Combine PLC digital I/O with pre-written Mint application for simple point to point positioning of e190 axes

Introduction

Older Baldor drives (DBSC, Flex+, Flex+II) were available with embedded functionality for pre-set positioning. Pre-set positioning allowed the drive to be controlled by a Programmable Logic Controller (PLC), or any similar device, via an easy to use digital I/O interface. Typical applications might be tool changers, lane changers, palletisers etc… In short, any axis performing a variety of pre-defined relative and/or absolute moves.

This application note details a pre-written pre-set positioning Mint program – a simple application that allows the MicroFlex e190 drive to be controlled from any vendor’s PLC via defined digital I/O signals.

The sample program with this application note provides a mechanism for a PLC or similar device to:

- Issue a home command
- Issue a relative move
- Issue an absolute move
- Reset axis errors
- Control modulo or non-modulo axes

At the same time the PLC is able to monitor status information from the drive including:

- Enabled state
- Motor brake state (released or engaged)
- Idle state
- In Position state
- Homed state
- Fault state

For a more comprehensive way to control a MicroFlex e190 drive using a PLC to command motion please refer to Application Note AN00204 which details the Generic Drive Interface and how this may be used to issue motion instructions via a fieldbus connection. Alternatively, if you are interested in PLCopen motion control of MicroFlex e190 via EtherCAT please refer to Application Note AN00205.
IO considerations of the e190

Due to the e190’s compact design the default IO count for the e190 is 4 digital inputs and 4 digital outputs. Since the basis of this application notes is to use digital inputs to define drive operation then we will need more IO than this. The e190 'OPT-SIO-1 Option Card’ will allow us to expand the drives total IO count to 10 digital inputs, 7 digital outputs, 2 analog inputs (Please see document ‘3AXD50000296361’ for more information). The OPT-SIO-1 Option Card fits in the slot to the left of the drive;

The rest of this application presumes that the IO module is fitted to the e190.

Configuring the pre-set positioning Mint program

The pre-written Mint program only requires only a small amount of customisation to suit the user’s application. The following sections detail the program sections that should be edited as required.

Application Constants

At the beginning of the main program (after the program header) are a set of application related constants:

```
' Application specific data (edit as required)...

Const nScale As Float = 131072 'counts per user unit
Const nEncoderWrap As Integer = 0 'set to number of counts in one cycle if using modular axis (e.g. tool changer)
Const nHomeType As Integer = _hmNEGATIVE_SWITCH 'edit to suit homing method required
Const nStopInput As Integer = 0 'set to -1 if limit not used
Const nFwdLimit As Integer = 1 'set to -1 if limit not used
Const nRevLimit As Integer = 2 'set to -1 if limit not used
Const nPosMode As Integer = 2 'set to -1 if stop input not used
Const nLimitMode As Integer = _ltCRASH_STOPDISABLE 'edit to suit limit mode required
Const nStepMode As Integer = _stCRASH_STOP 'edit to suit stop mode required
Const nInputLevel As Integer = 2 '#11111110011 'inputs 1 to 3 active low (edit as required)
Const nMotorBrakeOutput As Integer = 8 'set to -1 if no motor brake control
Const bDiagnosticsOn As Integer = _true 'Display diagnostic information via USB port
```

These should be edited as required to suit the application:

_\$Scale – the user can set a scale factor representing the number of encoder counts produced by the motor for one user unit of travel. The default value of 131072 represents a user unit of “revs” for an ESM04X101302T2B0A00 servo motor (as used on ABB e190 demo kits)

_\$nEncoderWrap – if the application is using a modulo axis (e.g. a turntable that requires the axis position to be wrapped in the range 0 to 360 degrees) then this constant should be set to the number of encoder counts in one full cycle of the axis. For non-modulo axes set this constant to zero

_\$nHomeType – the user can define what type of home sequence the axis performs when asked to datum (refer to the HOME keyword in the Mint help file for a full list of available home types and their associated Mint constant values)

_\$nHomeInput – allows the user to specify which of the drive’s local digital inputs (0 to 3) is to be used as the home sensor input. If a home type is used that does not require an input (e.g. _hmPOSITIVE_INDEX) then set this value to -1.

_\$nFwdLimit / _\$nRevLimit – allow the user to specify which of the drive’s digital inputs (0 to 3) are to be used as directional limit inputs. If the application does not require travel limits then set these constants to -1

_\$nStopInput – allows the user to specify which of the drive’s local digital inputs (0 to 3) is to be used as the Mint stop input (activation of the Mint stop input results in the Mint application’s stop event being processed). If there is no requirement for a stop input then set this constant to -1
Application note

Pre-set positioning with MicroFlex e190

AN00218

ABB Motion control products

new.abb.com/drives/low-voltage-ac/motion

...
Move Profile
The final section of code the user may have to adjust to suit the application relates to the move profile. Settings are provided to allow the user to adjust whether the drive uses s ramping (jerk control) or not. If s ramping is required then the user can adjust the acceleration and deceleration jerk rates as required.

' Move profile
PROFILEMODE(0) = _pmdTRAPEZOIDAL  'or _pms_ramp as required
ACCRJ jerk(0) = 100  'edit as required if s-ramp needed
DECJ jerk(0) = 100  'edit as required if s-ramp needed
HOMERACKOFF(0) = 8  'edit as required
IDLEPOS[0] = 0.5  'edit as required
IDLEVEL(0) = 20000/SCALEFACTOR(0)  'edit as required

Settings are also provided to allow the user to adjust the home backoff ratio as well as the idle position and velocity tolerance values to suit the application. It is recommended that the value for IDLEVEL is not lowered beyond 20000/SCALEFACTOR(0) as this could result in intermittent “Motion in progress” errors as the axis could be detected as “moving” with low values for IDLEVEL.

Mint application interface
In most applications it is unlikely that the user will need any knowledge of the Mint application (other than editing the application related data described above). The default I/O interface and some example operation sequences are detailed below.

Digital Input/Output Interface
The following table details the default interface between the PLC and the e190 drive:

<table>
<thead>
<tr>
<th>Digital Input</th>
<th>Function</th>
<th>Active State</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Home sensor</td>
<td>High</td>
</tr>
<tr>
<td>1</td>
<td>Forward limit switch</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Reverse limit switch</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>Stop input</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Pre-set selection bit 0</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>Pre-set selection bit 1</td>
<td>High</td>
</tr>
<tr>
<td>6</td>
<td>Pre-set selection bit 2</td>
<td>High</td>
</tr>
<tr>
<td>7</td>
<td>Pre-set selection bit 3</td>
<td>High</td>
</tr>
<tr>
<td>8</td>
<td>Trigger move</td>
<td>Rising Edge</td>
</tr>
<tr>
<td>9</td>
<td>Fault reset</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital Output</th>
<th>Function</th>
<th>Active state</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Homed</td>
<td>High</td>
</tr>
<tr>
<td>1</td>
<td>Idle</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>At target position</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Healthy</td>
<td>High</td>
</tr>
<tr>
<td>4</td>
<td>Motor brake control</td>
<td>High (release brake)</td>
</tr>
</tbody>
</table>
Example sequences:

Enabling the drive
1. Ensure the local interlocks (e.g. stop input, STO inputs, AC supply) are all present on the drive. The drive will enable automatically providing all interlocking conditions are met
2. The drive will indicate it is enabled by activating digital output 4 (this would typically be wired to a PLC digital input that can then be used by the PLC program to verify whether the drive is ready to accept motion commands)
3. If a motor brake is fitted and the e190 drive is controlling this via its MOTORBRAKEOUTPUT then the PLC can also detect when the brake is released via drive digital output 5. Motion should not be attempted until the brake is released

Issuing a home
1. Ensure the drive is enabled and the brake is released if fitted (see above)
2. Turn off drive inputs 4 to 7 (the Pre-set selection inputs) so that a Pre-set selection of zero is made
3. Activate drive input 8 (motion trigger)
4. The ‘idle’ and ‘at target position’ digital outputs should deactivate
5. If homing completes successfully drive digital output 0 should activate (drive outputs 1 and 2 will also activate to indicate the axis is stopped and in position)

Issuing a move
1. Ensure the drive is enabled and the brake is released (see above)
2. Set digital inputs 4 to 7 to select a Pre-set position index from 1 to 15 (note, absolute moves are prevented unless the axis has already been homed)
3. Activate drive input 8 (motion trigger)
4. The ‘idle’ and ‘at target position’ digital outputs (1 and 2 respectively) should deactivate
5. If the move completes successfully drive outputs 1 and 2 will activate to indicate the axis is stopped and in position)