■____ %4 Park delay: 10:0	Standby POS/SPD <0-100%>:50/3 Position ■■_ %50 Speed ■____ %3 Timeout: 10:0sec Auto-Park Actuat >All Axis Normal >6act +Rotation >5act +TL +Surge >4act +TL +Surge >3act +TL +Surge >2act +TL +Surge
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Software Setup

SRS – Sim Racing Studio:

<http://simracingstudio.rurl.me/thanos>

SRS automatically detects the AMC controller and its ready to use almost immediately. Since SRS handles setting the Spike filter value you need to disable it on the AMC LCD menu or if not sure, just [restore defaults](#) on the AMC controller and just set your stroke/leadscrew/Auto-park settings, leaving all else to default values.

Quick start guide for AMC-AASD15A controller setup:

<https://bit.ly/3IX6ON5>

The order of connecting the actuators on the platform in a manner that works correct with SRS can be found in the SRS app:

ACTUATOR	PORT	REVERSE
RL	1	
FL	2	
FR	3	
RR	4	
TL Rear	5	<input checked="" type="checkbox"/> Off
Surge	6	<input checked="" type="checkbox"/> Off
TL Front	7	<input checked="" type="checkbox"/> Off

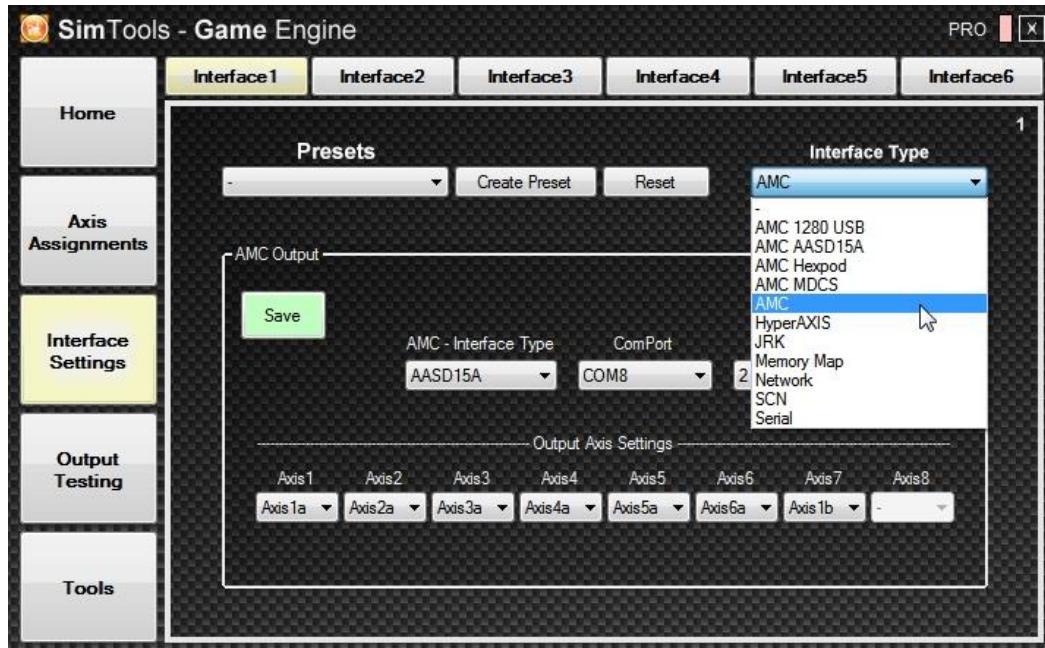
Don't forget to have a look at the Tuning guide:

<https://www.simracingstudio.com/forum/motion-profiles/srs-2-0-motion-tuning-guide>

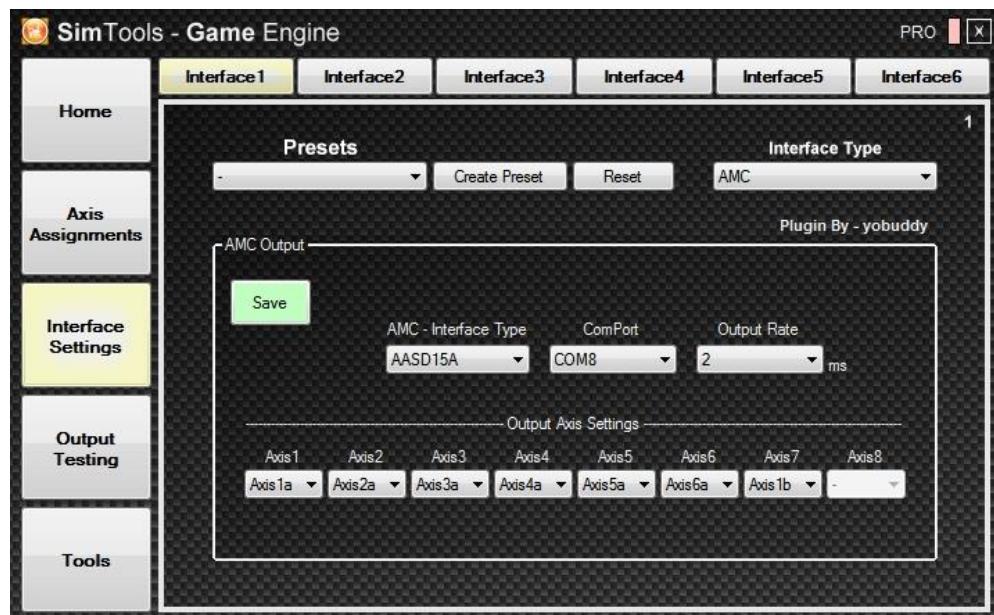
Simtools:

The Simtools v2.4 should already include the AMC interface plugin. Start Simtools, you should see 8axis available now for the AMC1280USB interface plugin. You can watch the basics here: https://www.youtube.com/watch?v=RG3atym_IKo

Or you can watch Barry's videos from Sim Racing Garage: <https://www.youtube.com/watch?v=-J65OE7cJoM>



Interfacing the Simtools with direct axis is simple as seen on the below capture. It requires to select the AMC interface plugin, select the AASD15A interface type and select the COM Port that is assigned to the AMC-AASD15A in the PC device manager.

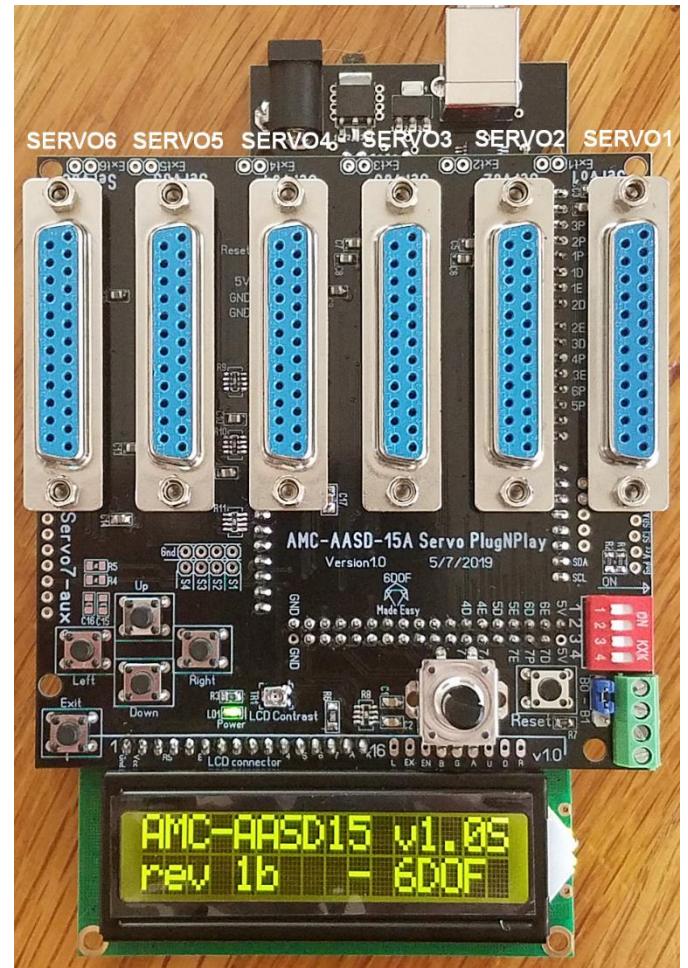


The axis assignments for each DOF provided is up to the user to mix and use as needed. The AMC-AASD15A can be configured to use any of the 3axis, 4axis or 5axis outputs.

To get the desired motion from the computer game to the actuators, you will have to create some profiles that mix the axis information from the game to the axis setup of the actuators. This can be done in the Axis Assignments section of the Game Engine of Simtools. If additional traction loss actuator is used, it can be assigned to Axis5a (extra1 for many games).

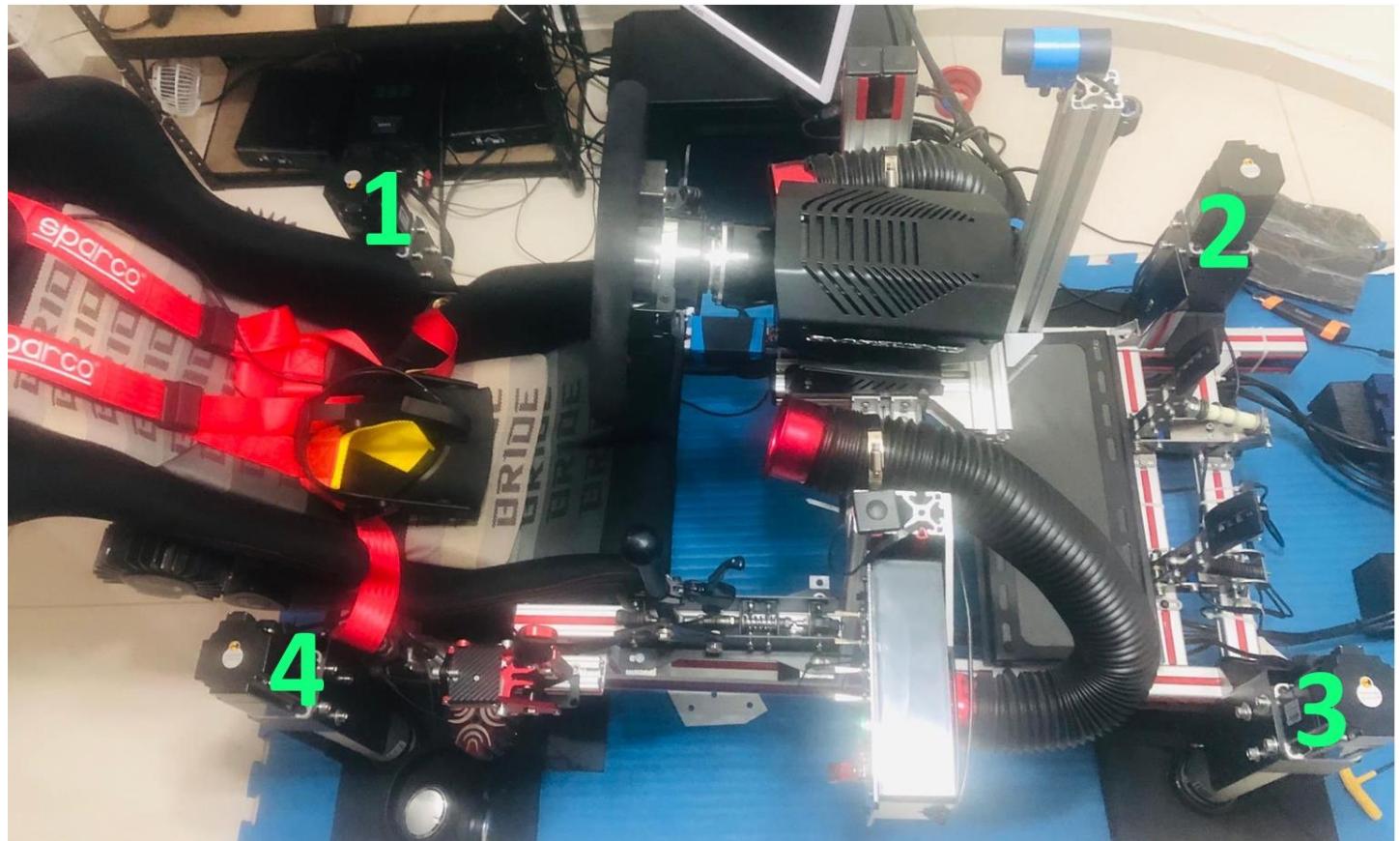
Setup example of the Axis assignments with various DOF (degrees of freedom) motion cues data inputs for combined motion. The axis5a on the example uses just the “Extra1” that is traction loss usually and axis6a holds the pure Surge value for the surge actuator:

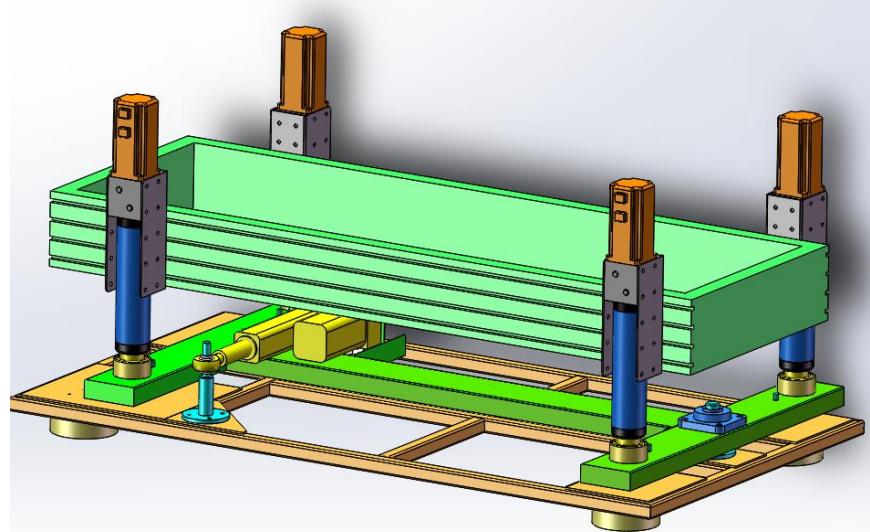




Physically you will need to arrange the order of connection of each actuator to the AMC-AASD15A controller to correspond to correct order described to the Axis assignments of Simtools. For 5DOF platform the order of connection of each actuator 1-5 is:

- Rear left - Servo 1 connector of AMC-AASD15A
- Front left - Servo 2 connector of AMC-AASD15A
- Front right - Servo 3 connector of AMC-AASD15A
- Rear right - Servo 4 connector of AMC-AASD15A
- Traction Loss - Servo 5 connector of AMC-AASD15A
- Surge Actuator - Servo 6 connector of AMC-AASD15A





You can see the four actuators mounted vertically and the traction loss actuator (foldback) mounted horizontally

Example videos from Sim Racing Garage: <https://www.youtube.com/watch?v=Os4EiGsz4CM>

https://www.youtube.com/watch?v=rhXrQlctt_E

Actually this is old example, now most platforms use two inline actuators for Front/Rear Traction loss:

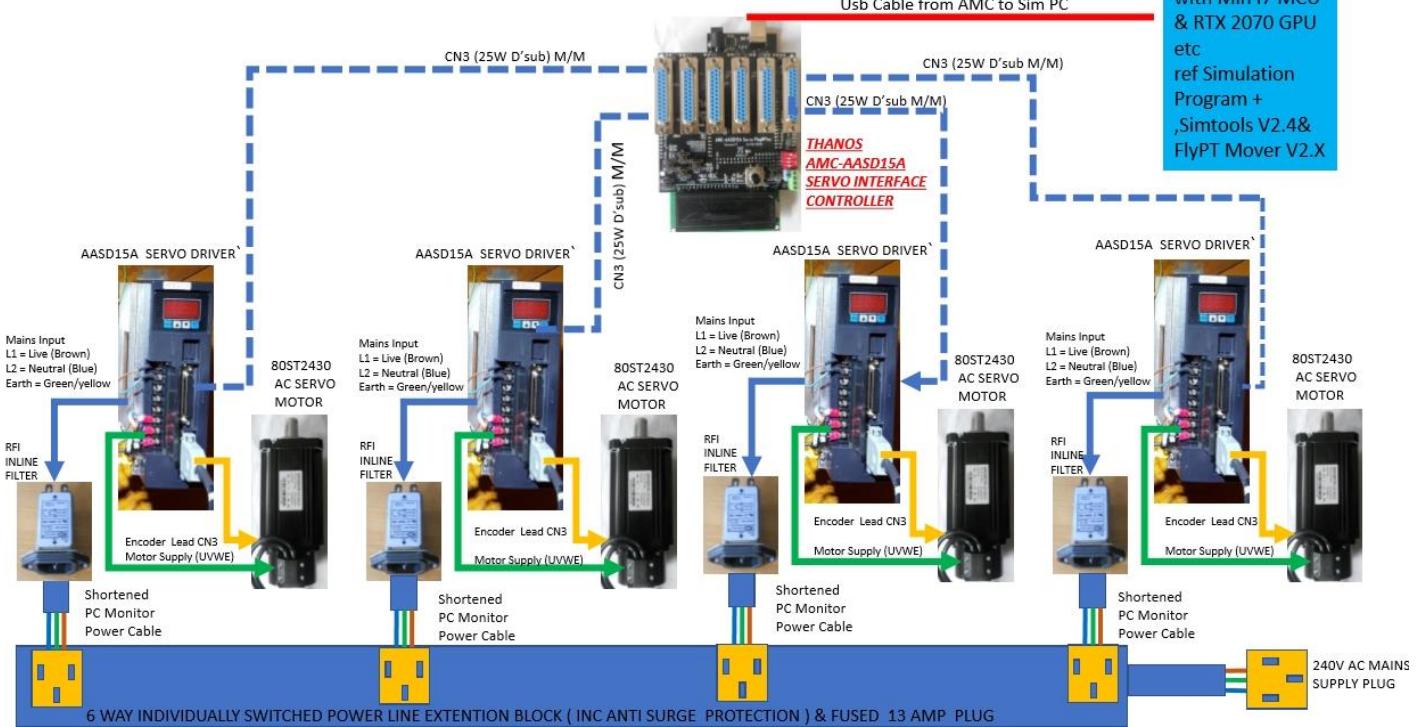
<https://www.youtube.com/watch?v=c98oRO2VjOc>



The wiring of the servo drives is not too complicated if you do some basic cable managing

AMC-AASD15A 4DOF servo driver wiring diagram 6/10/19

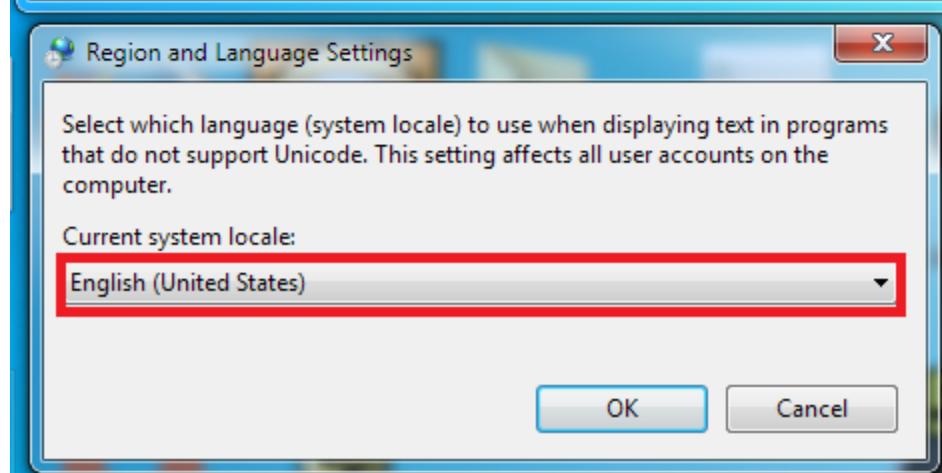
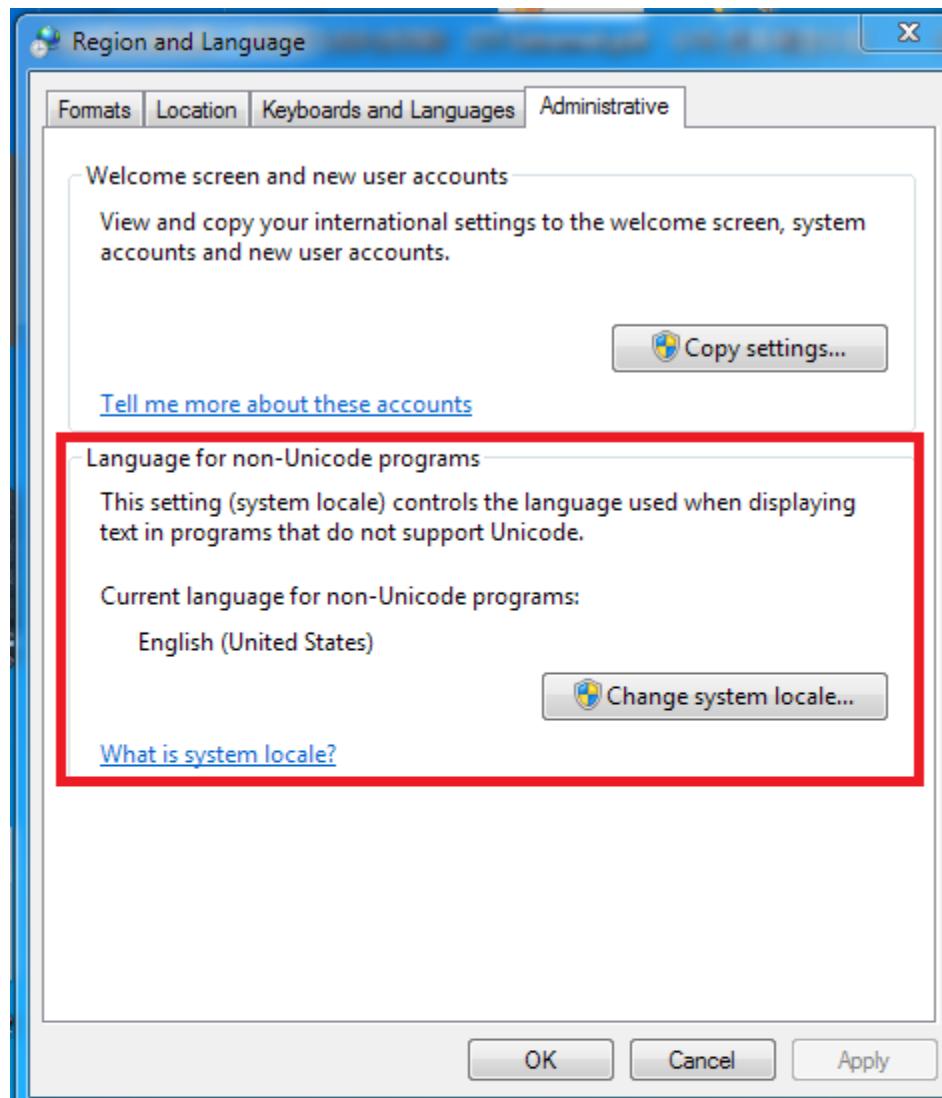
High Spec Sim PC
with Min I7 MCU
& RTX 2070 GPU
etc
ref Simulation
Program +
,Simtools V2.4&
FlyPT Mover V2.X



A better way would be using a small rack to enclose the AASD-15 drives and arrange the wiring. Also including some filtered power strips and chokes on each cable. Such racks often have their own fans that allow cooling of the servo drives while on operation and block much of the noise.

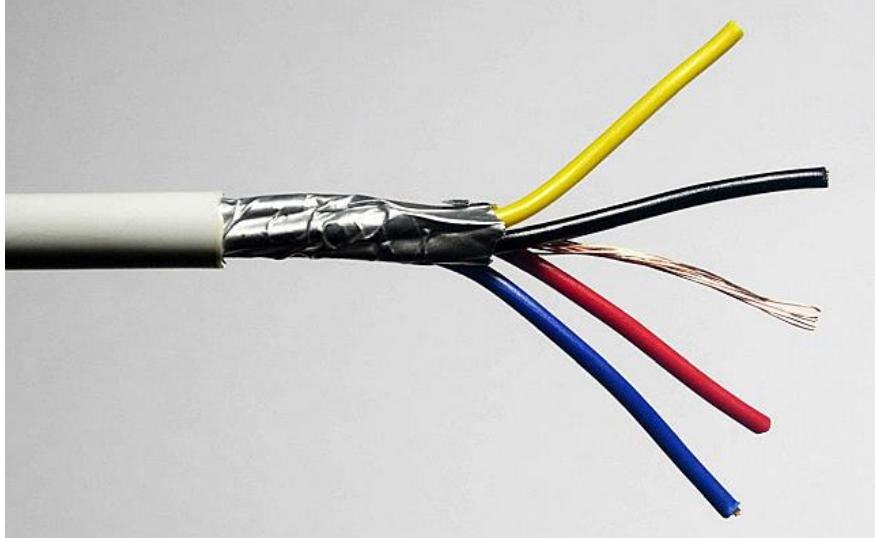
Troubleshooting for Simtools:

If no there is no motion when you test manually the sliders in Simtools, please change the computer Region and Language settings as below:



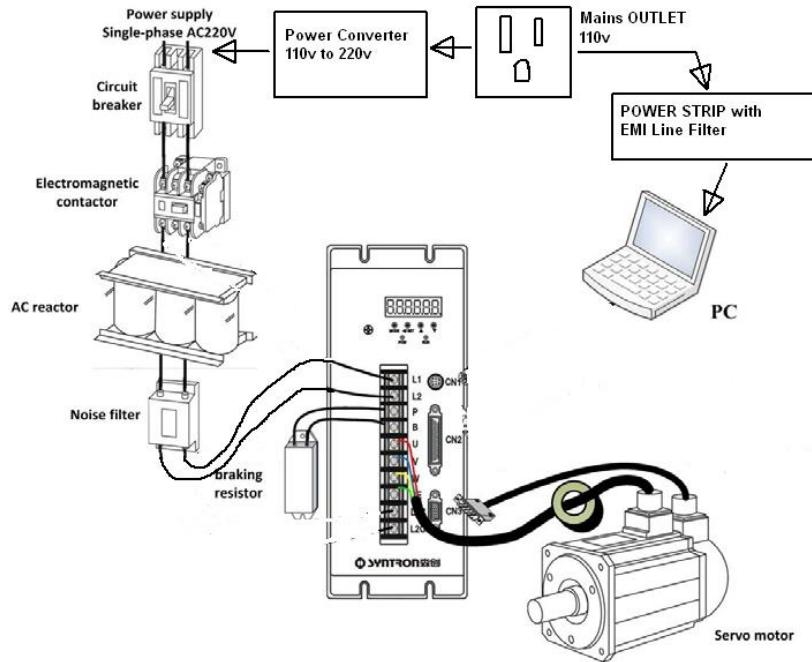
EMI and EMC considerations

Most of the servomotors are delivered from the factories without proper shielded cable that leaves all other nearby equipment subject to severe EMI interferences. This can be really bad for devices that are really sensitive like many VR equipment that are usually positioned right on top of these interferences. The long unshielded cables of the servomotors can act as antennas for transmitting these EMI interferences several feet away. The source of these is the servo drive itself that generates a 10khz PWM signal on the three phase AC power signals that is used to power and position the servomotors. These signals swing up to 110v in many cases can affect nearby low voltage devices (5v or 3.3v devices). The best way to solve this is to cover these power cables with conductive tape from the servo drive all the way up to the motor. See example capture of the noise on the same cable when it's measured on covered and an uncovered region of the cable:

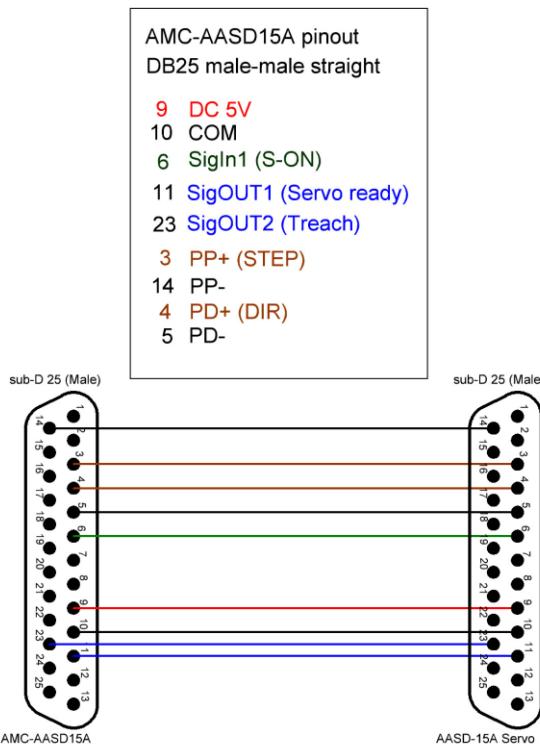


As you can see on the photos above the power cable is not shielded. Next to it, is a [shielded cable](#).

Consider adding a line filter to prevent some of the EMI noise to propagate to other connected devices on same power line like the PC or peripherals. Usually all system must be star connected to a single outlet to avoid ground loops:



If you want to see which wires are used in the DB25 cable:



Here are some examples of platforms for use with the AMC-AASD15A:



Programmer's information:

The data packet string now is 20 bytes long and includes additional spare motion data slots for up to 8axis

The ID is byte values 0xFF + 0xFF

Each Axis is 16bit wide.

LF+CR is required in the end (0x0A + 0x0D)

ID AXIS1 AXIS2 AXIS3 AXIS4 AXIS5 AXIS6 AXIS7 AXIS8 LF/CR

The parameters can be changed via terminal (250000 bps)

---List of commands---

Command Number	Display Parameter	Save Parameter
CMD01	Motornumber:	spv012-spv018
CMD04	Park Position:	spv04001-spv04254
CMD05	Park Move Speed:	spv05001-spv05100
CMD06	Park Move Timeout:	spv0601-spv0690
CMD07	Standby Position:	spv07010-spv07245
CMD08	Standby Speed:	spv08000-spv08100
CMD09	Standby Timeout:	spv0901-spv0990
CMD10	Disable park type:	spv111-spv115
CMD13	Actuator Limits:	spv1300-spv1350
CMD14	Kill switch mode:	spv141-spv142
CMD44	Display all parameters	

Command Number	Display Parameter	Save Parameter
CMD45	Print this help page	
CMD55	Print delimited parameter list for simtools	
spv45	Saves all parameters at once	
RQM	Displays model,revision and number of motors	
Park	Parks the actuators if in standby mode	

Some Commands may not change value - locked

The CMD\$\$ displays each parameter, and spv\$## saves each parameter with the value indicated. To actually store the parameters in the flash memory you need to send "spv45" to save all parameters at once. The "\$\$" on the spv is the command number, and the "###" is the value, Some parameters have single digit value, some two digit value and some 3 digit value. All values are characters!

Here is a list of the default parameters values you should get when you issue the CMD44 command (if not like this, you may reset the default parameters via button combination)

```

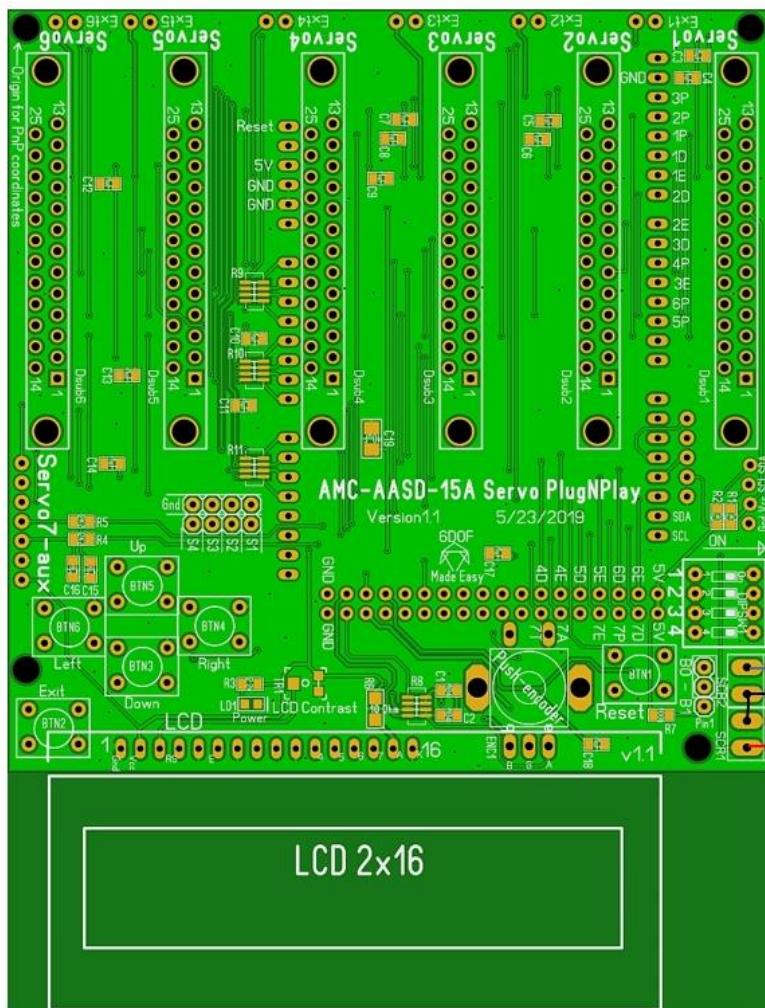
01.Motornumber 2-8: 4
04.Park Position 0-254: 1
05.Park_Move_Speed 1-100%: 11
06.Park_Move_Timeout 1-90: 5
07.Standby Position 10-245: 127
08.Standby Speed 0-100%: 24
09.Standby Timeout 1-90: 5
10.Disable park type 1-5: 1
13.Actuator Limits 0-50%: 1
14.Kill switch mode 1-2: 1

```

"CMD55" returns the following numeric values separated by colon (:) punctuation mark:
" data:" <Motornumber> ":" <Parkposition> ":" <Parkmovespeed> ":" <Parkmovetimeout> ":"
<StandbyPosition> ":" <StandbySpeed> ":" <StandbyTimeout> ":" <Disableparktype> ":"
<ActuatorLimits> ":" <Killswitchmode> ":" <Firmwareversion> ":" <AMCModel>

Wiring Button – E-STOP switch – Force Offline switch

Note that the switches/buttons must be “NO” type (Normally Open)



You can use a 3.5mm panel mount audio jack to simplify wiring and use ready available shielded audio wire (stereo type)

Wiring DB25 female connector on Servo7-aux pins

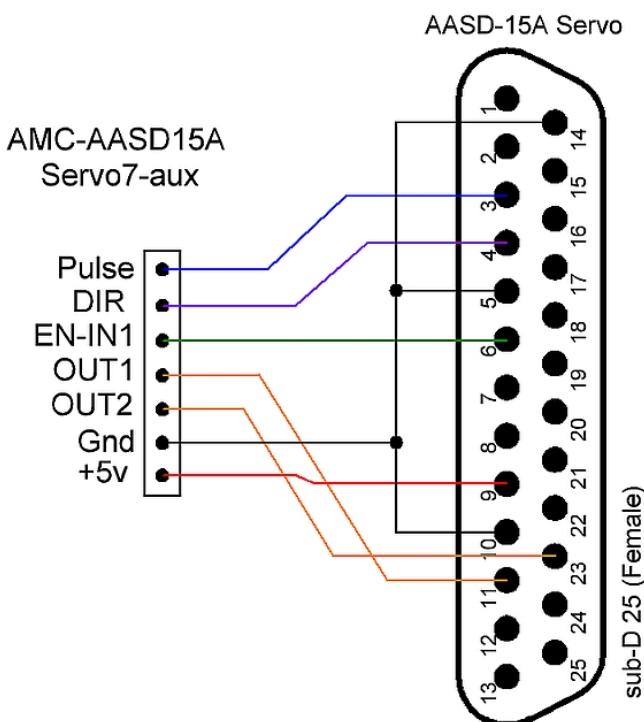
If you need more than 6 axis, you can add a DB25 female connector and plug a 7th servo in the controller. Possible uses are 4DOF+TL+Surge+Belt tension, or 6DOF+rotation axis...

See the videos for details on wiring

<https://www.youtube.com/watch?v=CT7M-8LCCwc>

<https://www.youtube.com/watch?v=pVbQSvhRTq4>

<https://www.youtube.com/watch?v=gEhakHadHmc>



You can now order that allows easy attachment of the BD25 connector without wiring, just a 2.54mm header (male and female): https://oshpark.com/shared_projects/pSGIJpx4

Wiring indication LEDs on AMC-AASD15A

You may need LED indication for the state of the controller from within the cockpit, in that case you can wire some simple LEDs if you don't have access to the LCD display of the controller.

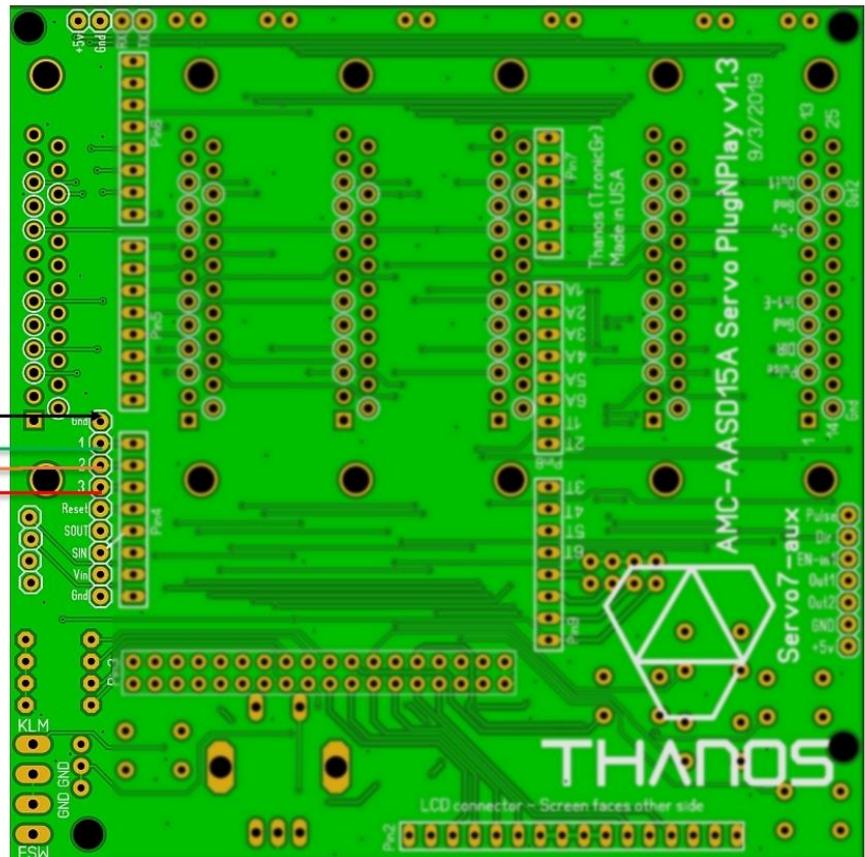
Meaning of LED indications depending on the state of the controller:

Green ----->	Motors online
Blinking Yellow --->	Standby
Yellow ----->	Parked
Only Red ----->	E-Stop
Blinking Red ----->	Force offline
Red + Yellow ----->	Force offline and parked

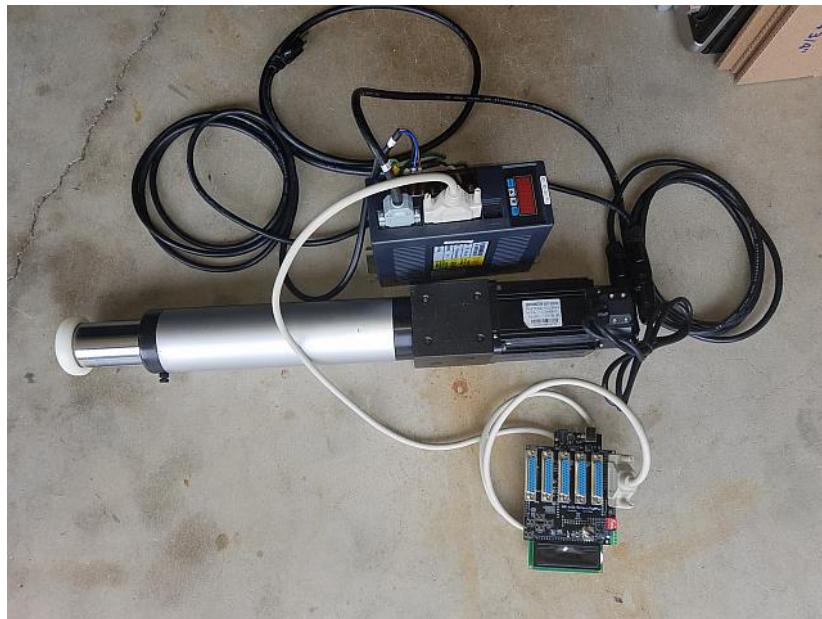
Wiring Indication LEDs for
AMC-AASD15A servo controller



Green ----->	Motors online
Blinking Yellow --->	Standby
Yellow ----->	Parked
Only Red ----->	E-Stop
Blinking Red ----->	Force offline
Red + Yellow ----->	Force offline and parked



AASD-15A Servo drives SETUP



The AMC-AASD15A can be interfaced to all models of AASD that have the DB25 connector and are compatible. Example servo and drive below.

80ST-M02430 220V 0.75W AC Servo Motor 2.4N.M 3000RPM Servo Motor Single-Phase AC Drive Permanent Magnet Matched Driver AASD-15A

<https://www.aliexpress.com/item/80ST-M02430-220V-0-75W-AC-Servo-Motor-2-4N-M-3000RPM-Servo-Motor-Single-Phase/32973113245.html>

Or visit PT-Actuator for selection of servos on various actuators that may fit your motion simulator type:
<http://www.pt-actuator.com/index.html>

The AASD-15A drives need some parameters before they are ready to be used. Most of the parameters are same as SFX100 DIY but some additional one are required.

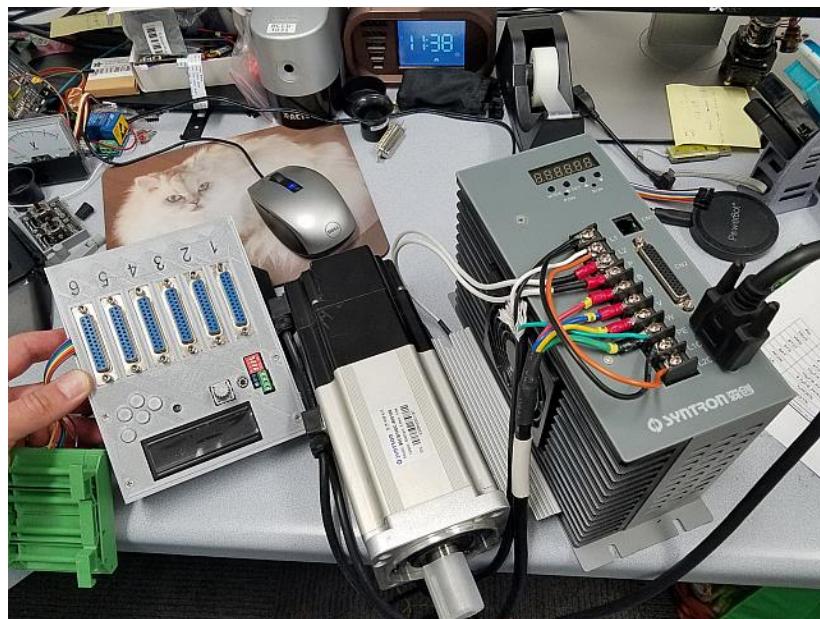
AASD-15A Servo Settings:

Push MOD until you see Pn000. This enters the parameter mode.

Change and check these settings on all motors:

- Pn8 = **300** - Max peak torque % CW
- Pn9 = **-300** - Max peak torque % CCW
- Pn51 = **3000** - Max servomotor speed in RPM
- Pn98 = **20** - Pulse Multiplier (electronics gear)
- Pn109 = **1** - smoothing, (1=fixed smoothing, 2=s-Shaped smoothing)
- Pn110 = **30** - Smoothing Filter Time
- Pn113 = **20** - Feedforward %
- Pn114 = **10** - Feedforward Filter Time (ms)
- Pn115 = **100** - Gain %
- Pn24 = **100** - Torque level for home calibration
- Pn52 = **1**
- Pn60 = **2**
- Pn61 = **6**

Syntron HS Servo drives SETUP



Note: Syntron HS drives require 101Khz Pulse Frequency setting on the AMC-AASD15A servo controller

Example cable between AMC-AASD15A and Syntron HS .

AMC-AASD15A pinout
9 DC 5V
10 COM (GND)
6 SigIn1 (S-ON)
11 SigOUT1 (Servo ready)
23 SigOUT2 (Treach)
3 PP+ (STEP)
14 PP-
4 PD+ (DIR)
5 PD-

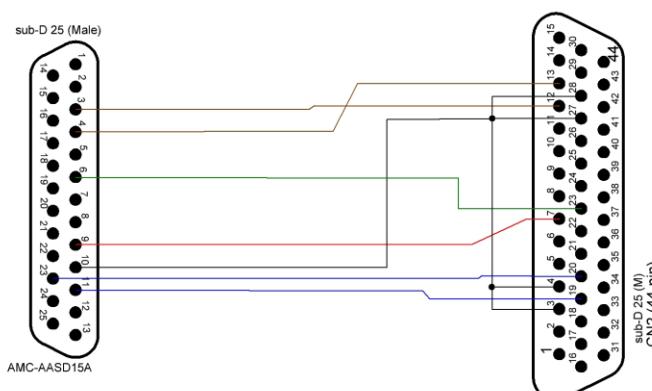
Syntron HS CN2 pinout
7 DC 5V
23 SigIn1 (S-ON)
19 SigOUT1 (Servo ready)
3 Digital Output 1 (-) (GND)
20 SigOUT2 (Treach)
4 Digital Output 2 (-) (GND)
12 PULS+ (STEP)
27 PULS- (GND)
13 SIGN+ (DIR)
28 SIGN- (GND)

Complete list of values to enter in the Syntron HS:

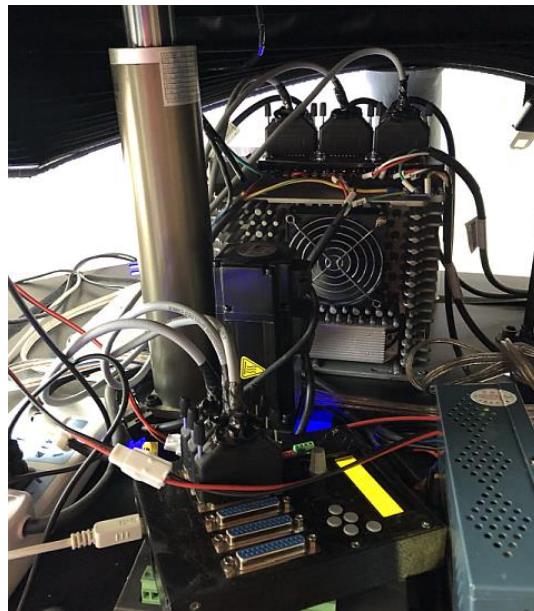
- Fn 000 = 1 Hard-wired control port work mode
- Fn 001 = 2 External pulse position mode
- Fn 010 = -1 Servo Enabling (S-ON)
- Fn 030 = -18 Servo Ready (ENA-SRV)
- Fn 031 = -6 Target Torque Reached
- Fn 038 = 1 Single pulse Positive logic (Pulse/DIR)
- Fn 039 = 0 (2.5Mhz filter)
- Fn 049 = 100 Torque threshold
- Fn 04A = 10 Torque hysteresis
- Fn 050 = 20 Electronic gear ratio numerator
- Fn 054 = 1 Electronic gear ratio denominator
- Fn 004 = 0 Motor direction 0=CCW - 1=CW
- Fn 056 = 120 Pulse input command exponent filtering (Acceleration - deceleration)
- Fn 057 = 32 Pulse input command moving smoothing filtering
- Fn 05A = 0 Position loop speed feed-forward coefficient
- Fn 05B = 10 Position-loop speed feedforward low-pass filter's time constant
- Fn 05C = 80 Position loop's No. 1 proportional gain Kp1
- Fn 05D = 80 Position loop's No. 2 proportional gain Kp2
- Fn 0DA = 32767 Number of tracking error pulses

Fn 0AC = 3000 (MAX MOTOR RPM)

- Monitoring:
- DN 00 RPM
 - DN 01 COMMAND FREQ
 - DN 02 TORQUE
 - DN 03 Position Tracking errors
 - DN 07 Motor speed command value (RPM)



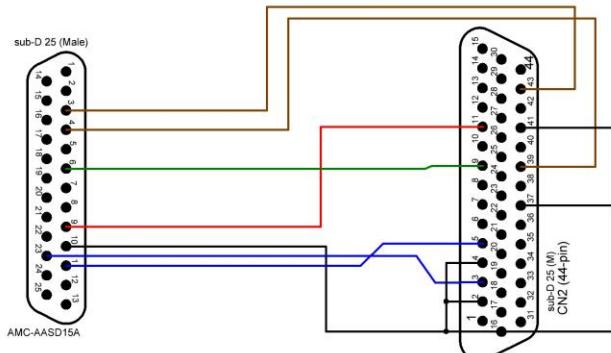
Dorna M1 Servo drives SETUP



Example cable between AMC-AASD15A and Dorna M1

AMC-AASD15A pinout	
9	DC 5V
10	COM
6	SigIn1 (S-ON)
11	SigOUT1 (Servo ready)
23	SigOUT2 (Treach)
3	PP+ (STEP)
14	PP-
4	PD+ (DIR)
5	PD-

Dorna M1 pinout	
11	DC 5V
16	COM SG
9	SigIn1 (S-ON)
5	SigOUT2 (Servo ready)
4	Digital Output 2 (-) (GND)
3	SigOUT3 (Treach)
2	Digital Output 3 (-) (GND)
43	PULS+ (STEP)
41	PULS- (GND)
39	SIGN+ (DIR)
37	SIGN- (GND)



Complete list of values to enter in the Dorna M1:

PA000 = h0000
 PA001 = h0000
 PA200 = 0000
 PA205 = 20
 PA206 = 1
 PA214 = 5
 PA215 = 5
 PA216 = 30
 PA402 = 120
 PA403 = 120
 PA404 = 100
 PA405 = 100
 PA500 = 0
 PA508 = b.0000
 PA510 = h.0d40
 PA511 = b.0000

PA500 = 0 (DEC) (INPUT)
[0] Servo-on (S-ON)

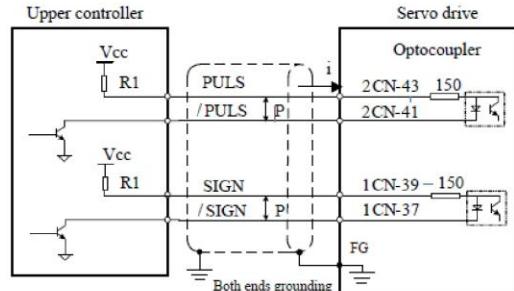
PA510 = 0d40

[4] Servo ready signal (S-RDY): active when servo is in proper status.

[D] Torque Reach signal (Treach): active when load torque reaches PA404/PA405.

- Open collector, option 2 (external 5VDC, 12VDC or 24VDC)

Upper controller



Input current I = 10 ~ 15mA, thus R1 resistance:

If 24VDC, R1=2K Ω ;

If 12VDC, R1=510 Ω ;

If 5VDC, R1=180 Ω ;