# Pride Speed, Tilt, Lift (STL) Controller Project

## Technical Description Ver 1.2A 9/1/2016

**Function:**

The STL Controller is designed to provide safety related drive speed and seat positioning limits for a Wheelchair fitted with a Dynamic Controls 2 actuator Shark Control System and REAC LTS0033 Tilt/Lift Cassette.

The STL Controller consists of a control box and two level sensor enclosures, each with 3 level sensors. One for Seat Tilt and one for Seat Lift. The Tilt sensors operate at 15 degrees, 20 degrees and 35 degrees. Lift sensors operate at 3 inch, 5 inches and maximum lift.

Programmable seat position lockouts and drive speed limits are programmable for combinations of the above to allow safe wheelchair operation.

**Design:**

Direct simple Microswitch operation was considered, but that would have involved complex mounting of 6 double pole microswitches and a lot wiring mostly capable of handling maximum inductive actuator current in a very compact and restricted space. Difficult and expensive switch mounting and additions to the mechanical structure of the existing REAC seating system would likely have been required.

The STC controller is designed to allow fast efficient retro fitting of safe (low current 5v) custom 3D printed enclosure tilt sensor assemblies and wiring using low assembly cost cable ties and adhesive tape.

The 3D printed sensor enclosures allowed precise and snug fitting structures with channels for locking cable ties in place.

The level sensor trigger angles can be physically set to any angle during manufacture. The sensor enclosures are then sealed so are not adjustable after manufacture. It is intended that sensor angles, once decided, are fixed and not changed thereafter.

The Shark power module on-board-charger inhibit input is used by the STL Controller to sense if the Remote is powered on or off, so it is not possible to use an on board charger on the same chair.

**Operation:**

The STL Controller is "always on", this is required to allow sensing if the Shark Remote is powered on or off. The STL Controller draws only 8 milliamps in standby mode whilst the Remote is powered off. On Remote power up, the STL Controller performs a quick scan of sensors once and sets limit function relays to suit seat position at that time. In drive mode, sensors are not scanned and lockouts/speed limits (if active) are not changed until the Remote next enters Actuator mode. Seat position is not required to be monitored in drive mode because actuators can't be operated whilst driving (so seat position cannot change). This operation removes the difficult problem of handling sensor bounce during rough driving.

When the Remote is in actuator mode (and not driving), sensors are scanned continuously and lockout/speed limiting is applied as seat position is changing.

The following lockout/speed limit combinations are default, but are easily reprogrammable (by factory only).

Actuator lockout means the seat can only be driven down for lift, or up for tilt.

| | |
|---|---|
| Tilt full down and lift full up. | Full drive speed and no actuator lockout. |
| Tilt at 15 deg or lift at 1 inch. | Slow drive speed and no actuator lockout. |
| Tilt at 20 deg or lift at 5 inches | Slow drive speed and the other axis to that being operated is locked out. |
| Tilt at 35 deg or lift at max height | Drive inhibit and the other axis to that being operated is locked out. |

It is theoretically possible for the chair user to stop on a steep slope facing up and operate the seat lift to a position the level sensors misread due to the chair angle. To overcome this, the lift microswitch fitted by REAC is also used to limit speed. The microswitch is not sensitive to chair angle on a slope.

**Maintenance:**

A blue status LED is mounted near the connectors on the STL control box.

On Remote power up, this LED flashes once (during initial sensor scan) for 1 second and then turns off. It remains off in drive mode and turns on again only whilst the Remote is in Actuator mode.

Sensor condition is monitored whilst in Actuator mode and a LED diagnostic flash code will occur if sensors are detected to be operating out of sequence. E.g. tilt sensor 20 deg is active and tilt sensor 15 deg is inactive. This situation cannot normally occur so a sensor must be faulty. Codes are 1 flash for a faulty Tilt sensor and 2 flash for Tilt. This code would be used to indicate which sensor assembly needs to be replaced. Faults are only indicated while a fault is present. Latching fault indication can be programed if required.

A sensor fault detection does not cause a change in operation (other than that caused by the fault itself) except full speed is not possible. Other speed limiting and lockout functions on sensor fault detection can be programed if required.

If a faulty sensor causes tilt or tilt lockout, seat position at that time could make sensor assembly replacement physically impossible, so a pushbutton is provided on the STL Controller to allow lockout bypass and so the ability to move the seat to a position that allows access to the sensor assemblies.

This lockout bypass pushbutton does not affect speed limiting. The Pushbutton is momentary, so it needs to be pushed at the same time as an actuator is being operated on the Remote.

**STL Controller Failure Modes:**

If the STL Controller simply fails, then by default both actuators are locked out and speed is set to slow. The bypass pushbutton will still be active to allow maintenance. This default behaviour can be changed with soldered links on the STL Controller PCB.

If the STL Controller fuse blows then both actuators are locked out, speed is slow, and the bypass pushbutton will not operate. The STL Controller will need replacement before the bypass pushbutton is active to allow sensor assembly replacement if required.

**Electrical spec:**

Battery voltage: 18v min to 32v max.
Operating current: less than 50ma.
Standby current (Shark remote off): 8 ma.
Reverse battery protected.