MILFORD INSTRUMENTS Limited

TECARM6 Robotic Arm Kit

Designed and created by David Buckley

WARNING

This product is intended for educational instruction use only.

Robotic Arms may move rapidly and in an unpredictable manner. Ensure that the arm is sited where if such movements do occur, no damage will be done to property or persons nearby.

Parts List:

Description	Qty
TecArm6 body components pack	1
18swg Brass wire (300mm)	2
SO4 Servo	2
S666 Servo	1
SO6 Servo	1
SO3 Servo	2
Servo Driver Board (assembled)	1
Servo Driver Software (1-927)	1
Assembly Sheets	1
Component bag with:	
Stick-on rubber-feet	4
M4 x 12 Pan head steel	16
M4 x 16 Pan head steel	4
M4 Washers steel	24
M4 Nuts full steel	20
No. 2 x 3/8in Pan head self tap	20
No. 2x1/2in Pan head self tap	4
Nylon wire tie 100mm	12
Servo extension leads	4
M3 x 10 Pan head steel	4
M3 Washers steel	4
M3 Nuts full steel	4
50mm sleeving to retain brass wire	1
Serial Programming Cable (1-429)	1

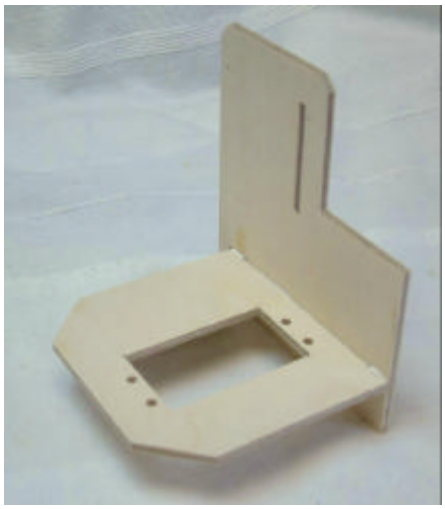
28/3/2004

Start Here!

The assembly of the TecArm6 is relatively simple requiring only two small screwdrivers and some wood-glue. Please follow these guidelines and also refer to the exploded view drawings on sheets TecGrip1 (sheet 15) and TecArm6 (sheet24).

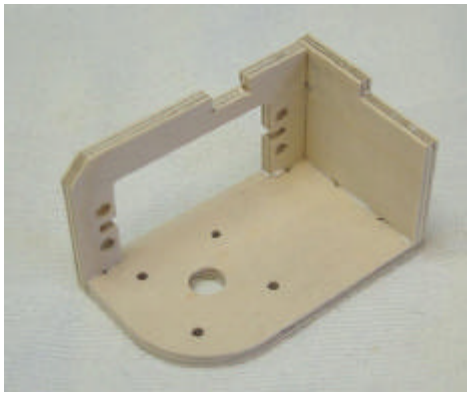
Glueing first
We recommend using standard wood-glue: be very sparing with its application as the wooden pieces are precision cut so there's not much room in the joints!

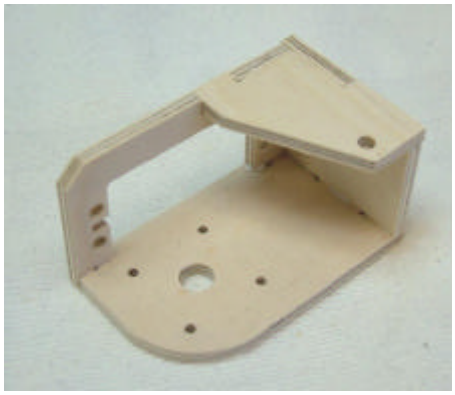
TecArm Base



The tabs on part-2 (Body Base) fit into the cut-outs in part-4 (Body Back) and the tab on part-7 (Body Side) fits into the slot in part-4, the tab on part-3 fits up against the side of the large cut-out in part-2 as indicated by the arrow in the drawing.

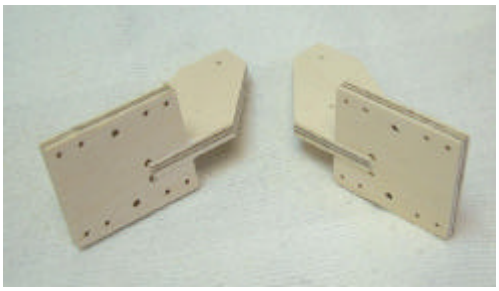
Gripper Wrist





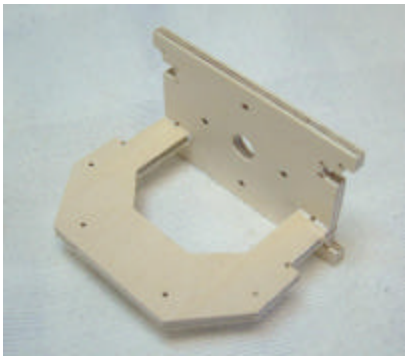
Glue together parts 9, 10, 11 and 12 (sheet 24) as shown.

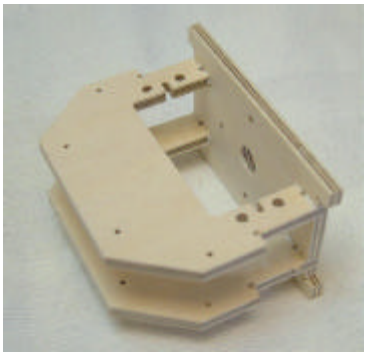
Gripper Finger Tips

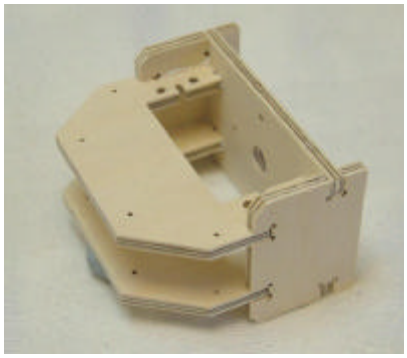


Glue together the 'Finger-tips' parts 10 & 11 (sheet 15)
Note the two ‘Fingers-tips’ are handed and make sure that part-10 is at right angles to part-11.

Gripper Palm



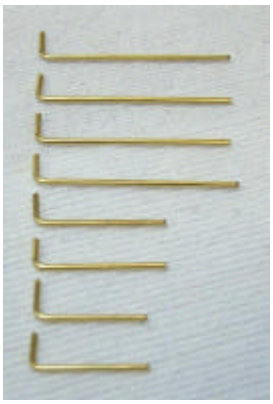




Glue together parts 2, 2, 3, 6 and 7 to make up the palm.

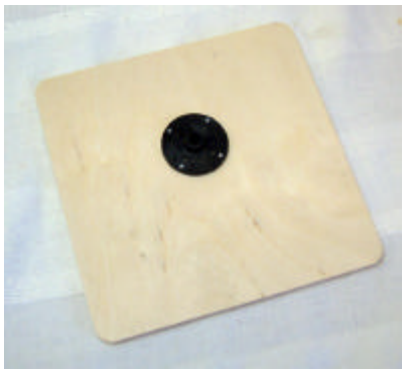
This completes the main glueing work- set the assemblies aside to completely set.

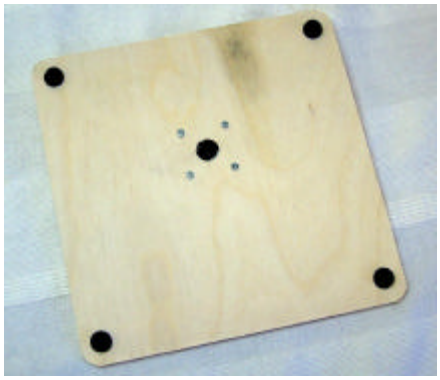
Pre-Form the Wire Tendons



Make up the eight brass wire pivots according to the dimesions on sheet15. There are: 2x18mm long, 2x22mm long and 4 x35mm long. Make the two servo links and cut the suppled plastic sleeving into eight 5mm long lengths.

Base Plate



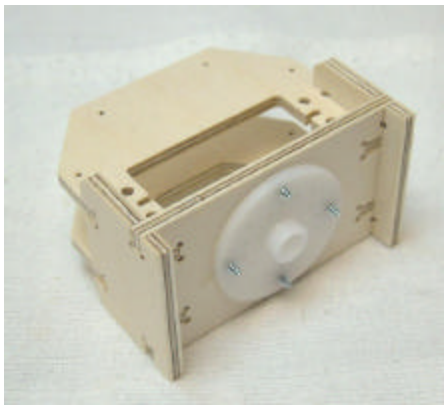


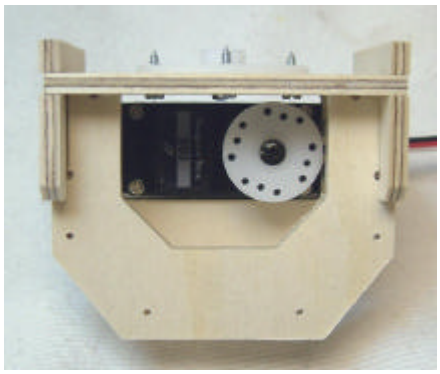
Fasten a large SO4 servo disc to one side of the Base plate (item 1 sheet 24) using 4 x #2x3/8 self tapping screws. Flip the Base and stick the 4 rubber feet in the corners of the base.

That completes the pre-assembly work. Wait until all the glued parts are fully set before proceeding.

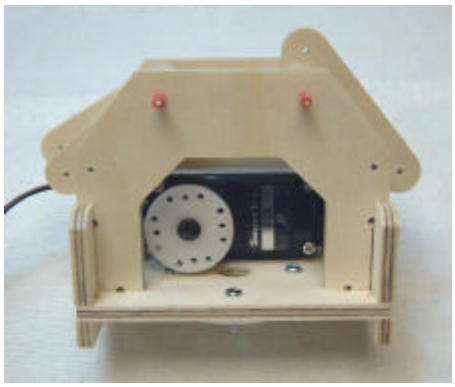
Gripper Assembly

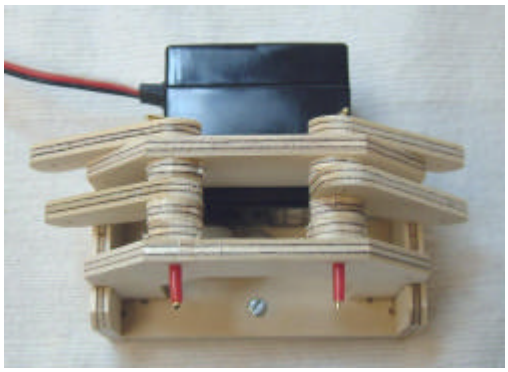
Assemble the gripper parts referring to sheet 15 and the instructions below).





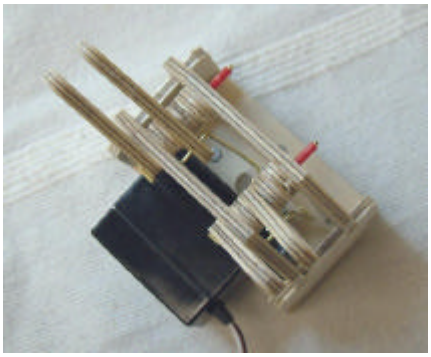
Fasten a large SO3 servo disc to the back of gripper part-3 using 4 #2x3/8 self tapping screws. Fasten an SO3 servo into the Palm using 4 M3x12 screws. Check the underside view and the servo orientation matches the above image.





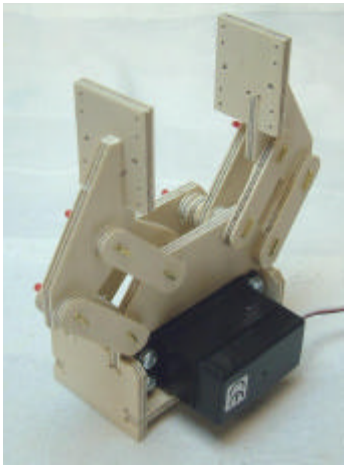
Using two of the 35mm long brass pivot wires assemble the links (Fingers) and spacers to the Palm at holes BB CC.

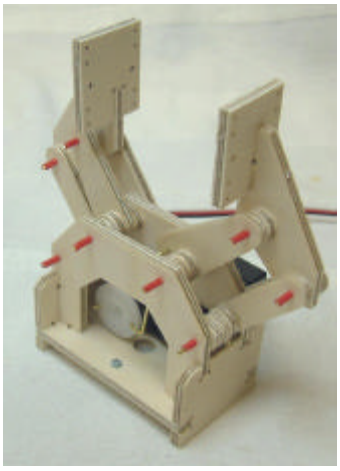
Note that pieces 12 and 13 are very similar but that piece 12 is larger than piece 13.
Remove the servo disc retaining screw and loosen the disc from the shaft- this will help assembly of the the tendons.
Insert the servo links through the servo disc, see the drawing for which holes to use, and with the Fingers swivelled sideways insert the servo links one at a time into the Fingers, the servo disc can then be manipulated into place on the servo shaft. Centralise the rotation of the servo and with the Fingers making an included angle of about 90 degrees with each other place the disc on the shaft. Now assemble the rest of the Fingers and Finger-tips.



Connect the servo to a controller and check that the gripper opens and closes correctly, adjust the position of the disc on the shaft as necessary. Note that the effective length of the servo links is quite critical for the jaws to move symmetrically and the given lengths are measured to the centre-line of the wire. If you have a problem make sure the finger cranks are on the correct pivots and that the servo links are the correct lengths and in the correct place, see the drawing.
Once you're happy with the action, you might wish to kink the tendons over slightly as they pass through pieces 12 and 13 to ensure they can't come out.

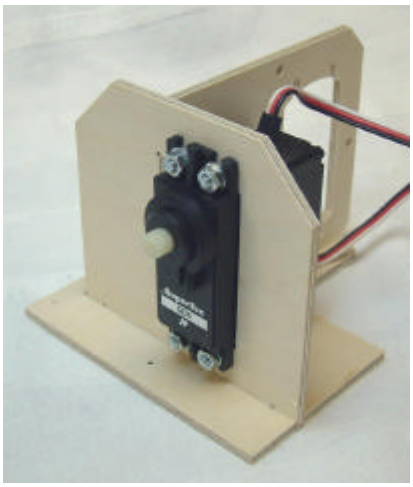
When everything is working correctly screw the disc to the servo with the screw provided with the servo, glue the wire pivots to the lower links (Fingers) and put a spot of glue on the top of each pivot to retain the sleeving.

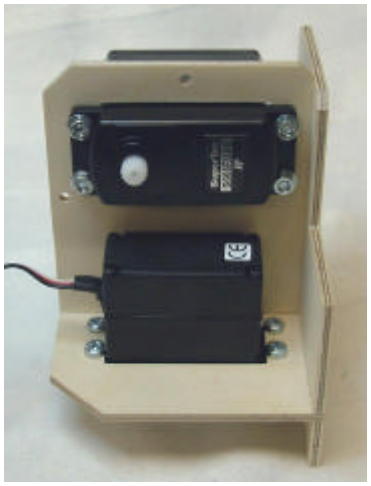


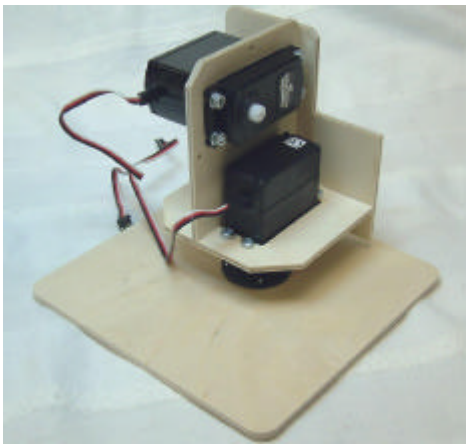


Put the Gripper assembly to one side while we complete the rest of the Arm.

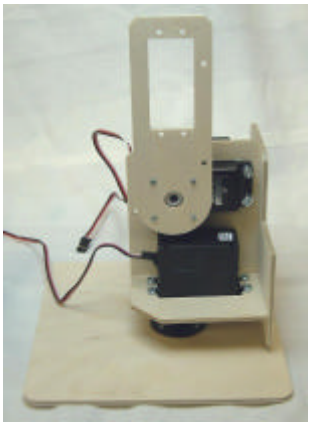
Arm Assembly

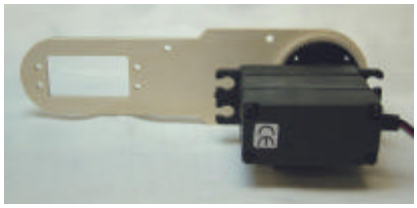




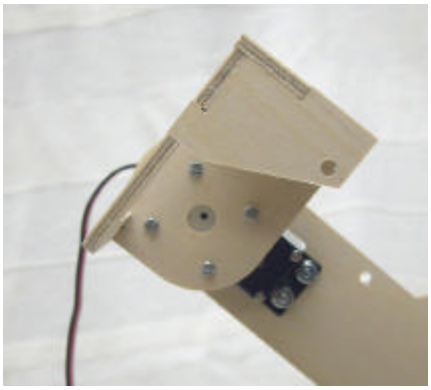


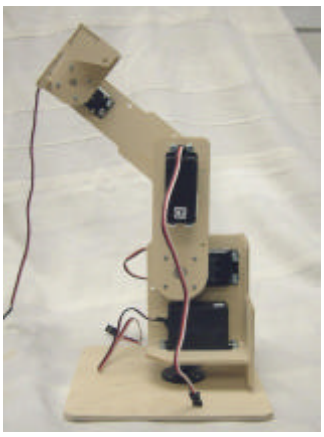
Insert an SO4 servo through the hole in part-2 (Body-Base), make sure the servo shaft is towards the front of the body and secure the servo in place with M4x12 pan head screws, nuts and washers as shown. Insert a 666 servo through the hole in part-7, again with the servo shaft towards the front of the body and fasten in place. Using the TecArm controller, set the SO4 servo to its mid position. Place the SO4 servo onto the Base servo disc in the above shown position- the hole in part-1 (Base) is in the centre towards the back and the body should be assembled to the base so that part-4 is parallel to the back edge of the base. Fasten in place from underneath with the supplied servo screw.



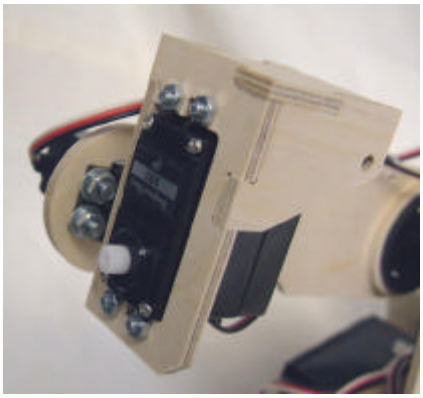


Position the 666 servo disc on on the 666 servo and then fasten part-5 (Upper-arm) to the servo disc using No2 x 3/8" self tappers, making sure that the holes 'T' for the wire ties are as shown. Fasten an S04 servo disc to the Upper-arm using the four No2 x 1/2" self tapping screws with the spacer disc part-13 between the forearm and the servo disc. Make sure that the holes 'T' are in the correct place as shown.



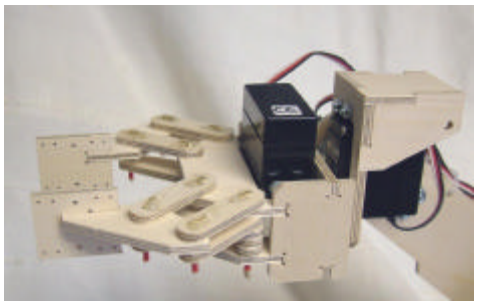


Fasten the SO6 servo to the other end of the forearm making sure that the servo shaft is towards the end of the limb, note that the SO6 servo is mounted differently from the other servos, see the drawing.
Place the disc on the S06 servo so that the axis of the S03 wrist rotate servo will be in line with the forearm as shown on the drawing and fasten in place with the short screw supplied with the servo.



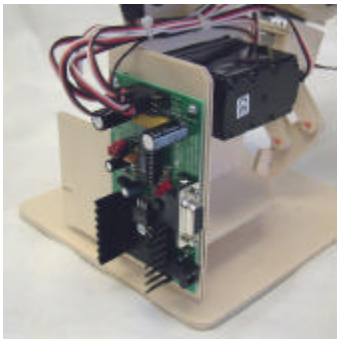
Insert an S03 servo into the wrist, with its output shaft towards the bottom and fasten in place.

Adjust all the servos to their mid position then fit the SO4 and 666 servo shafts into the bosses on the servo discs and fasten in place using the short screws provided with the servos. Make sure to align each servo as you assemble the arm: t the Upper-arm should be vertical, and the Forearm 45 degress towards the front from a straight line with the Upper-arm.

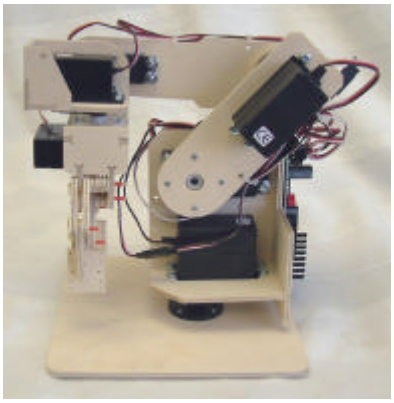


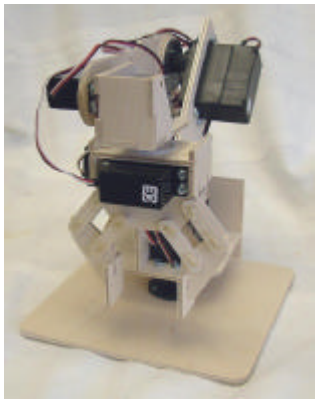
Connect a servo extension lead to the wrist SO3 and run it to its mid point using the controller. Position the Gripper assembly onto the servo so that the gripper is horizontal with the gripper servo uppermost. Fasten in place by threading the fixing screw carefully through the palm assembly.

Attach the servo lead extensions to the Gripper, Wrist rotate, and Wrist swivel servo leads, and plug the extensions into the Control-board and then fasten in place using wire ties through the holes 'T', see the drawing for the routing. Make sure there is enough slack at the joints for full rotation of the limbs.



Fasten the controller board to the rear of the body back- piece 4 sheet 24- using 4 #2x3/8 screws. Connect the servo leads to the 3-way headers on the controller board- it doesn't matter which servo goes to which position- just ensure the colour on the leads match those on the controller board.





The TecArm is now complete

SERIAL SERVO DRIVER BOARD

The Serial Servo Driver Board (SSDB) supplied with the TecArm allows the control of up to 8 Hobby type servos from an RS232 input. The SSDB is supplied fully assembled and tested and with full feature Windows software. Please refer to the separate instruction sheet for full information regarding the operation of the software.

THEORY OF OPERATION

The Serial Servo Driver Board receives RS232 signals and generates 8 continuous pulse streams suitable for driving and holding in position, 8 hobby type servos.RS232 signals conform to the following 3 byte protocol:

Byte 1	255	(Synchronization byte)
Byte 2	Servo # (0-7)	(Address jumper out)
Byte 3	Servo Position (0-254)	

eg the following string will send servo 6 to the mid point of its travel:

<255> <6> <127>

SIGNAL SOURCE

At power up, the red LED will light. When a suitable serial signal is received, the LED will extinguish and thereafter only light momentarily when a valid synchronisation byte is received.
The SSDB may be driven directly from a PC using a standard 9 way serial cable or from our optional Keypad module which incorporates speed control and a record facility (part number 5-505).

POWER SUPPLY

The SSDB uses a separate regulator for the Servos and one for the electronics. The SSDB will accept DC voltages up to 9v DC via the supplied power plug (2.1mm diameter type, centre positive). The servo regulator is rated at 3 Amps and should be sufficient for most applications though, as servos may draw up to 400mA each when under load, high load applications involving a number of servos may need to be provided with a separate power supply (4.8-6v DC). If the heat-sink becomes too hot to touch then consider a separate +5V power supply to the servos and/or reduce the supply voltage.
The SSDB has a “soft-start” facility- the power to the servos is gradually increased at switch-on to prevent damage to the structure.

HOOK-UP

Fasten the SSDB to the back of Part#4 as shown on sheet 24.Connect the servos to the 3 pin headers at the end of the SSDB making sure the colour of the leads corresponds to those noted on the board- especially the red and black wires.
Connect a suitable power supply to the power socket.
The red LED should light and the servos move to their mid positions. The servos should resist being changed by finger pressure.
If this is not the case then switch off immediately and check the polarity of the incoming power supply and the servo wire colours.
Run the Windows control software.
Once a valid control signal is received, the LED will extinguish and will thereafter only light momentarily when a synchronization byte is received.
If this is not the case and/or the servos will not respond under software control then check the servo cable- it must be a straight through type with pin 1 connected to 1, 2 to 2 etc (modem type cable, not a null-cable).

SERVOS

Most hobby type servos operate in a standard manner. Their movement is proportional to the pulse width of an incoming signal stream. These pulses are normally between 1 and 2 ms in duration and must be repeated every 20msecs or so. A pulse width of 1.5msecs will generally centre the servo, a pulse width of 2msec will cause the servo to move to the +45deg position and one of 1.0msecs will

move the servo to the -45 degree position.
Hobby servos are generally rated for a total movement of 90 degrees though to allow for set-up, the actual range is often greater than 90 degrees. The SSDB allows you to use this extra range but care should be taken to ensure the servo is not driven beyond its maximum physical range otherwise damage may occur.
If using the 180 degree range, it is recommended that the servo be moved a few degrees at a time until the end of its travel is detected (the servo stalls). Once the maximum travel limits have been established, these should be incorporated into the driving software to prevent servo damage.