Electronics – Target Workshop 7th January 2013

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Target Controllers

The target controllers are and have been operating now for ~18 months –to 2 years. There are 3 of them: R78, ISIS, Sheffield.

Changes that are now being made to the system are in general relatively minor as the controller system appears to be reliable/stable.

Main upgrades over the last 12 months or so have been to:

We adjusted the controller algorithm so that all 3 phases are utilised during the drive phase, this improves the efficiency of the motor and increases the drive current. This has yielded about a ~10% improvement in acceleration for a given voltage.

The BPS was finally commissioned and this system is now used during ISIS running. We've done minimal running in ISIS this year so it hasn't been tested extensively live but we didn't have a single trip during running in December. Formal procedure for changing operating parameters.

There has been a few other adjustments to control parameters, usually in response to data collected from running in R78.

Target Controllers

There was a possible issue with third controller. Appears to be an intermittent power supply problem. A new PSU has been bought and is just waiting to be fitted.

Power Supply

Progress with building a spare target PSU has been slow. As of December Chris White reported:

1) Snubber PCB We have made more snubber PCBs. Each board has two resistors and 8 capacitors.
2) Fibre-optic receiver PCB We have the details of the fibre optic board so we can make more of these. The intention is to mount the receivers close to the PCB so they are firmly fixed
3) Actuator power board (DL 55 9550) PCB manufacturer has the original design data so can make more of these. Version fitted in R78 crate is 9550-C and has a number of modifications. We have found two spare boards which are rev D and which appear to have most (if not all) mods done. They are populated apart from the 8 way DIL chips which need to be obtained and plugged in.
4) Actuator control board (DL 55 9555) PCB manufacturer has the original design data so can make more of these. Version fitted in R78 crate is 9550-A and has a number of modifications - 3 resistors on the front and some wiring on the back. We have found two spare boards which are rev A but which still need these mods. They are populated apart from the 8 way DIL chips which need to be obtained and plugged in.

I think therefore we have most parts to hand and could get a system going again pretty quickly. Obviously it would be best to have all boards ready to just swap over with any existing board so I will continue to work on this.

Quadrature Signals

Voltage monitoring of the mains was done in R78 to see if there was any correlation between the mains voltage and the observed changes in the level of the returned quadrature signals.

By eye there appeared to be a correlation, but the data has not yet been properly analysed. But we can draw a couple of conclusions.

There is no evidence of any long term degradation in the signals in R78.

It is difficult to understand what is cause and what is effect with the observed changes in signal level –would require additional equipment and testing. In my opinion it's not worth the time and effort to do this at the moment.

I don't think we have enough data from running in ISIS to establish whether there has been a long term trend of fibre degradation, need extensive running. It did appear that the return signal was 'stronger' in December – hard to know what conclusions to be drawn. Once again there is some data but requires someone to analyse it.

Possible Summer Project for a student on analysing this data?

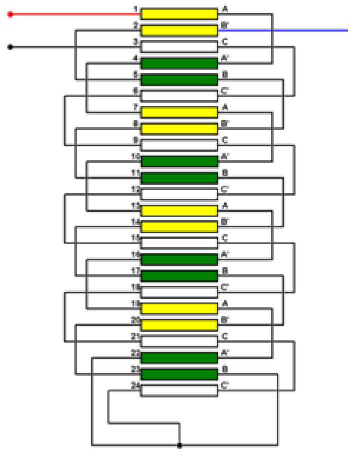
Anything Else?

Can we disassemble the old target controller from ISIS?

Other Questions?

Additional Slides –
A Quick guide to how the target controller works

State 1



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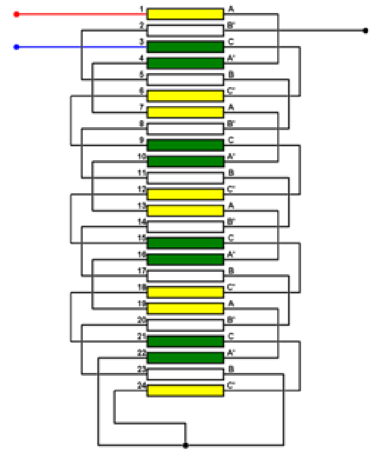

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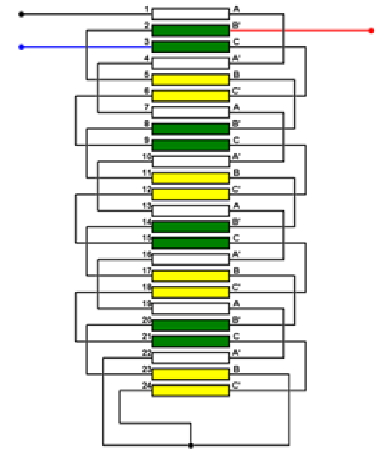

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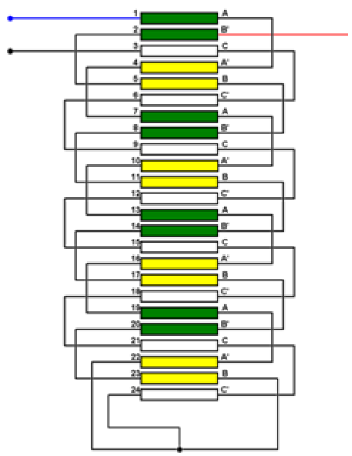

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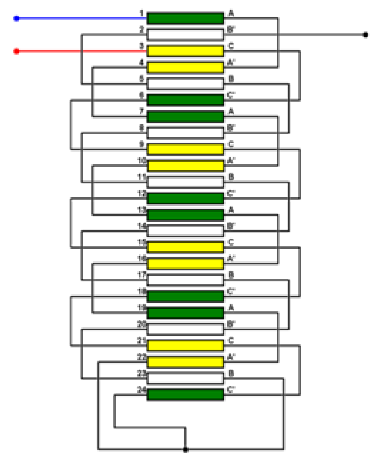

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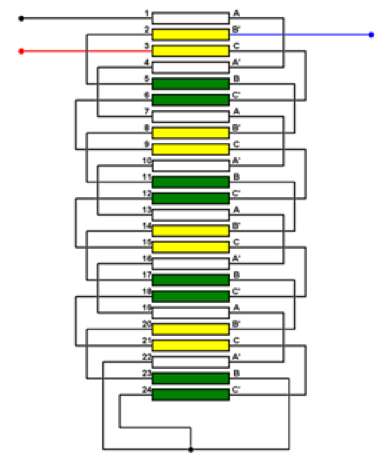
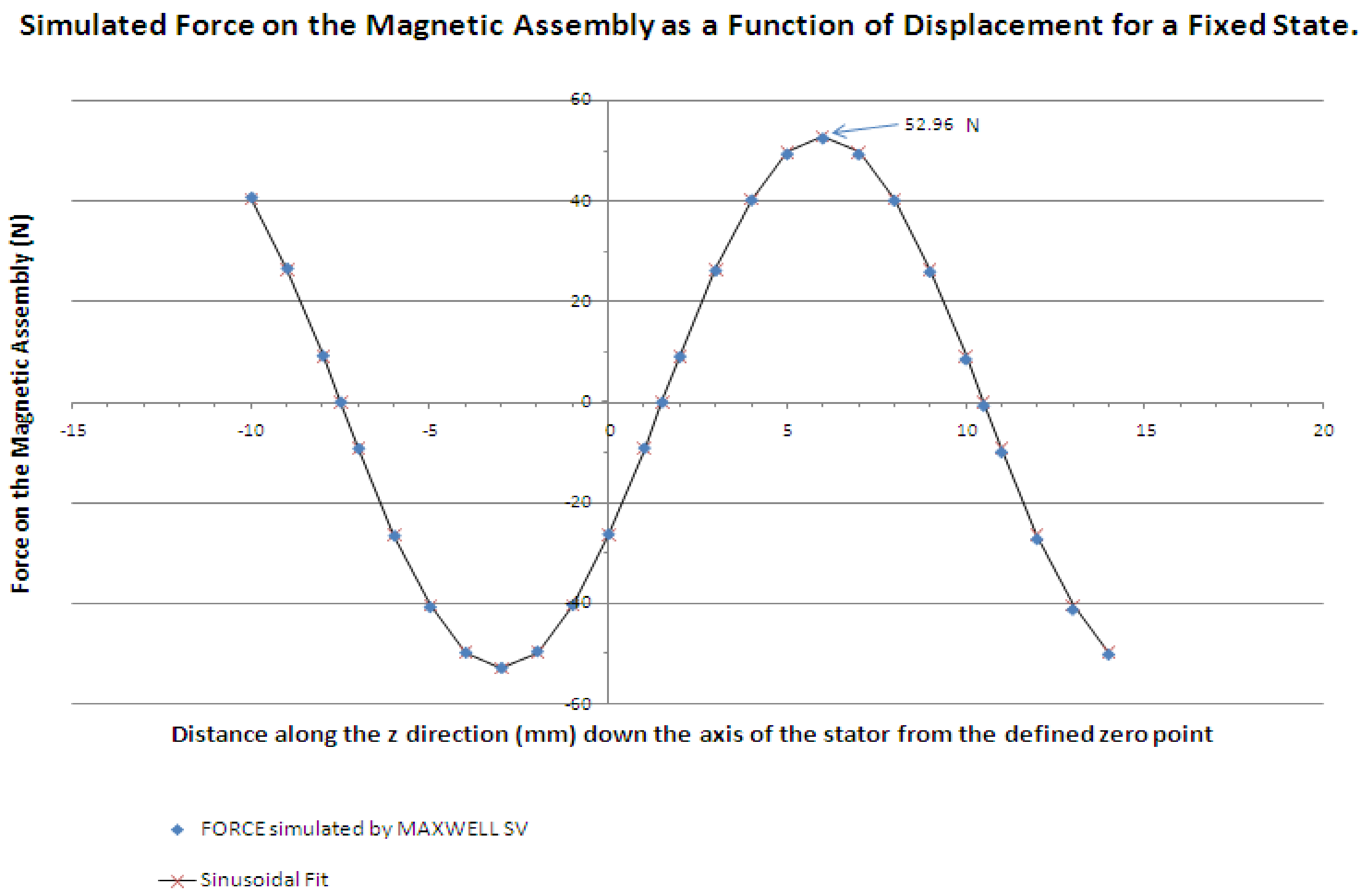


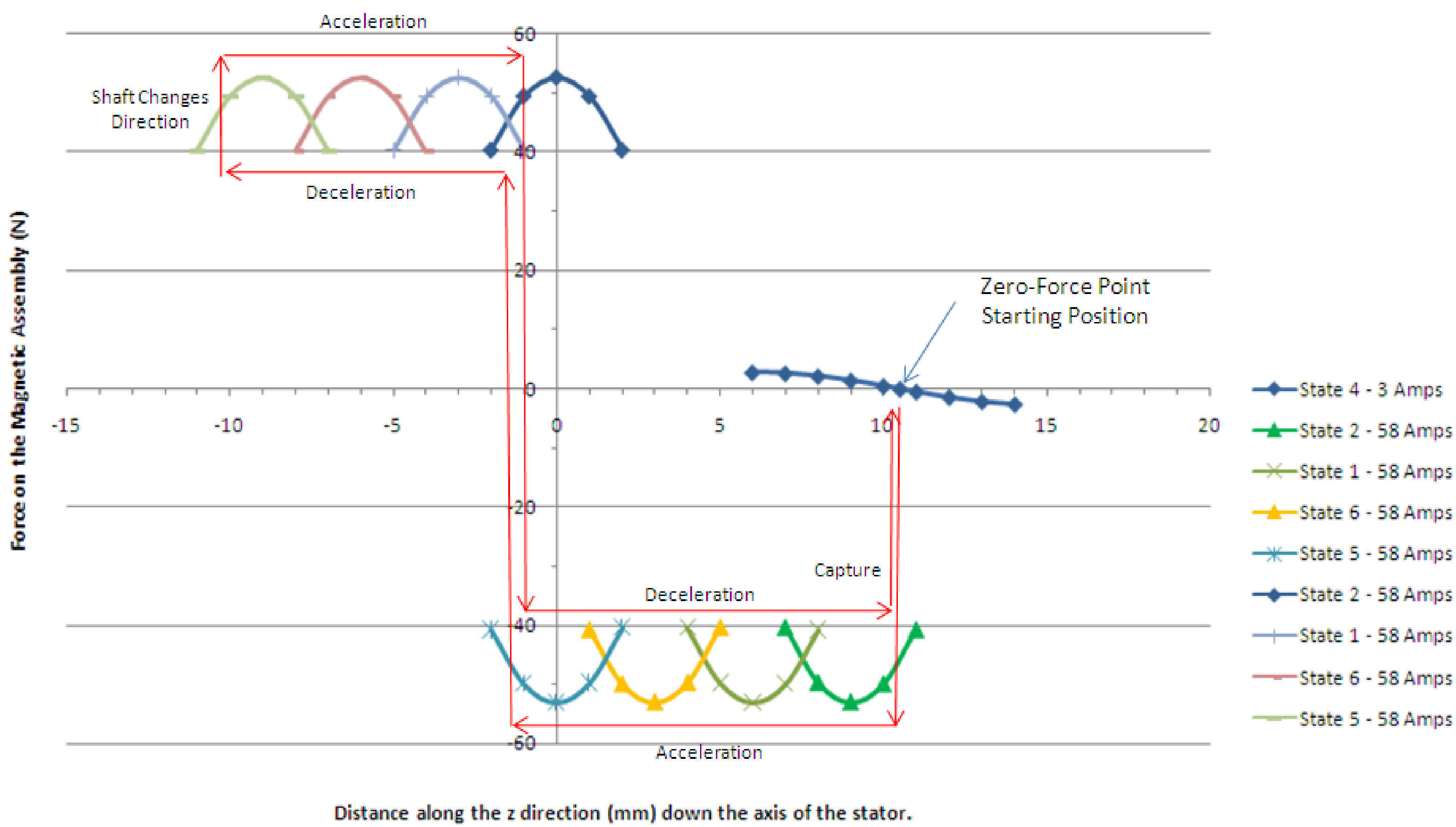
Current Flowing Through Coil Clockwise

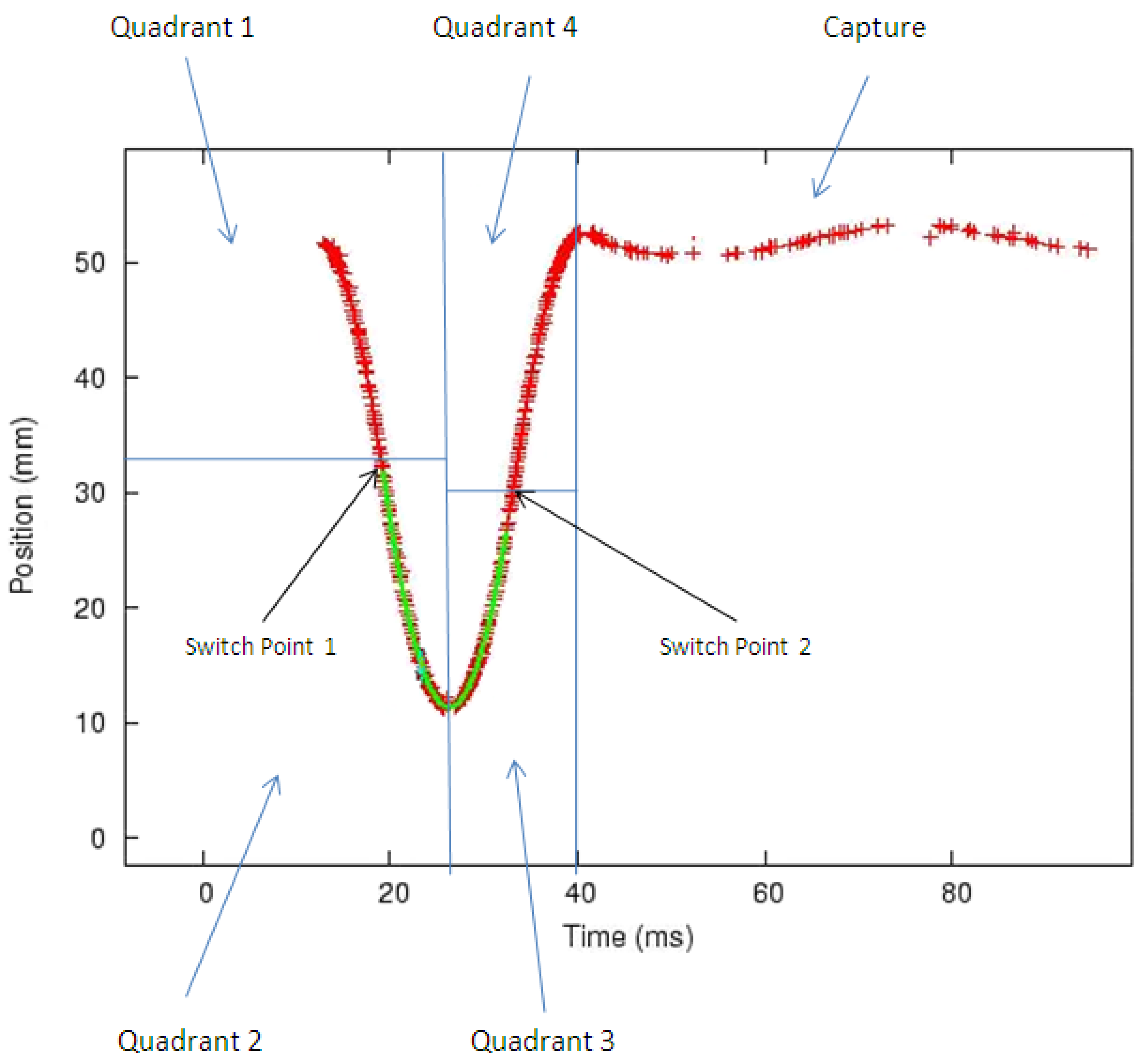
Current Flowing Through Coil Anti -Clockwise

Take any of these states and then try and push the magnets through the stator. You would feel a force on the magnets as a function of position that looks like this…



But of course we don't push the magnets through the stator we want the reverse of this… The coils are switched so that the magnets feel either no force (Hold) or maximum force (Acceleration). The coils that are powered at any time is dependent upon the position of the magnets.




Quadrant 1
Quadrant 4
Capture
Position (mm)
50
40
30
20
10
0
0
20
40
60
80
Time (ms)
Switch Point 1
Switch Point 2
Quadrant 2
Quadrant 3

A peek under the hood… Close your eyes now if you're squeamish about code

Coil Switching is dependent upon the quadrature position. Values are held in a ROM. Four Hex digits for each address (address = quadrature position). First 2 digits are used during actuation to give coil state. The other 2 digits are used during hold to give position in terms of state counts (or hold position), which is then later decoded to give coil states.

```
X"B508", X"B508", X"B508", X"B508", X"B508", -- addr 88 - 92
X"C609", X"C609", X"C609", X"C609", X"C609", -- addr 93 - 97
X"C609", X"C609", X"C609", X"C609", X"C609", -- addr 98 - 102
X"170A", X"170A", X"170A", X"170A", X"170A", -- addr 103 - 107

-- Coil Switch Point
-- addr 116 represents Maximum Force Point
-- addr 126 represent Hold Position 12

X"170A", X"170A", X"170A", X"170A", X"170A", -- addr 108 - 112
X"280B", X"280B", X"280B", X"280B", X"280B", -- addr 113 - 117
X"280B", X"280B", X"280B", X"280B", X"280B", -- addr 118 - 122
X"390C", X"390C", X"390C", X"390C", X"390C", -- addr 123 - 127

-- Coil Switch Point
-- addr 136 represents Maximum Force Point
-- addr 146 represent Hold Position 14

X"390C", X"390C", X"390C", X"390C", X"390C", -- addr 128 - 132
X"4A0D", X"4A0D", X"4A0D", X"4A0D", X"4A0D", -- addr 133 - 137
X"4A0D", X"4A0D", X"4A0D", X"4A0D", X"4A0D", -- addr 138 - 142
X"5B0E", X"5B0E", X"5B0E", X"5B0E", X"5B0E", -- addr 143 - 147

-- Coil Switch Point
-- addr 156 represents Maximum Force Point
-- addr 166 represent Hold Position 16

X"5B0E", X"5B0E", X"5B0E", X"5B0E", X"5B0E", -- addr 148 - 152
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Fundamentally this is how the stator has always operated. What has changed over the years is incremental improvements to the robustness/ease of use of this mechanism.