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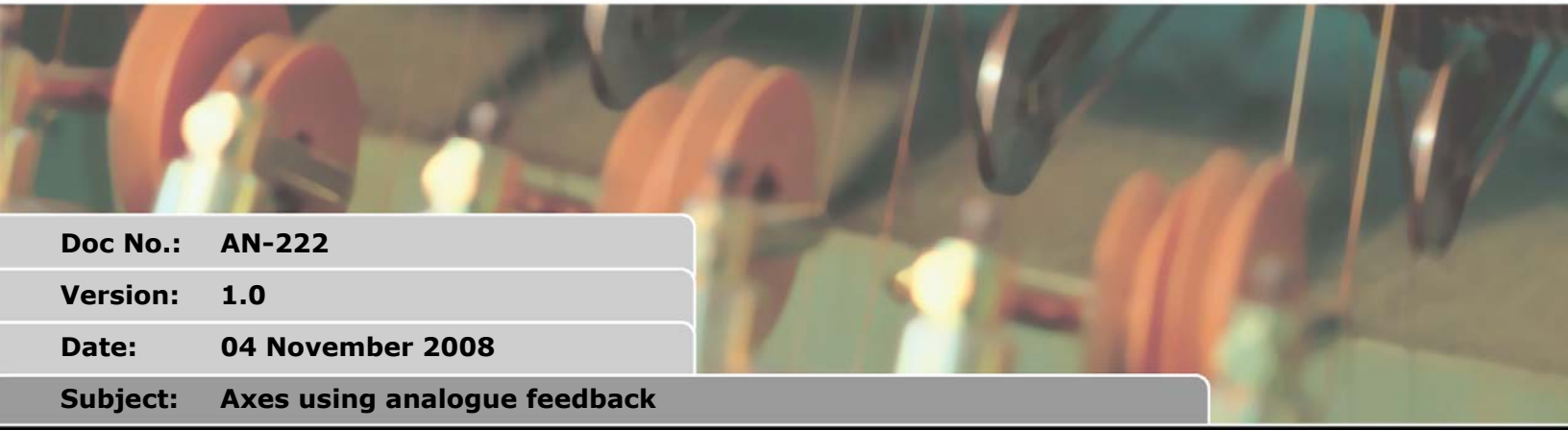

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Subject: Axes using analogue feedback

APPLICATION NOTE

www.triomotion.com

1. Introduction

While the majority of systems use standard incremental encoder feedback, there are a growing number that require position feedback in the form of an analogue voltage. Trio's P225 analogue input daughter board is designed to make closed loop operation possible using 0 to 10V voltage feedback.

The P225 has 8 x 16-bit analogue inputs which are synchronised to the servo cycle. All 8 inputs are read by the system software every servo cycle which can be set to 2000, 1000, 500 or 250 microseconds.

This application note describes how to set up a servo loop with analogue position feedback and analogue velocity demand signals using the Trio MC224 Motion Coordinator.

2. System requirements

Analogue feedback can be implemented on any of the following Motion Coordinators using the P225 8 Analogue Input daughter board: MC224, MC206X, Euro209 and Euro205X. The PCI208 can do analogue feedback using the P184 Analogue Input/Output mezzanine board.

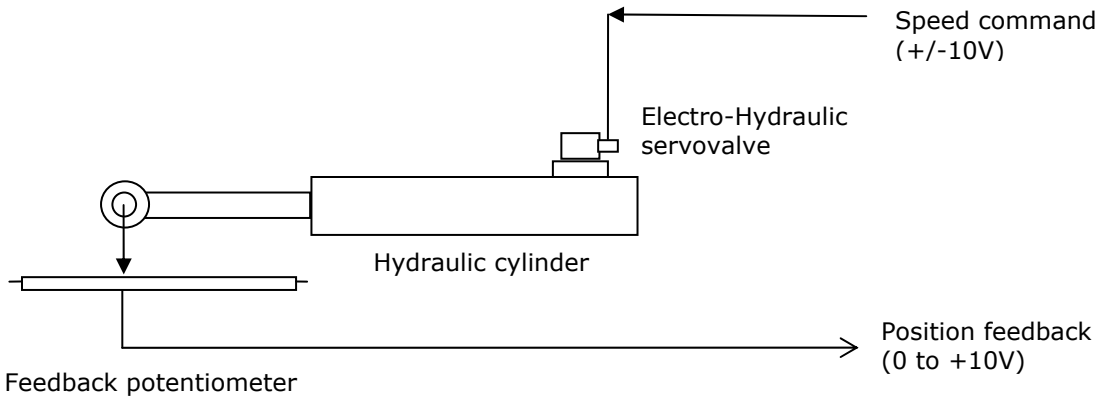
In addition, it is possible to use the Motion Coordinator's internal analogue inputs as feedback, but the resolution is lower than with the P225.

For the example below, the system consists of:

- P170 – MC224 Motion Coordinator
- P260 – Analogue output daughter board (x 2)
- P225 – Precision analogue input daughter board
- P702 – 2 Remote axes (Feature Enable Code)

3. Application example

A machine design requires 2 axes of electro-hydraulic control. Each hydraulic axis consists of a hydraulic servo-valve with +/- 10V signal input and a hydraulic cylinder actuator with a potentiometer giving 0 to +10V position signal for feedback.



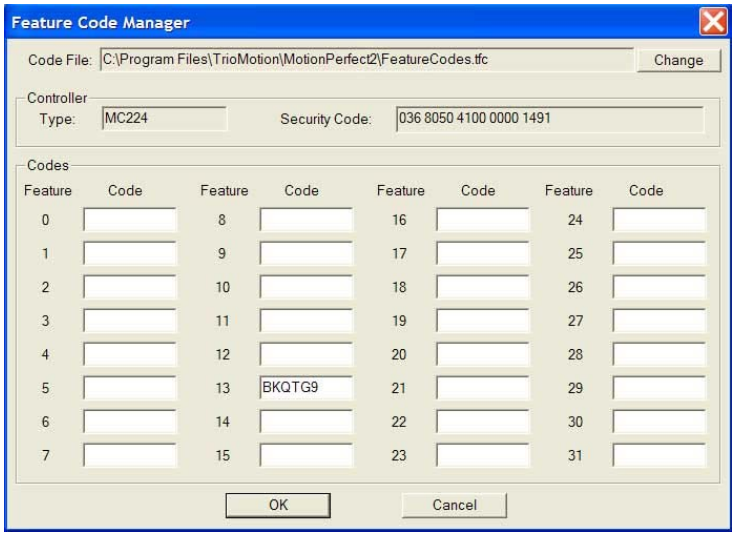
Single axis layout

The MC224 is assembled with one P260 in slot 0, one P260 in slot 1 and the P225 in slot 2. Axis assignment follows the slot number for the P260 daughter boards, so axes are AXIS(0) and AXIS(1). Analogue inputs are also assigned by slot number and for slot 2, the inputs are AIN(56) to AIN(63). For this example the analogue inputs AIN(56) and AIN(57) will be used.

4. Axis setup

For an axis to work with analogue feedback it must have its axis type (ATYPE) set to 30. The system software will only allow this ATYPE if there is a remote axis feature code available, so to prepare the Motion Controller for analogue feedback it is first necessary to purchase and enter the Remote Axis feature code. Remote Axis codes are supplied in blocks of 1, 2, 4, 8 or 16. The Trio part number for these feature codes are P701, P702, P704, P708 and P716 respectably. For this 2 axis system we require a P702 code.

Once the feature code has been purchased, it must be entered into Motion Perfect so that the Remote Axes can be enabled. From the menu in Motion Perfect, select “Controller” then “Controller Configuration”. In the window that then opens, click the button marked “Enable Features”, then in the next window, click “Enter Codes”. You will see a window as shown on the right.



F12 = feature code for P701

F13 = feature code for P702

F14 = feature code for P704

F15 = feature code for P708

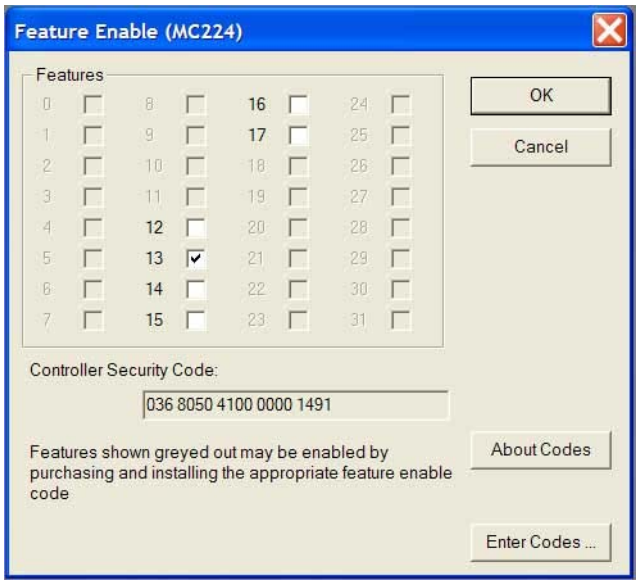
Etc.

Click OK to return to the previous window, then tick the check-box for F13 as shown below.

Notice that where the feature code has not been purchased and entered into Motion Perfect, the check-box remains "greyed out".

Only codes purchased can be ticked or un-ticked.

After you click OK on this page, you will be asked if it is OK to reset the controller. The feature code changes will only be applied after the Motion Coordinator has been reset.



5. Initialisation and STARTUP

With the daughter boards installed and the correct feature enable code activated, the initialisation of the analogue feedback axes is straight forward. All that needs to be done is to tell the system software which analogue input is to be used for each axis. The axis parameter for this is AXIS_ADDRESS. Here is an example:

```
BASE(0) ' set up analogue feedback axis 0
AXIS_ADDRESS = 56 ' uses analogue input AIN(56)
ATYPE = 30 ' set axis type for analogue feedback

BASE(1) ' set up analogue feedback axis 1
AXIS_ADDRESS = 57 ' uses analogue input AIN(57)
ATYPE = 30 ' set axis type for analogue feedback
```

Once the axes are set up in this way, the servo loop gains can be set as required. It is recommenced to run a step response test to evaluate the closed-loop dynamics and to tune the gains. A typical set of gains might look like this:

```
P_GAIN = 1.2
I_GAIN = 0.143
D_GAIN = 14.9
OV_GAIN = 0.0
VFF_GAIN = 0.0
```

For more information about position loop tuning, please refer to Trio document TN20-72 "Axis Tuning".

6. Axis scaling

Motion Coordinator axes are scaled using the UNITS axis parameter. This is set to the number of counts per real-world unit. Here is an example:

It is required to calibrate a potentiometer feedback in mm. The span of the actuator is 500mm and

this corresponds to 0 to 10Volts on the potentiometer.

As the P225 has 16 bit analogue inputs, the range 0 to 10V is given by 0 to 2^16-1, or 0 to 65535.

This means that every mm of movement will result in a change in AIN value of:

65536 / 500 = 131.072

So the UNITS should be set to 131.072 and the system will have a resolution of 1/131 = 0.0076 mm, or 7.6 micrometres.

7. Operation

Once the startup program has been run to set up the axes as discussed above, the SERVO=ON and WDOG=ON commands will activate the servo control in the usual way. Operation of the axis is quite normal and all move types can be used. FS_LIMIT and RS_LIMIT can be used to define the limits of movement in software and hard limit switches can be set up if required as well.

It should be remembered that the absolute position of the axis is read only at the time of setting ATYPE=30. After this all changes of position are treated as relative. This feature allows the programmer to apply an offset to the absolute position, if required, by using the OFFPOS command.