

Application note

Pre-set positioning with MicroFlex e190

AN00218-003

Combine PLC digital I/O with a 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

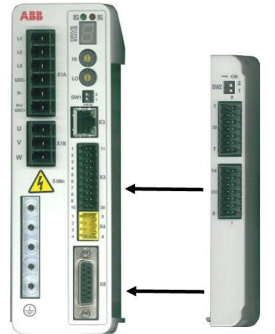
At the same time the PLC is able to monitor status information from the drive including:

- 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 and 1 analog output (Please see document '3AXD50000296361' for more information). The OPT-SIO-1 Option Card fits in the expansion slot on the side of the drive as shown below;



The rest of this application presumes that the IO module is fitted to the e190. Firmware version 5900.4 or later should be installed on the drive in order to use the IO expansion module.

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 _fScale 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 _nHomeInput As Integer     = 0
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 _nStopInput As Integer     = 3               'set to -1 if stop input not used
Const _nLimitMode As Integer     = _emCRASH_STOP_DISABLE 'edit to suit limit mode required
Const _nStopMode As Integer      = _smCRASH_STOP    'edit to suit stop mode required
Const _nInputLevel As Integer    = 2#1111110001    'inputs 1 to 3 active low (edit as required)
Const _nMotorBrakeOutput As Integer = 5           'set to -1 if no motor brake control
Const _bDiagnosticsOn As Integer = _true          'Display diagnostic informatio via USB port

```

These should be edited as required to suit the application:

_fScale – 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

`_nLimitMode` – allows the user to specify how the drive reacts to activation of one of the limit inputs. By default the drive will crash stop and disable (refer to the LIMITMODE keyword in the Mint help file for other options and their associated Mint constant values)

`_nStopMode` – allows the user to specify how the drive reacts to activation of the stop input. By default the drive will crash stop (i.e. stop as rapidly as possible) and then the Mint stop event handler will disable the drive (refer to the STOPMODE keyword in the Mint help file for other options and their associated Mint constant values)

`_nInputLevel` – allows the user to specify whether inputs are considered to be active high or active low. The default value is specified as a binary value (input 0 is the least significant bit) setting inputs 1,2 and 3 (the default inputs for limit switches and the stop input) as active low and all other inputs as active high

`_nMotorBrakeOutput` – allows the user to define which digital output is used for motor brake control. Set this to -1 if there is no motor brake. The default value is output 5 (this can be left set to 5 even if no brake is fitted providing the user doesn't attempt to use output 5 for any other function). NOTE: The motor brake output should be considered active low – this must be done via the drive's parameter table to ensure the correct state is implemented at power up. If the active level is set only via the Mint program there will be a delay before the motor brake is initially engaged.

`_bDiagnosticsOn` – allows the program to display diagnostic messages relating to run-time errors via the Mint Workbench terminal window when connected to the MicroFlex e190 via USB. Set this value to `_false` for a slight increase in program execution speed

Pre-set table

After the constants section, the program includes a definition of the 16 possible Pre-set positions (there are 16 possible combinations of the 4 Pre-set selection inputs). Selection 0 is always the home selection.

Mint constants are provided to allow the user to define whether each selection is either an absolute move (`_nMA`) or a relative move (`_nMR`). The user is able to define individual speeds, acceleration and deceleration times for each move in the table as well as specifying the absolute move position or relative move distance (in user units). As the example application is scaled for revolutions of the motor used on the ABB MicroFlex e190 demo kit the default values in the table represent revolutions also.

Digital inputs 4 to 7 are defined as the selection inputs (where input 4 is the least significant bit). So for example...

Digital Input 4 = Off
 Digital Input 5 = On
 Digital Input 6 = Off
 Digital Input 7 = On

} Selects Pre-set table entry number 10

```
' Preset table
'
Dim nMoveTypes(0 To _nMaxSelection) As Float = { _nMA, _nMR, _nMA, _nMA, _nMR, _nMR, _nMA, _nMA, _nMR, _nMR, _nMA, 10, _nMA, _nMR, _nMR, _nMA, _nMR }
Dim fPosition(0 To _nMaxSelection) As Float   = { 0, 10, 20, 30, -10, -20, 60, 70, 1, 5, 10, 0, 2, -2, -10, -3 }
Dim fSpeeds(0 To _nMaxSelection) As Float     = { 2, 10, 10, 10, 10, 10, 10, 20, 20, 20, 20, 20, 20, 15, 15, 15 }
Dim nAccelTimes(0 To _nMaxSelection) As Integer = { 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500 }
Dim nDecelTimes(0 To _nMaxSelection) As Integer = { 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500, 500 }
```

Typically, the home position (set after completion of the homing procedure) would be zero, but the user can edit this value as required.

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) = _pmTRAPEZOIDAL      'or _pms_ramp as required
ACCELJERK(0)   = 100                 'edit as required if s-ramp needed
DECELJERK(0)   = 100                 'edit as required if s-ramp needed
HOMEBACKOFF(0) = 5                   '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:

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

Digital Output	Function	Active state
0	Homed	High
1	Idle	High
2	At target position	High
3	Healthy	High
4	Motor brake control	High (release brake)
5	Enabled	High

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)

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