OPERATION AND USE OF THE ANIMATICS JOY2/3 JOYSTICK

1. Introduction

1.1 Product Description

The JOY2/3 is a potentiometer-based, two axis joystick designed for use as part of an operator interface for Animatics Motion controllers. The joystick relies on the AniLink network to provide controller communications . The joystick has a toggle switch provides the option of controlling either the X-Y or X-Z axes.

The JOY2/3 relies on a four-input, eight-bit analog input module, the AIO-100. The Series 5000 controller provides firmware level support for the joystick by addressing the AIO module several times per second. Each return is scaled by a conversion velocity and used to set a velocity of a Velocity Mode move.

The JOY2/3 is powered by the +5 V and ground lines on the AniLink. The AniLink Network is a proprietary, serial-based, high-speed data network shared by the Series 5000 and SmartMotor™ lines of motion control products.

1.2 Features

- Simple plug in operation
- 2 / 3 axis control by selection switch
- High speed / Low speed selection switch
- Joystick On /Off (safety) switch
- Convenient size and mounting
- Firmware-level software support under both Series 5000
- +5 V DC operation, powered by AniLink
- AniLink Network Addressable
  - High speed serial communications (100K bps)
  - Multi-drop addressing,
- Compatible with other AniLink peripheral modules
- Four axis unit available

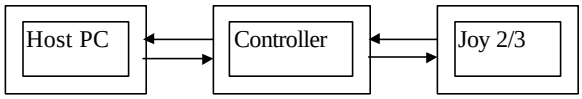
1.3 Part Numbering

The model number JOY2/3 identifies the standard 2 / 3 axis joystick module. Certain special products of similar construction are manufactured within the same family of part numbers. Please contact your application engineer for specific details about special products.

1.4 Theory of Operation

The JOY2/3 joystick acts as a slave to a Series 5000 controller. The joystick is based on an eight-bit analog I/O module. The I/O module has two inputs in series with the precision pots of the joystick. The voltage seen by the I/O changes as the resistance of the joystick changes.

The Series 5000 controller has a firmware level loop which queries the AIO module mounted inside the joystick several times per second about the position of the joystick arm. When a return from the AIO module is received by the controller, the values corresponding to each axis are scaled by a user-controlled value to calculate a velocity for the motors. The units of velocity are determined by the (axis)SPU value.



System Block Diagram

2. Specifications

Note -- All listed specifications are believed correct as of the date of printing. See errata for latest details. Any and all product specifications are subject to change without notice by the manufacturer.

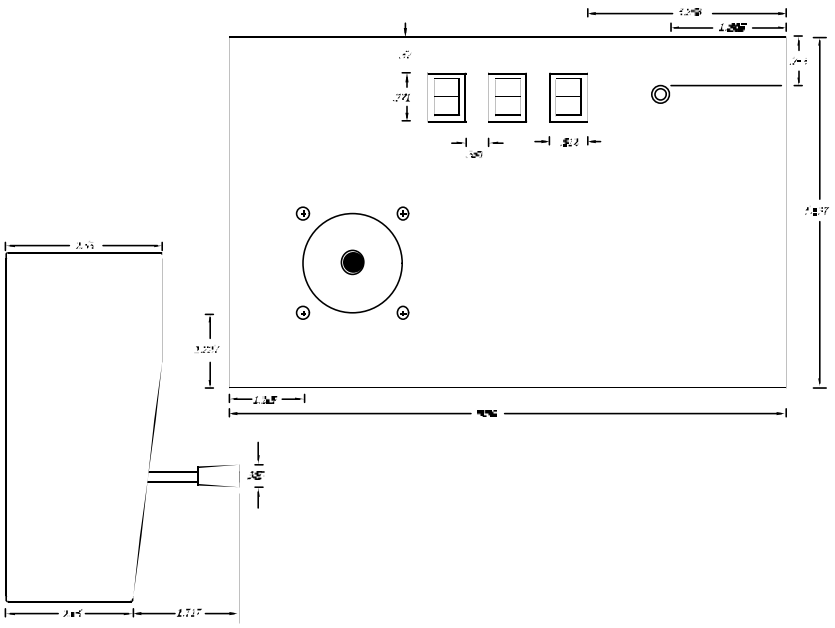
2.1 Electrical

Bus DC line voltage	5V DC
Normal Maximum DC current	65 ma

2.2 Mechanical

Dimensions: See Figure
Case: 9” x 5-9/16” x 2-1/2”, allow 4” minimum clearance for joystick handle.

Weight: 48 oz



2.3 Environmental

Operating temperature	0°C to 50°C
Storage temperature	-20°C to 70°C
Humidity	0 % to 90 % (non-condensing)

3. Installation

3.1 Unpacking and Inspection

Upon receipt of the equipment, carefully inspect to ensure that no damage has occurred during shipment. If damage is detected, notify the carrier immediately. Equipment should be stored in its original shipping container until ready for use.

3.2 Mounting

The joystick should be mounted on a cabinet or suitable enclosure to protect it from physical and environmental damage. Keep the joystick free of combustible or flammable material, oil vapor, steam, excessive moisture, corrosives and debris.

The joystick may be mounted in any orientation.

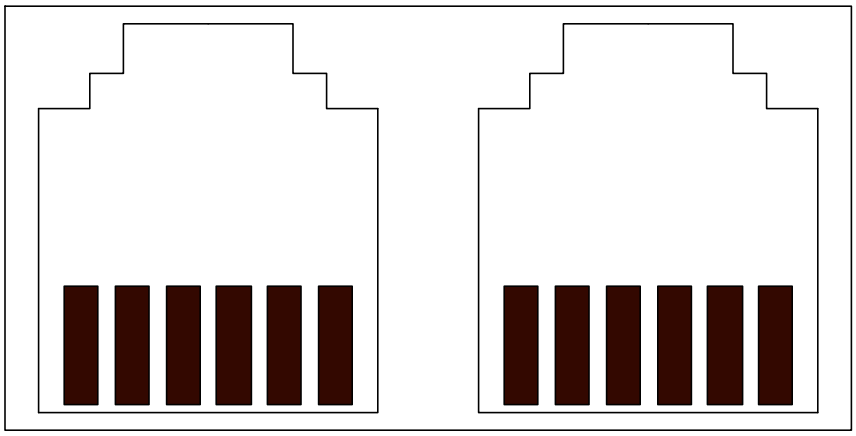
3.3 Wiring

Wiring the joystick is simple. Plug in the supplied "phone cable" into the RJ11-6 type connector on the bottom PCB of the unit, then plug the opposite end of the cable into the controller. The second RJ11-6 is wired in parallel. Additional AniLink modules can be plugged in and added to the network.

Longer runs of AniLink cable are possible. Maximum tested runs for the "phone cable" wiring and RJ11-6 type connectors are about 6 feet. Use of higher efficiency shielded cable and better connectors will allow greatly expanded performance.

User looking for more industrial-type communications connections often remove the RJ11 jack and solder shielded cable directly to the lower p.c. board. While this is a generally accepted practice, understand that poor workmanship will void any warranty on this product.

3.3.1 Connector Pin Out



1 6 1 6

Connector C1 (RJ11-6 connector, x 2 in parallel)

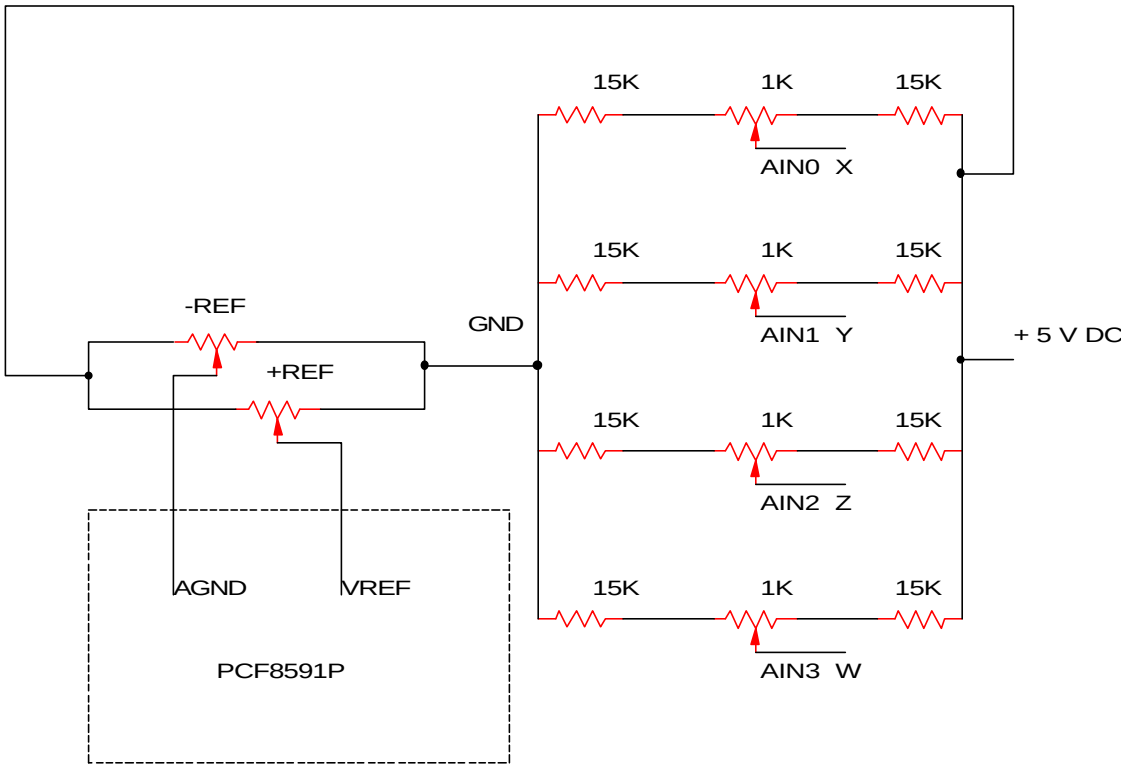
PIN	SIGNAL	DESCRIPTION
1	IN #5	Speed Select
2	+5 V DC	AniLink Power from controller (limited to about 150 Ma)
3	GND	To controller
4	CLOCK	Aniline Clock
5	DATA	Aniline Data
6	IN #6	Joy On/Off

3.4 Power-up and Checkout

No particular power up procedure is necessary for the JOY2/3 joystick. Be sure to apply common safety practices when working on any motion based system: Before you power up your system for the first time, make sure that there is no possibility of personal injury or machine damage.

4. Adjustments

4.1 Adjusting +REF, -REF and the Input Potentiometers



Your joystick has been calibrated at the factory. Under normal use, it should never require adjustment. The following diagram and explanation will help you understand the joystick's operation and function. Call your applications engineer before attempting any adjustments or calibration on your joystick.

The input and output signal ranges are tied to the PCF8591's AGND and VREF signal levels. The +REF and -REF potentiometers on the AIO-100 set the signal maximum and minimum.

The AIN# potentiometers are independent channel adjustments for the inputs, used to center the input range. The input potentiometers are parallel to the AIN# wipers.

When building a proportional joystick, start by adjusting the +REF and -REF to allow the full 0 - 5V swing. Next adjust the joystick center point and the X, Y, Z, and W channel potentiometers such that the neutral stick position reads 128 +/- 2 and the full 0 to 255 swing is available to the stick.

4.2 AniLink Bus Module Address

Peripherals on a AniLink network must have non-conflicting addresses to function properly. This normally means a unique address for each AniLink peripherals. The AniLink peripherals use a three bit address scheme based on the of jumpers 1, 2 and 4.

Module Address	Jumper State			X = jumper in place O = jumper absent
	1	2	3	
A	**O**	**O**	**O**	**Bold values only valid on Series 50000**
B	**X**	**O**	**O**	
C	**O**	**X**	**O**	
D	**X**	**X**	**O**	
E	O	O	X	
F	X	O	X	
G	O	X	X	
H	X	X	X	

A joystick must use address A to be addressed by the JOY1ON firmware support.

Maintenance and Repair

5.1 Maintenance

There are no user serviceable components on the JOY2/3 units. The only periodic maintenance requirement is to keep the clear of dust, dirt, or contaminant build up by cleaning with a damp cloth when necessary.

5.2 Indications

The appearance of the power LED back light is a definite indicator of power. If power is available and unit is not responding to the controller, check the cable.

5.3 Trouble Shooting

As these units have no user serviceable parts, trouble shooting is limited to checking for power and ground, and checking for communications signal.

If your unit is not working:

0. Check cabling for unplugged connectors or cable cuts

1. Check for power using a DMM
   - A. On connector C1: +5 between pins 2 and 3
   - B. On IC 7805: +5 between pins 1 and 2
   - C. External power source (if applicable)

   If not receiving power, locate cause.

2. Check for signal on AniLink Clock and Data lines using a logic probe or oscilloscope. Logic and Data lines are normally high between data transmissions.

3. If power, data and clock all show correct signals, and your unit is still not working, return your unit for inspection and repair.

6. Programming

The languages and programming techniques for the Series 5000 and the SmartMotor are radically different. Consistent between these languages is the direct command support and module addressing scheme. Each AIO-100 card on an AniLink network can be addressed by a letter address, A-D or A-H, and each module has four channels, 1 through 4.

Additional information about the command sets and languages demonstrated in this section can be found in the Series 5000 and SmartMotor User's Manuals.

6.1 Series 5000 Command Set

The Series 5000 command set supports two types of interaction with the Joy2/3 joystick. A firmware based method based on the JOY1ON command allows complete joystick control. A firmware based simple interrogation command is also supplied, JOY1?. Direct address programming is also possible.

The AniLink bus on a Series 5000 controller runs throughout the controller, and is ported to the outside in two locations. Addresses E, F, G, and H are used for processes within the controller and are therefore not available to the outside network. See the Series 5000 User's manual for details on this feature.

The Series 5000 command set provides two levels of communication to the AIO-100: firmware level joystick support, and direct communications commands. To be addressed by the firmware level joystick commands, the target AIO-100 must use address A.

Command	Comments
AIN(let)	Upload the value of the corresponding analog input (let) valid from A through D – module address # valid from 1 to 4 – channel number
AOUT(let)#	Set the level of the analog output for the corresponding module (let) valid from A through D – module address # valid from 0 though 255 – output level
JOYVH#	Set the high speed max. deflection velocity for the JOY1ON mode, #'s units determined by the system's SPU values
JOYVL#	Set the low speed max. deflection velocity for the JOY1ON mode #'s units determined by the system's SPU values
JOY1OFF	Disable the controller joystick mode
JOY1ON	Enable the controller joystick mode
JOY1?	Returns the current channel levels of the AIO-100 module A in XYZW format

Joystick Programming

Many joystick control systems can be accomplished with programs of the following form:

```
XKP2000          'SET THE PID FILTER PARAMETERS FOR ALL MOTORS
XKI300
XKD5000
XIL3000
F                'F ACTIVATES THE CURRENT FILTER PARAMETERS
XSPU2000         '2000 COUNTS PER REVOLUTION
ACC2000          'ACCELERATION 2000 RPM/S
JOYVH2000        'SET MAX HIGH SPEED VELOCITY TO 2000 RPM
JOYVL20          'SET MAX LOW SPEED VELOCITY TO 20 RPM
JOY1ON
END
```

The first program that most designers and technicians want is a test loop. This program uses GOTO statements and increments variables to set up a test loop displaying modes. Variations of the program are often used in the integration of AIO-100 applications. Run the program from TERM5000 in UNTERM mode.

```
VART500
VARA0
100
JOY1?
VARA?
AOUT[VARA]
WAIT[VART]
IF([VARA]=0)
GOTO(105)
IF([VARA]=128)
GOTO110
IF([VARA]=225)
GOTO(115)
200
GOTO(100)
END
105
VARA128
GOTO(200)
110
VARA225
GOTO(200)
115
VARA0
GOTO(200)
END
```

This program demonstrates a joystick subroutine. Auxiliary input #1 is used as a joystick enable for this application. Note that JOY1ON mode uses Auxiliary inputs #5 and #6 as speed select and joystick enable respectively. Auxiliary output #6 is used as an enable confirmation.

```
100
ACC40000
X200Y300F500
WAIT
ACC10000
X0Y0F200
WAIT
IF(1ON)
GOSUB105
GOTO100
END
105
JOY1ON
106
IF(1ON)
GOTO106
JOY1OFF
RETURN
END
```

Direct Command Programming

The 100 subroutine in the first joystick program relies on the JOY1? Command to format the return from the AIO-100 module addressed as A. We could address other modules by slightly changing the program.

```
…                       Replaces from above
AINB1?                  JOY1?
AINB2?                  “
AINB3                   “
AINB4                   “
VARA?
AOUTB[VARA]             AOUTA[VARA]
…
```

The Series 5000 language can evaluate the complicated expressions used in some feedback control algorithms.

```
VARA0                   Initialization for first iteration
VARN0                   Initialization for first iteration
100                     Label statement
VARN[VARN+1]
VARB[AINA1/255]
VARB([VARB]+[AINA2/255])
VARB([VARB]+[AINA3/255])
VARB([VARB]+[AINA4/255])
VARB[VARB/4]
VARA(([VARA]*([VARN-1]))+[VARF]/[VARN])
AOUTA[VARAl*255]        Output the moving average
…
…
GOTO(100)
```

6.2 SmartMotorÔ Command Set

The SmartMotor has direct command software support for the AIO-100 module upon which the JOY2/3 is based. There are two major differences in firmware support between the SmartMotor and the Series 5000:

> The SmartMotor uses a different self-diagnostic design than the Series 5000. This different makes it possible to address up to eight unique AIO-100 modules on a single SmartMotor AniLink network.
>
> The SmartMotor does not have firmware level joystick support.

Since the SmartMotor is by its nature a single axis control system, the idea of using a multi-axis joystick to control the motor seems unreasonable. The following is presented for testing and demonstration purposes.

An example of a stored user program joystick program can be found in the SmartMotor User's Manual (JOY.SRC on page 234).

Command	**Comments** Port is valid from A through H Input is valid from 1 to 4 Exp. expressions must evaluate to an integer
AIN{port}input	Fetch analog byte from port, input
AOUT{port}, exp.	Output an analog byte on channel port
RAIN{port}input	Fetch analog byte from port: report ASCII integer value on RS-232

This program demonstrates the use of these commands.

```
MV          'Set mode velocity
A=500       'Set acceleration to 500 =  63.13 rev. / sec.²
V=0         'Set velocity = to 0
O0          'Set current position equal to the origin
UAI
UBO
RAINA1      'Report channel 1 value
RAINA2      'Report channel 2 value
RAINA3      'Report channel 3 value
RAINA4      'Report channel 4 value
WHILE 1
a=AINA1
V=a
b=AINA2
```

```
c=AINA3
d=AINA4
G
IF UA==1 GOSUB 0 ENDIF
LOOP
END
C0                              'Subroutine 0 reports on RS-232 in format
UB=1                            'User output B signals you to get your finger off of A
WHILE UAI==0 LOOP
UB=0
PRINT("INPUT A1 = ",Ra,#13)     'Notice the formatting of this statement
PRINT("INPUT A2 = ",Rb,#13)
PRINT("INPUT A3 = ",Rc,#13)
PRINT("INPUT A4 = ",Rd,#13)
RETURN
END
```