# FEIMM application n°71

# User's manual

Manual Code: MW01201E00 V_1.2

## INDEX

# VERSION APPLICATION: 71.00

# 1. INTRODUCTION

## 1.1 ABOUT THIS MANUAL

This manual is meant as a brief explanation of OPDE CAN OPEN DSP402. The manual contains the following chapters:

- **Revision Table** contains the history revision of the manual;
- **Introduction** provides information background about the manual;
- **CAN OPEN DSP402 Profiles** contains the DSP402 Profiles cabling instruction and general information about EtherCAT connections;

## 1.2 COMMON SYMBOLS AND ABBREVIATIONS

| Abbreviations | Explanations |
|---|---|
| CAN | Controller Area Network |
| CiA | CAN in Automation |
| EMCY | Emergency Object or Service |
| OPDE | Open Drive Exp or OPDExp |
| OPD Explorer | OPD Explorer Supervisory Software |
| SDO | Service Data Object |

## 1.3 INTENDED AUDIENCE

The manual is intended for those persons who are responsible for commissioning and using an OPDE CAN Module. The reader should have some basic knowledge of networking, electrical fundamentals, electrical wiring practices and how to work the OPDE drive and OPD Explorer.

## 1.4 UNIT MEASURING SYSTEM

The units of measurement used by CAN Open DSP 402 are the following:

- Positions are expressed in “ie” (encoder pulse). One mechanical motor revolution is 65536 ie (or encoder pulses, default);
- Speed are expressed in “ie/s”. One revolutions-per-second is 65536 ie/s (default);
- Accelerations are expressed in “ie/s$^2$”. One revolutions-per-second$^2$ is 65536 ie/s$^2$ (default)

# 2. OpdeFEIMM PROFILES

## 2.1 OpdeFEIMM PROFILES SUPPORTED

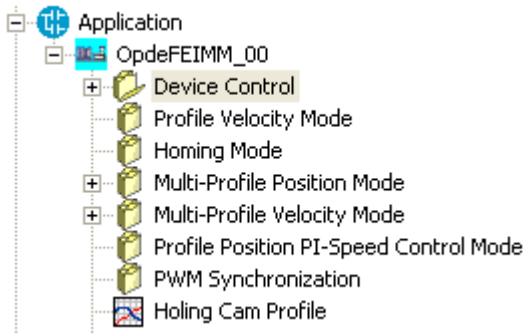
In OPDE drive are implemented the following CAN profiles:

- **Device Control;**
- **Profile Velocity Mode;**
- **Profile Position Mode;**
- **Multi-Profile Position Mode;**
- **Homing Mode;**
- **Profile velocity PI control Mode;**
-

## 2.2 NEW FIRMWARE FUNCTIONS

For ENDAT and ENDAT/BISS is possible to set feed-back baud-rate with **C65 – ENDAT_BISS_BAUD_SEL**.
Default value is 36 – 1 Mbit/s.
If the cable length is not very high, is possible to increase the baud-rate.

## 2.3 DEVICE CONTROL



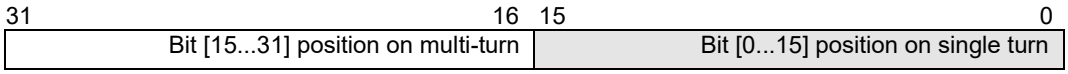

Device controls is a profile that define the behaviour of the control device. The master controls like the slave works with the following objects:

- Control Word;
- Status word;
- Modes of operation;
- Modes of operation display;
- Quick stop option code;
- Quick stop deceleration;

Parameter **E96-pCYCLICPERIOD** allows to set the synchronization for cyclic task.

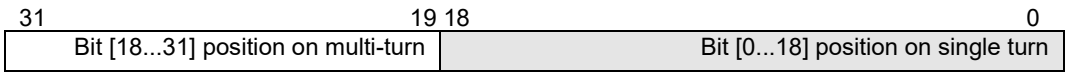
User can chose the resolution of the sensor with parameter **E97-pPOS_FRAC.** The default value is 16 which means 1 mechanical turn = 65536 ($2^{16}$) i.e.
If the value is different, the value of 1 mechanical turn is $2^{pPOS\_FRAC}$ i.e.

Example: E97-pPOS_FRAC = 16,




One mechanical turn is $2^{16}$ = 65536 ie,

E97-pPOS_FRAC = 19,




One mechanical turn is $2^{19}$ = 524288 ie,

**E99 – INIT_PAR** is used for the external control initialization.

Parameter **E96 – pCYCLIC_PERIOD** allows to set the cyclic task duration (default 0.8 – 1.0 ms).

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN**: 0x6040<br>**MODBUS:** 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1<br>2<br>3<br>4<br>6 | <br>1-Profile Position Mode<br>2-Multi Profile Position Mode<br>3-Profile Velocity Mode<br>4-Profile Velocity Mode with PI control<br>6-Homing mode | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | | 0x6061<br>0x03C1 | INTEGER8 | R |
| pQSDEC | E08 – 09 – Quick stop deceleration | 10223 | 2147483647 | 1638400 | ie/s$^2$ | 1 | 0x3102 sub 0x04<br>0x0134-0x0135 | INTEGER32 | R/W |
| pQSOPTC | E38 – Quick Stop Option Code | Range<br>0<br>2<br>6<br>8 | <br>2 – Switch On Disabled<br>6 – Stay in Quick Stop | | | 1 | 0x3102 sub 0x13 (16 lsb)<br>0x0152 | | R/W |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | | 0x6064<br>0x03C2 - 0x03C3 | INTEGER32 | R |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | | 0x606C | INTEGER32 | R |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0x03C4 - 0x03C5 | | |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48 | INTEGER32 | R |
| | | | | | | | 0x03C8 - 0x03C9 | | |
| INIT_PAR | E99 – Init Parameters from master Ok | -1999 | 1999 | | | | 0x3102 sub 0x62 (16 msb) | INTEGER32 | R/W |
| | | | | | | | 0x018F | | |
| pCYCLICPERIOD | E96 - Cyclic Period Duration | 0.2 | 10.0 | 1.0 | ms | 10 | 0x3102 sub 0x60 (16 lsb) | INTEGER32 | R/W |
| | | | | | | | 0x018C | | |
| pPOS_FRAC | E97 - Fractional position | 16 | 25 | 1.0 | Bit | | 0x3102 sub 0x60 (16 msb) | INTEGER32 | R/W |
| | | | | | | | 0x018D | | |
| CAN2_Selection | E899 – Position send/received by CAN2 | Range | | | | | | | |
| | | 0 | 0 - Use motor position | | | | | | |
| | | 1 | 1 – Use motor position and send it | | | | 0x231F | INTEGER16 | |
| | | 2 | 2 - Receive position by CAN 2 | | | | | | |
| | | 3 | 3 - Send Torque and position by SPI (Master) | | | | | | |
| | | 4 | 4 - Receive Pos by SPI (Slave) | | | | | | |
| CAN2_TX_ID | E900 – Transmitter CAN2 Address | 0 | 127 | | | | | | R/W |
| | | | | | | | 0x2320 | INTEGER16 | |
| CAN2_RX_ID | E901 – Receiver CAN2 Address | 0 | 127 | | | | | | R/W |
| | | | | | | | 0x2321 | INTEGER16 | |

**Tab. 1- Device Control Parameters and Objects**

### 2.3.1 CONTROL WORD AND STATUS WORD

Control word and status word are used for the device control of the system (See **Fig. 4**). Both of them became from standard CAN Open Dsp402. Some commands of Control Word are in OR state with Logical Inputs.

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TrqLFLB | bCw_PowRes | | | PrfNeg | PrfPos | | hlt | fr | b6 | b5 | nsp | eo | qs | ev | so |

**Fig. 1-Control Word**

| | |
|---|---|
| 0 | Switched On (Ds402) |
| 1 | Enable Voltage (Ds402) |
| 2 | Quick Stop (Ds402) |
| 3 | Enable Operation (Ds402) |
| 4 | New Set Point (Ds402) |
| 5 | b5 (Ds402) |
| 6 | b6 (Ds402) |
| 7 | Fault reaction (Ds402) |
| 8 | Halt (Ds402) |
| 9 | |
| 10 | Enable Positive Multi-profile position (rising edge) |
| 11 | Enable Negative Multi-profile position (rising edge) |
| 12 | |
| 13 | |
| 14 | Power reset |
| 15 | Enable Torque limit from fieldbus |

**Tab. 2- Meaning of control word**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ms_b1 | ms_b0 | oms_b1 | oms_b0 | ila | tr | rm | HmC | w | sod | qs | ve | f | oe | so | rtso |

**Fig. 2-Status Word**

| | |
|---|---|
| 0 | Ready to Switch On State (Ds402) |
| 1 | Switched On State (Ds402) |
| 2 | Operation Enable State (Ds402) |
| 3 | Fault State (Ds402) |
| 4 | Voltage Enabled (Ds402) |
| 5 | Quick Stop State (Ds402) |
| 6 | Switch On Disabled State (Ds402) |
| 7 | Warning (Ds402) |
| 8 | Homing Completed (Ds402) |
| 9 | Remote (Ds402) |
| 10 | Target Reached |
| 11 | Internal Limit Active (Ds402) |
| 12 | Op. Mode specific 0 |
| 13 | Op. Mode specific 1 |

| | |
|---|---|
| 14 | Manufacturer specific 0 |
| 15 | Manufacturer specific 1 |

**Tab. 3- Meaning of status word**

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4<br>Can2Rx | 3<br>Can2Tx | 2 | 1<br>NegLim | 0<br>PosLim |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

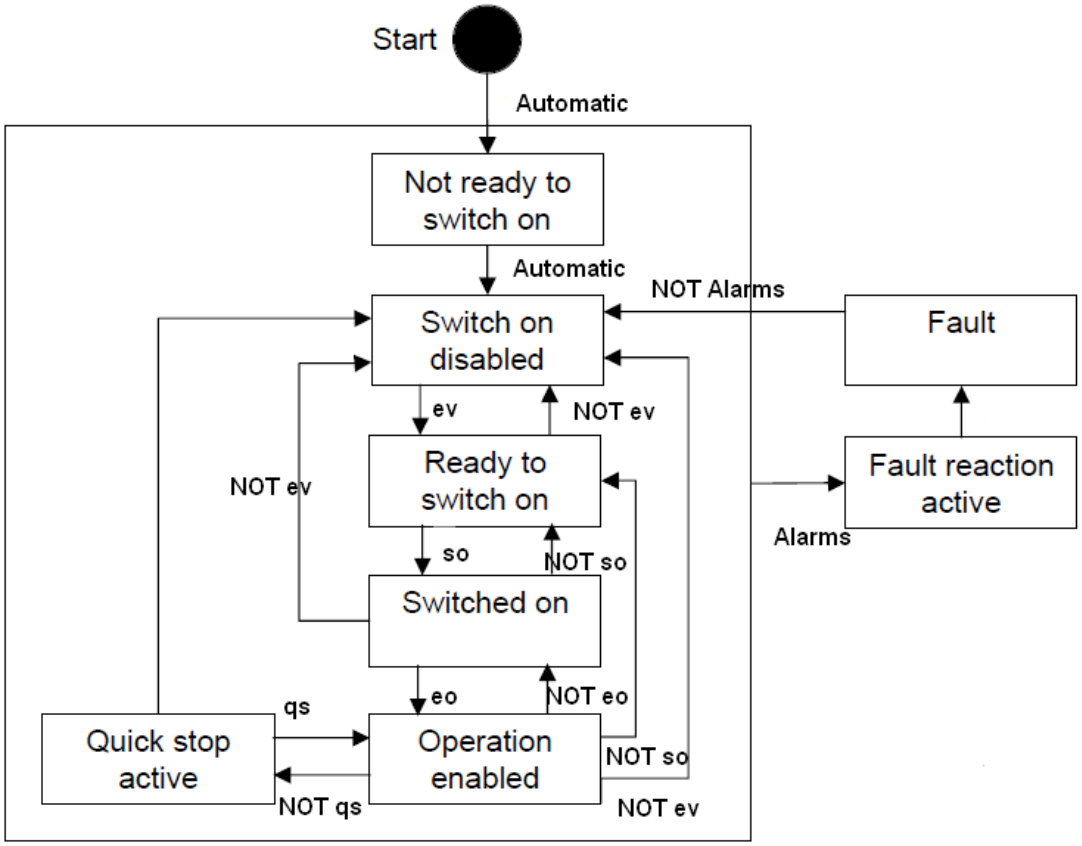
**Tab. 4- Meaning of status word**

| | |
|---|---|
| 0 | Positive limit active |
| 1 | Negative limit active |

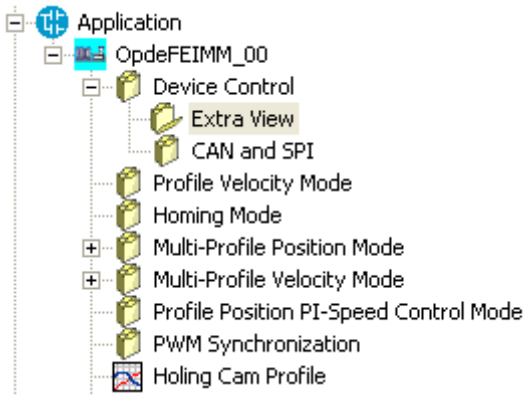
**Fig. 3-Status Word 1**

### 2.3.2 STATE MACHINE

**Fig. 4** shows the device control of the machine and bits of control word used like transition between the states. Parameter **E101-RD_STATE_MACHINE** refreshes the actual state of the machine.
Speed references are processed only when the system is in **Operation Enabled State**.



### 2.3.3 EXTRA VIEW

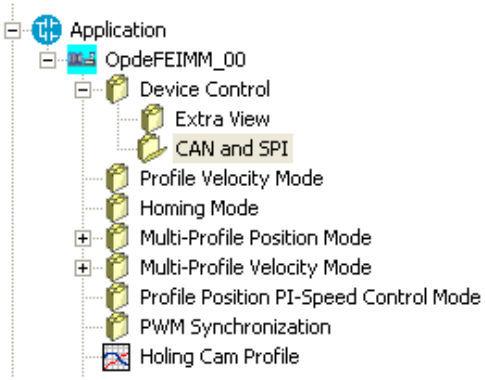



Extra view interface shows some usefully Only-Reading parameters calculated during Multi-Profile Position.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| REVISION_HISTORY | E102 – Application Revision History | | | | | | **CAN**: 0x3100 sub 0x0b<br>**MODBUS**: 0x2002 | INTEGER32 | R |
| MAX_SPEED_IE | D72-D73 - Speed Max [ie] (P65 MOT_MAX_SPEED) | | | | ie | | 0x2003 sub 0x48-0x49<br>0x03c8 – 0x03c9 | INTEGER16 | R |
| MAX_SPEED_POS | E200 - 201 - Maximum positive speed | | | | ie/s | | 0x3100 sub 0x0c<br>0x2064-2065 | INTEGER32 | R |
| MAX_SPEED_NEG | E202 - 203 - Maximum negative speed | | | | ie/s | | 0x3100 sub 0x0d<br>0x2066-2067 | INTEGER32 | R |
| ACT_TIME_TOTAL | E214 - 215 - Total During Time | | | | ms | | 0x3100 sub 0x09<br>0x2072-2073 | INTEGER32 | R |
| ACT_POW_TOT | E216 - 217 - Active total power delivered | | | | Wh | 1000 | 0x3100 sub 0x0a<br>0x2074-2075 | INTEGER32 | R |

**Tab. 5- Extra View**

### 2.3.4 CAN2 AND SPI




FEIMM can use SPI or CAN2 Communication for send the data between the drives.
In the 300 Ton FEIMM the Injection Master send to Injection slave the torque reference and to Screw the actual position, this configuration could be realized with Analogue Input / CAN2 or with SPI.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| Comm_Sel | E899 - Communication selection | Range | | 0 - Use motor position | | 1 | **MODBUS:** 0x231F | INTEGER16 | R/W |
| | | 0 | 0 – Use motor position | | | | | | |
| | | 1 | 1 - Send Pos by CAN 2 | | | | | | |
| | | 2 | 2 - Receive position by CAN 2 | | | | | | |
| | | 3 | 3 - Send Torque and position by SPI (Master) | | | | | | |
| | | 4 | 4 - Receive Pos by SPI (Slave) | | | | | | |
| CAN2_TX_ID | E900 – Transmitter CAN2 Address | 0 | 127 | | | | 0x2320 | INTEGER16 | R/W |
| CAN2_RX_ID | E901 – Receiver CAN2 Address | 0 | 127 | | | | 0x2321 | INTEGER16 | R/W |
| SPI_BAUD_RATE | E45 – SPI Baud Rate | 5 - 6.25 Mbit/s | 20 - 1.79 Mbit/s | 12 - 2.88 Mbit/s | Mbit/s | | **CAN:** 0x201E sub 0x2d | INTEGER16 | R/W |
| | | | | | | | **MODBUS**: 0x0159 | | |
| THR_ALARM_COM | E46 – Threshold time for alarm communication | 0,1 | 300,0 | 10,0 | ms | | 0x201E sub 0x2e | INTEGER16 | R/W |
| | | | | | | | 0x015a | | |
| ACTUALPOS_2 | D75 – D76 – Position received from CAN2 / SPI | | | | | | 0x2003 sub 0x4b - 0x4c | INTEGER16 | R |
| | | | | | | | 0x03cb-0x03cd | | |
| CRC_ERROR_MAX | D86 – Maximum CRC error counter (SPI) | | | | | | 0x2003 sub 0x56 | INTEGER16 | R |
| | | | | | | | 0x03d6 | | |
| NOT_RECEIVED_MAX | D87 – Maximum losing communication counter (SPI) | | | | | | 0x2003 sub 0x57 | INTEGER16 | R |
| | | | | | | | 0x03d7 | | |

**Tab. 6- CAN2 and SPI parameters and Objects**

**Fig. 5** shows the configuration with Analogue Input/Output and CAN2. **Fig. 6** shows the configuration with SPI.

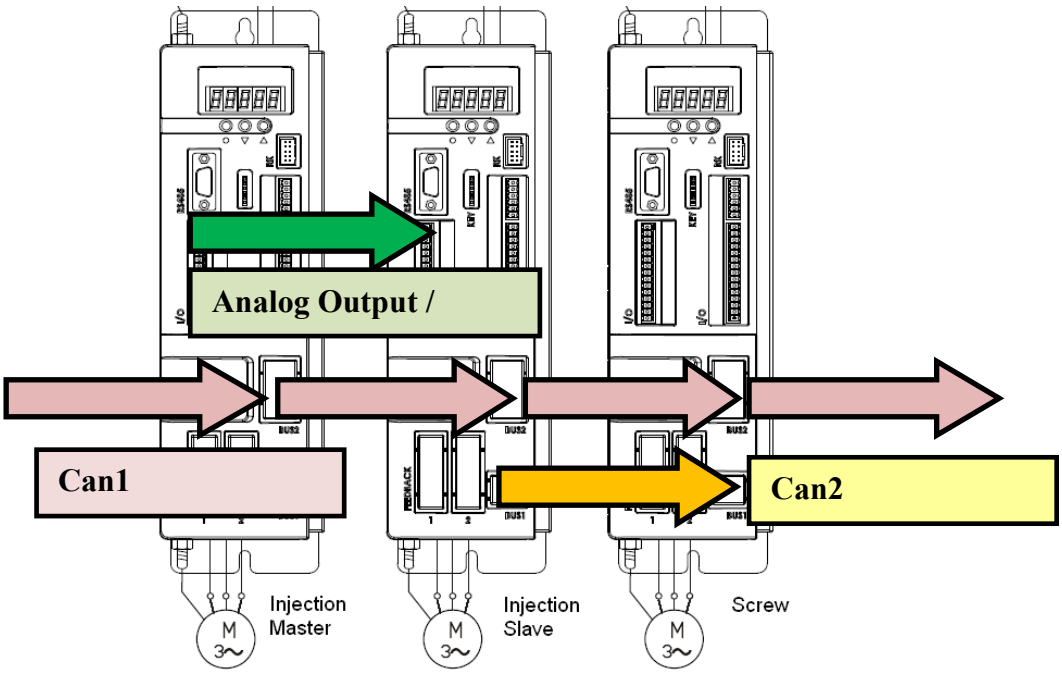



**Fig. 5-300 Ton machine configuration with Analogue Input/Output and CAN2**

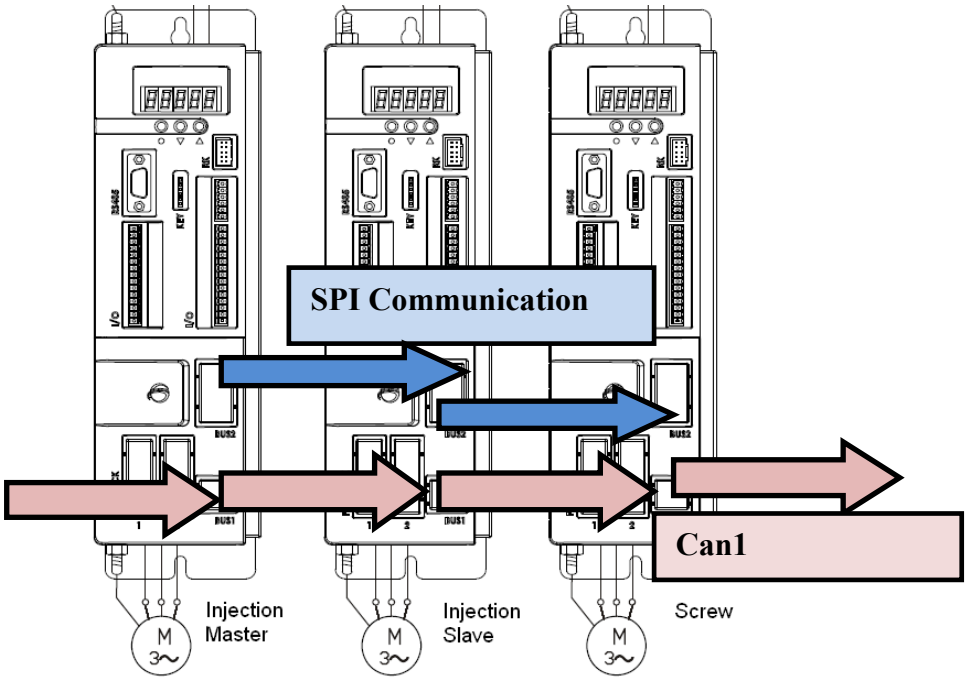


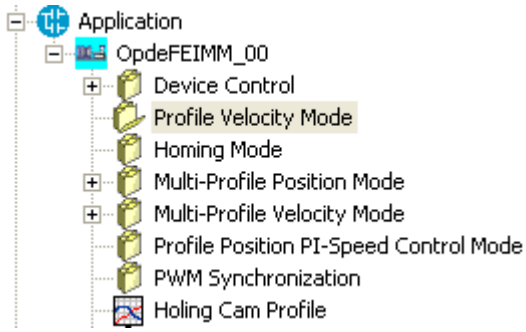

**Fig. 6-300 Ton machine configuration with SPI configuration**

At the end of Injection, Screw motor starts to run and the change of speeds depends on the position received from Injection Drive by second line CAN.

Parameters **Can2_Tx_COB_ID** and **Can2_Rx_COB_ID** are the transmitter and receiver COB_ID.
Parameter **Comm_Selection** allows to send and receive the position:

- *0-Use Motor Position*: the drive use the position read from the sensor in **Multi Profile Position Mode** and don't send it,
- *1-Use Motor Position and send it*: the drive send the position and use the motor position red from the sensor in **Multi Profile Position Mode** (Injection Axes)**,**
- *2-Use position received from CAN2*: the drive use the position received from CAN2 in **Multi Profile Velocity Mode** (Screw Axes),
- *3-Send Torque and position by SP*I (Master),
- *4-Receive position by SPI (Slave).*

## 2.4 PROFILE VELOCITY MODE




The profile velocity mode covers the following sub-functions:

- Demand value input via trajectory generator;
- Velocity capture using position sensor or velocity sensor;
- Velocity control function with appropriate input and output signals;
- Monitoring of the profile velocity using a window-function;
- Monitoring of velocity actual value using a threshold.

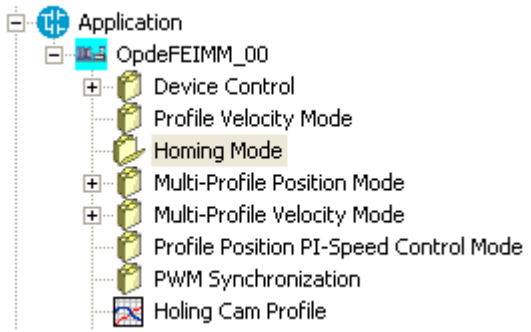
OPDE drive supports the following Profile Velocity Mode objects :

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN**: 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1<br>2<br>3 | <br>1-Profile Position Mode<br>2-Multi Profile Position Mode<br>3-Profile Velocity Mode | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | 4 | 4-Profile Velocity Mode with PI control | | | | | | |
| | | 6 | 6-Homing mode | | | | | | |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | | 0x6061<br>0x03C1 | INTEGER8 | R |
| pTARGETVEL | E02-E03 - Target velocity | -2147483648 | 2147483647 | 32768 | ie/s | 1 | 0x3102 sub 0x01<br>0x012E – 0x012F | INTEGER32 | R/W |
| pPROFACC | E04-E05 - Profile acceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x3102 sub 0x02<br>0x0130 – 0x0131 | INTEGER32 | R/W |
| pPROFDEC | E06-E07 - Profile deceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x3102 sub 0x03<br>0x0132 – 0x0133 | INTEGER32 | R/W |
| pQSDEC | E08 – 09 – Quick stop deceleration | 10223 | 2147483647 | 1638400 | ie/s$^2$ | 1 | 0x3102 sub 0x04<br>0x0134 – 0x0135 | INTEGER32 | R/W |
| pQSOPTC | E38 – Quick Stop Option Code | Range | | | | 1 | 0x3102 sub 0x13 (16 lsb)<br>0x0152 | INTEGER32<br>NTEGER32 | R/W |
| | | 0 | | | | | | | |
| | | 2 | 2 – Switch On Disabled | | | | | | |
| | | 6 | 6 – Stay in Quick Stop | | | | | | |
| | | 8 | | | | | | | |
| pTHRVEL | E18 - Velocity threshold | 100 | 65535 | 10000 | | 1 | 0x3102 sub 0x9 (16 lsb)<br>0x013E | NTEGER32 | R/W |
| pTIMEVEL | E20 - Velocity threshold time | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0A (16 lsb)<br>0x0140 | NTEGER32 | R/W |
| pWINVEL | E22 - Velocity window | 0 | 65535 | 0 | | 1 | 0x3102 sub 0x0B (16 lsb)<br>0x0142 | NTEGER32 | R/W |
| pWTIMEVEL | E24 - Velocity window time-out | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0C (16 lsb)<br>0x0144 | NTEGER32 | R/W |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | | 0x6064<br>0x03C2 - 0x03C3 | INTEGER32 | R |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | | 0x606C<br>0x03C4 - 0x03C5 | INTEGER32 | R |
| pENSPDFDW | E36 - Enable Speed Feed-forward | 0 | 1 | 1 | | 1 | 0x3102 sub 0x18 (16 lsb)<br>0x0150 | NTEGER32 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |

**Tab. 7- Device Control Parameters and Objects**

## 2.5 HOMING MODE




Homing Mode implements the methods which a drive seeks the home position, or initial reference point (also called, the datum or zero point). There are three methods of achieving this using positive/negative torque limits or current position.

OPDE drive supports the following methods:

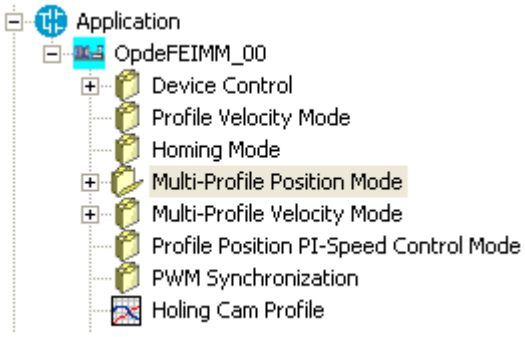
1. ***Homing on current position.*** *The home position is the current position ;*
2. ***Homing on Negative Limit Torque (without index).*** *The home position is at the left of the point where the system founds the negative limit torque ;*
3. ***Homing on Positive Limit Torque (without index).*** *The home position is at the left of the point where the home switch changes state;*

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN**: 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 1-Profile Position Mode<br>2 2-Multi Profile Position Mode<br>3 3-Profile Velocity Mode<br>4 4-Profile Velocity Mode with PI control<br>6 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | 1 | 0x6061<br>0x03C1 | INTEGER8 | R |
| pHMMODE | E26 - Homing method | 1 | 48 | 35 | | 1 | 0x3102 sub 0x0D (16 lsb)<br>0x0146 | INTEGER32 | R/W |
| pHMOFFSET | E28-E29 - Home offset | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3102 sub 0x0E<br>0x0148-0x0149 | INTEGER32 | R/W |
| pHMSPD | E30-E31 - Homing speed during search for switch | 0 | 2147483647 | 32768 | ie/s | 1 | 0x3102 sub 0x0F | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0x014A-0x014B | | |
| pHMSPDEND | E32-E33 - Homing speed during search for zero | 0 | 2147483647 | 32768 | ie/s | 1 | 0x3102 sub 0x10<br>0x014C-0x014D | INTEGER32 | R/W |
| pHMACC | E34-E35 - Homing acceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x3102 sub 0x11<br>0x014E-0x014F | INTEGER32 | R/W |
| pHMMAXTRQ | E92 - Homing Max Torque | 0.00 | 400.00 | 400.00 | % MOT_T_NOM | 100 | 0x3102 sub 0x2E<br>0x0188 | INTEGER32 | R/W |
| pQSDEC | E08 – 09 – Quick stop deceleration | 10223 | 2147483647 | 1638400 | ie/s$^2$ | 1 | 0x3102 sub 0x04<br>0x0134 – 0x0135 | INTEGER32 | R/W |
| pQSOPTC | E38 – Quick Stop Option Code | Range<br>0<br>2<br>6<br>8 | <br><br>2 – Switch On Disabled<br>6 – Stay in Quick Stop<br> | | | 1 | 0x3102 sub 0x1C (16 lsb)<br>0x0152 | INTEGER32 | R/W |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | 1 | 0x6064<br>0x03C2 - 0x03C3 | INTEGER32 | R |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | 1 | 0x606C<br>0x03C4 - 0x03C5 | INTEGER32 | R |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | 1 | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |

**Tab. 8- Homing objects**

## 2.6 MULTI PROFILE POSITION MODE




Multi-Profile position mode allows realizing a multi step-speed profile with up to 10 different speeds, the change of the speed depends on the position of the motor.
During the positioning, the user can also choose different steps of limit torque. Position Loop is enabled during this operative mode.

The multi-profile position could be Positive or Negative. Only for Negative profile is possible to enable an Holding Cam Profile at the end or during the positioning.

In a FEIMM this operative method can control the following axes:

- Clamp, for open and close the Mould,
- Injector, during the injection (with Holding Cam Profile enabled) and Suck-back (without Holding Cam Profile),
- Ejector, for open and close Ejector

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN:** 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 – 1-Profile Position Mode<br>2 – 2-Multi Profile Position Mode<br>3 – 3-Profile Velocity Mode<br>4 – 4-Profile Velocity Mode with PI control<br>6 – 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | 1 | 0x6061<br>0x03C1 | INTEGER8 | R |
| pQSDEC | E08 – 09 – Quick stop deceleration | 10223 | 2147483647 | 1638400 | ie/s$^2$ | 1 | 0x3102 sub 0x04<br>0x0134 – 0x0135 | INTEGER32 | R/W |
| pQSOPTC | E38 – Quick Stop Option Code | Range<br>0 –<br>2 – 2 – Switch On | | | | 1 | 0x3102 sub 0x13 (16 lsb) | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | Disabled | | | | | | |
| | | 6 | 6 – Stay in Quick Stop | | | | 0x0152 | | |
| | | 8 | | | | | | | |
| pTRQPOS_RAMPS | E10 – Positive Torque acc/dec ramps | 0.1 | 6500.0 | 655.0 | ms | | 0x3102 sub 0x05 (16 lsb) | INTEGER32 | R/W |
| | | | | | | | 0x0136 | | |
| pTRQNEG_RAMPS | E11 – Negative Torque acc/dec ramps | 0.1 | 6500.0 | 655.0 | ms | | 0x3102 sub 0x05 (16 msb) | INTEGER32 | R/W |
| | | | | | | | 0x0137 | | |
| pWINPOS | E14-E15 - Position window | 0 | 2147483647 | 0 | ie | 1 | 0x3102 sub 0x07 | NTEGER32 | R/W |
| | | | | | | | 0x013A – 0x013B | | |
| pFOLLERR | E16-E17 - Following error window | 0 | 2147483647 | 0 | ie | 1 | 0x3102 sub 0x08 | NTEGER32 | R/W |
| | | | | | | | 0x013C – 0x013D | | |
| pTHRVEL | E18 - Velocity threshold | 100 | 65535 | 10000 | ie/s | 1 | 0x3102 sub 0x09 (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x013E | | |
| pTIMEVEL | E20 - Velocity threshold time | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0A (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0140 | | |
| pWINVEL | E22 - Velocity window | 0 | 65535 | 0 | ie/s | 1 | 0x3102 sub 0x0B (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0142 | | |
| pWTIMEVEL | E24 - Velocity window time-out | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0C (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0144 | | |
| pTHREVEL_FILTER_TF | E44 – First order filter time constant on actual velocity | 0.1 | 200.0 | 100.0 | ms | | 0x3102 sub 0x16 (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0142 | | |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | 1 | 0x6064 | INTEGER32 | R |
| | | | | | | | 0x03C2 - 0x03C3 | | |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | 1 | 0x606C | INTEGER32 | R |
| | | | | | | | 0x03C4 - 0x03C5 | | |
| ERRORPOS | d70-d71 Following error actual value | | | | ie | 1 | 0x60F4 | INTEGER32 | R |
| | | | | | | | 0x03C6 – 0x03C7 | | |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | 1 | 0x200F sub 0x48 | INTEGER32 | R |
| | | | | | | | 0x03C8 – 0x03C9 | | |
| pENSPDFDW | E36 - Enable Speed Feed-forward | 0 | 1 | 1 | | 1 | 0x3102 sub 0x12 (16 lsb) | INTEGER32 | R/W |
| | | | | | | | 0x0150 | | |
| pENTRQFDW | E37 - Enable Torque Feed-forward | 0 | 1 | 1 | | 1 | 0x3102 sub 0x12 (16 msb) | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0x0151 | | |
| pPOS_REG_KP | E39 - Kv position loop proportional gain | 0.0 | 100.0 | 4.0 | | 10 | 0x3102 sub 0x13 (16 msb) | INTEGER32 | R/W |
| | | | | | | | 0x0153 | | |
| PrfPP_Pos_PosTrg | E448 - 449 - Positive Profile Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3006 sub 0x00 | INTEGER32 | R |
| | | | | | | | 0x215C – 0x215d | | |
| PrfPP_Neg_Sel_End_Trq | E749 - Profile Negative - Type Switch mode | Range | | | | 1 | 0x301C sub 0x004 | NTEGER32 | R/W |
| | | 0 | 0 - None | | | | | | |
| | | 1 | 1 – Target reach locking | | | | | | |
| | | 2 | 2 – Target reach holding start CAM profile | | | | | | |
| | | 3 | 3 - Pos start holding CAM profile | | | | 0x2289 | | |
| | | 4 | 4 – Pos and trq start holding CAM profile | | | | | | |
| | | 5 | 5 – Pos and AI start holding CAM profile | | | | | | |
| | | 6 | 6- Pos and DI start holding cam profile | | | | | | |
| PrfPP_Pos_PosTrg | E704 - 705 - Profile Negative Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3016 | INTEGER32 | R |
| | | | | | | | 0x225C – 0x225D | | |
| pSWLIMITMIN | E40 – 41 – Min Position Limit | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3102 sub 0x20 | NTEGER32 | R/W |
| | | | | | | | 0x2400 | | |
| pSWLIMITMAX | E42 – 43 – Max Position limit | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3102 sub 0x21 | NTEGER32 | R/W |
| | | | | | | | 0x2401 | | |

**Tab. 9- Device Control Parameters and Objects**

Position loop works in the way shows in the

**Fig. 7**. Error position is multiply by **E39 - pPOS_REG_KP** and give an additional speed reference (in pulses) to speed regulator. Speed Feed-forward can be enabled with **E36-pENSPDFDW**.
Eventually also a Torque Feed-forward can be enabled with **E37-pENTRQFDW**.

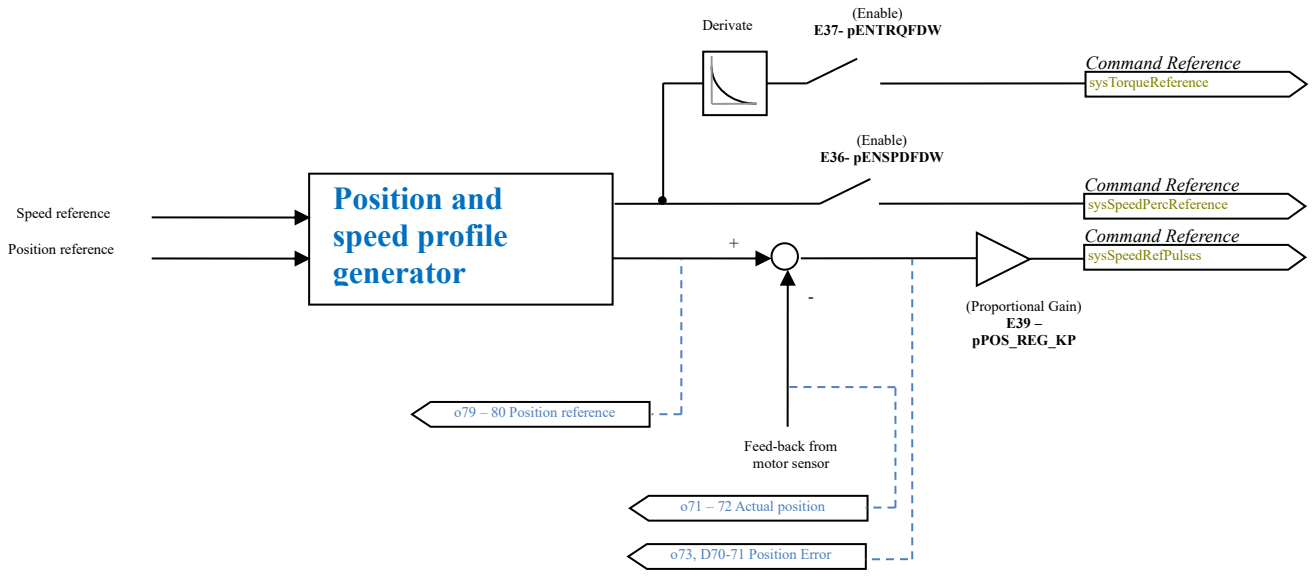



**Fig. 7-Multi-Profile position loop**

If position error (*d70-71 ERRORPOS*, *o73-Absolute position error*), becomes greater than threshold **E16-17 – pFOLLERR** the drive trips in alarm **A4.2**.
When, at the end of positioning, the real position is inside the position reference with threshold E14-15 – pWINPOS, the bit 10 of STATUS WORD “Target Reached” is enabled.

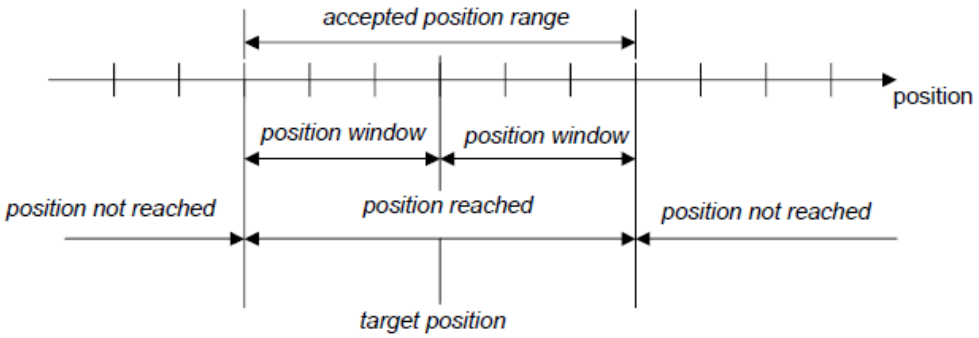
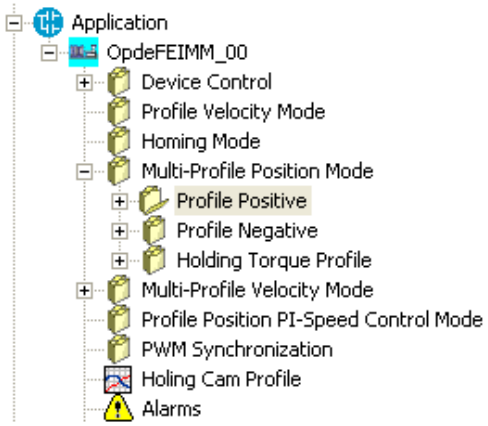



**Fig. 8-Target Reached Position**

### 2.6.1 PROFILE POSITIVE




Multi Profile Position Positive can be enabled with bit 10 of control word **Fig. 1**, **Tab. 2** or with logical input **I11 – Profile positive start enable**.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN**: 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite state automation | | | | | | 0x2001 | INTEGER16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 1-Profile Position Mode<br>2 2-Multi Profile Position Mode<br>3 3-Profile Velocity Mode<br>4 4-Profile Velocity Mode with PI control<br>6 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | | 0x6061<br>0x03C1 | INTEGER8 | R |
| PrfPP_Pos_PosTrg | E448 - 449 - Positive Profile Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3006 sub 0x00<br>0x215C – 0x215D | INTEGER32 | R |
| PrfPP_Pos_EndSpdRef | E450 - 451 - Profile Positive End Speed Open Loop | 0 | 2147483647 | 0 | ie/s | 1 | 0x3007 sub 0x00<br>0x215E | INTEGER32 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| MAX_SPEED_POS | E200-201 – Maximum Positive speed | | | | ie | 1 | 0x3100 sub 0x0c<br>0x2064-0x2065 | INTEGER32 | R |

**Tab. 10- Multi Profile Positive Parameters and Objects**

### 2.6.1.0 Speed Positive Profile

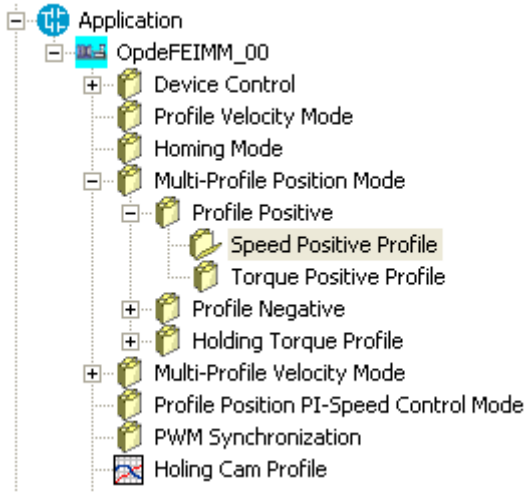



Table **Tab. 11** shows the 10 positions for change the speed (**PrfPP_Pos_PosChgSpd_0..... PrfPP_Pos_PosChgSpd_9**) and 10 speeds (**PrfPP_Pos_Speed_0**.... **PrfPP_Pos_Speed_9**).
Parameters **PrfPP_Pos_NrPrfSpd** and **PrfPP_Pos_IndTrgPos** set the numbers of the change of speed for the profile.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Pos_PosChgSpd_0 | E356 - 357 - 0 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3000 sub 0x00<br>**MODBUS**: 0x2100-0x2101 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_1 | E358 - 359 - 1 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x01<br>0x2102-0x2103 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_2 | E360 - 361 - 2 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x02<br>0x2104-0x2105 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_3 | E362 - 363 - 3 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x03<br>0x2106-0x2107 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_4 | E364 - 365 - 4 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x04<br>0x2108-0x2109 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_5 | E366 - 367 - 5 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x05<br>0x210A-0x210B | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_6 | E368 - 369 - 6 - Positive Profile Position | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x06 | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | Targhet/Change Speed | | | | | | 0x210C-0x210D | | |
| PrfPP_Pos_PosChgSpd_7 | E370 - 371 - 7 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x07<br>0x210E-0x210F | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_8 | E372 - 373 - 8 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x08<br>0x2110-0x2111 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgSpd_9 | E374 - 375 - 9 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x08<br>0x2112-0x2113 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_0 | E378 - 379 - 0 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x00<br>0x2116-0x2117 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_1 | E380 - 381 - 1 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x01<br>0x2118-0x2119 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_2 | E382 - 383 - 2 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x02<br>0x211A-0x211B | INTEGER32 | R/W |
| PrfPP_Pos_Speed_3 | E384 - 385 - 3 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x03<br>0x211C-0x211D | INTEGER32 | R/W |
| PrfPP_Pos_Speed_4 | E386 - 387 - 4 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x04<br>0x211E-0x211F | INTEGER32 | R/W |
| PrfPP_Pos_Speed_5 | E388 - 389 - 5 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x05<br>0x2120-0x2121 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_6 | E390 - 391 - 6 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x06<br>0x2122-0x2123 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_7 | E392 - 393 - 7 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x07<br>0x2124-0x2125 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_8 | E394 - 395 - 8 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x08<br>0x2126-0x2127 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_9 | E396 - 397 - 9 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x09<br>0x2128-0x2129 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_0 | E510 – 511 – Positive Profile Acc Dec 0 | 10223 | 2147483647 | 500000 | $ie/s^2$ | 1 | 0x300a sub 0x00<br>0x219a – 0x219b | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_1 | E512 – 513 – Positive Profile Acc Dec 1 | 10223 | 2147483647 | 500000 | $ie/s^2$ | 1 | 0x300a sub 0x01<br>0x219c – 0x219d | INTEGER32 | R/W |
| PrfPP_Pos_Acc | E514 – 515 – Positive Profile | 10223 | 2147483 | 5000 | $ie/s^2$ | 1 | 0x300a sub | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| _Dec_2 | Acc Dec 2 | | 647 | 00 | | | 0x02<br>0x219e – 0x219f | | |
| PrfPP_Pos_Acc_Dec_3 | E516 – 517 – Positive Profile Acc Dec 3 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x03<br>0x21a0 – 0x21a1 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_4 | E518 – 519 – Positive Profile Acc Dec 4 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x04<br>0x21a2 – 0x21a3 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_5 | E520 – 521 – Positive Profile Acc Dec 5 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x05<br>0x21a4 – 0x21a5 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_6 | E522 – 523 – Positive Profile Acc Dec 6 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x06<br>0x21a6 – 0x21a7 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_7 | E524 – 525 – Positive Profile Acc Dec 7 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x07<br>0x21a8 – 0x21a9 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_8 | E526 – 527 – Positive Profile Acc Dec 8 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x08<br>0x21aa – 0x21ab | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_9 | E528 – 529 – Positive Profile Acc Dec 9 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x09<br>0x21ac – 0x21ad | INTEGER32 | R/W |
| PrfPP_Pos_Final_Dec | E530 – 531 – Positive Profile Acc Dec 4 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x0a<br>0x21ae – 0x21af | | R/W |
| PrfPP_Pos_NrPrfSpd | E400 - Positive Profile Nr. Change Speed | 0 | 8 | 0 | | 1 | 0x300C sub 0x01<br>0x212C | INTEGER8 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C9 – 0x03C9 | | R |
| PrfPP_Pos_IndTrgPos | E401 - Index of Positive Profile Position Targhet | 0 | 9 | 9 | | 1 | 0x300C sub 0x00<br>0x212D | INTEGER8 | R/W |

**Tab. 11- Multi-profile Positive Speed parameters and Objects**

### 2.6.1.1 Torque Positive Profile

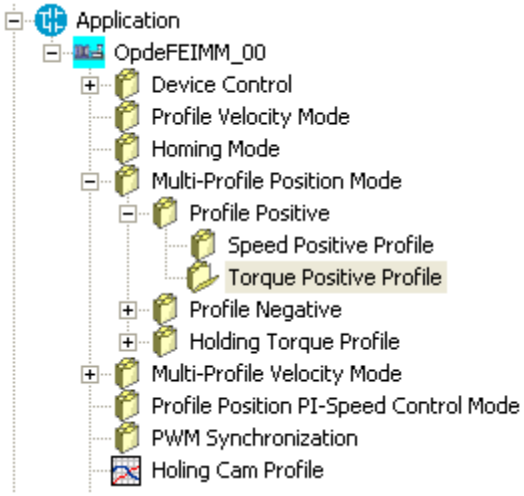



Table **Tab. 12** shows the 9 positions for change the speed (**PrfPP_Pos_PosChgTrq_0.... PrfPP_Pos_PosChgTrq_9**) and 10 speeds (**PrfPP_Pos_Torque_0**.... **PrfPP_Pos_Torque_1**).
Parameter **PrfPP_Pos_NrPrfTrq** allows to choose the numbers of the change of torque limits for the profile.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Pos_PosChgTrq_0 | E402 - 403 - 0 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3003 sub 0x00<br>**MODBUS**: 0x212E-0x212F | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_1 | E404 - 405 - 1 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x01<br>0x2130-0x2131 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_2 | E406 - 407 - 2 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x02<br>0x2132-0x2133 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_3 | E408 - 409 - 3 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x03<br>0x2134-0x2135 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_4 | E410 - 411 - 4 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x04<br>0x2136-0x2137 | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_5 | E412 - 413 - 5 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x05<br>0x2138- | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0x2139 | | |
| PrfPP_Pos_PosChgTrq_6 | E414 - 415 - 6 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x06<br>0x213A-0x213B | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_7 | E416 - 417 - 7 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x07<br>0x213C-0x213D | INTEGER32 | R/W |
| PrfPP_Pos_PosChgTrq_8 | E418 - 419 - 8 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3003 sub 0x08<br>0x213E-0x213F | INTEGER32 | R/W |
| PrfPP_Pos_Torque_0 | E425 - 0 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | ie | 100 | 0x3004 sub 0x00<br>0x2145 | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_1 | E426 - 1 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x01<br>0x2146 | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_2 | E427 - 2 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x02<br>0x2147 | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_3 | E428 - 3 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x03<br>0x2148 | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_4 | E429 - 4 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x04<br>0x2149 | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_5 | E430 - 5 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x05<br>0x214A | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_6 | E431 - 6 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x06<br>0x214B | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_7 | E432 - 7 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x07<br>0x214C | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_8 | E433 - 8 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x08<br>0x214D | UNSIGNED 16 | R/W |
| PrfPP_Pos_Torque_9 | E434- 9 - Profile Positive Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3004 sub 0x09<br>0x214E | UNSIGNED 16 | R/W |
| PrfPP_Pos_NrPrfTrq | E447 - Positive Profile Nr. Change Limit Torque | 0 | 8 | 0 | | 1 | 0x300C sub 0x02<br>0x215B | INTEGER8 | R/W |

**Tab. 12- Change torque Positive Parameters and Objects**

Example 1: **Multi-profile Positive**.

Parameters:

**pPOS_FRAC** = 23 bit (1 turn = 8388608 ie),
**PrfPP_Pos_NrPrfSpd** = 3,
**PrfPP_Pos_IndTrgPos** =9,
**PrfPP_Pos_NrPrfTrq** = 9.

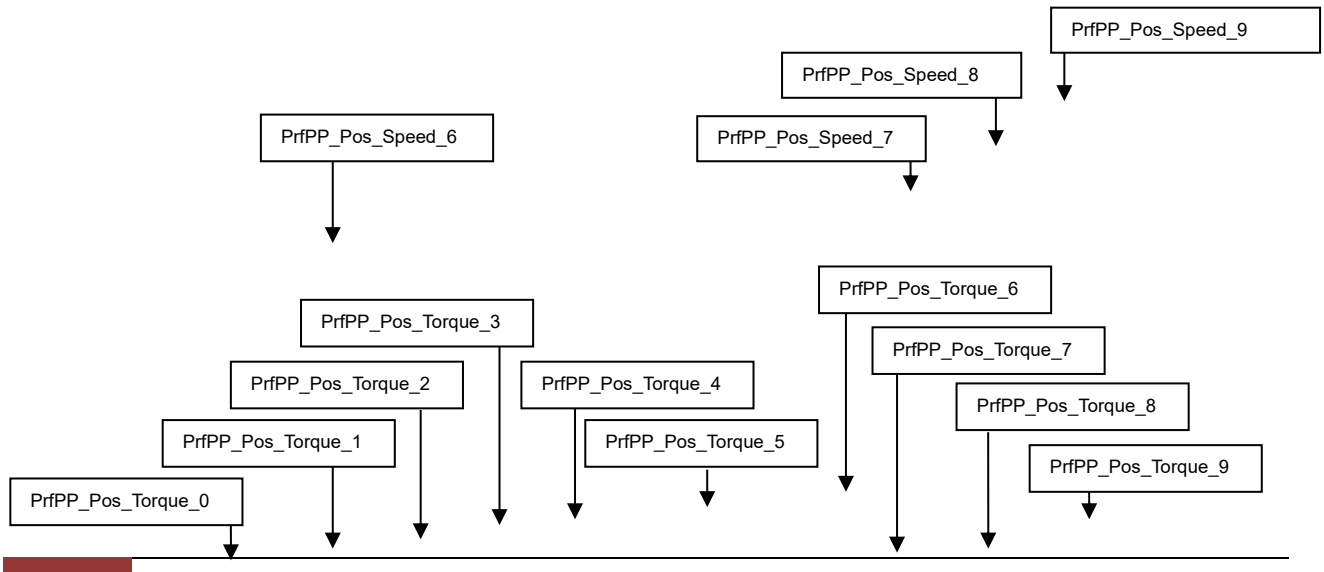
| | |
|---|---|
| PrfPP_Pos_PosChgSpd_0 = 2097152 ie | PrfPP_Pos_Speed_0 = 4194304 ie/s |
| PrfPP_Pos_PosChgSpd_1 = 4194304 ie | PrfPP_Pos_Speed_1 = 8388608 ie/s |
| PrfPP_Pos_PosChgSpd_2 = 6291456 ie | PrfPP_Pos_Speed_2 = 12582912 ie/s |
| PrfPP_Pos_PosChgSpd_3 = 8388608 ie | PrfPP_Pos_Speed_3 = 16777216 ie/s |
| PrfPP_Pos_PosChgSpd_4 = 10485760 ie | PrfPP_Pos_Speed_4 = 20971520 ie/s |
| PrfPP_Pos_PosChgSpd_5 = 12582912 ie | PrfPP_Pos_Speed_5 = 25165824 ie/s |
| PrfPP_Pos_PosChgSpd_6 = 14680064 ie | PrfPP_Pos_Speed_6 = 29360128 ie/s |
| PrfPP_Pos_PosChgSpd_7 = 16777216 ie | PrfPP_Pos_Speed_7 = 33554432 ie/s |
| PrfPP_Pos_PosChgSpd_8 = 18874368 ie | PrfPP_Pos_Speed_8 = 37748736 ie/s |
| PrfPP_Pos_PosChgSpd_9 = 20971520 ie | PrfPP_Pos_Speed_9 = 41943040 ie/s |

| | |
|---|---|
| PrfPP_Pos_PosChgTrq_0 = 2097152 ie | PrfPP_Pos_Torque_0 = 10.00 % |
| PrfPP_Pos_PosChgTrq_1 = 4194304 ie | PrfPP_Pos_Torque_1 = 20.00 % |
| PrfPP_Pos_PosChgTrq_2 = 6291456 ie | PrfPP_Pos_Torque_2 = 30.00 % |
| PrfPP_Pos_PosChgTrq_3 = 8388608 ie | PrfPP_Pos_Torque_3 = 40.00 % |
| PrfPP_Pos_PosChgTrq_4 = 10485760 ie | PrfPP_Pos_Torque_4 = 50.00 % |
| PrfPP_Pos_PosChgTrq_5 = 12582912 ie | PrfPP_Pos_Torque_5 = 60.00 % |
| PrfPP_Pos_PosChgTrq_6 = 14680064 ie | PrfPP_Pos_Torque_6 = 70.00 % |
| PrfPP_Pos_PosChgTrq_7 = 16777216 ie | PrfPP_Pos_Torque_7 = 24.00 % |
| PrfPP_Pos_PosChgTrq_8 = 18874368 ie | PrfPP_Pos_Torque_8 = 25.00 % |
| | PrfPP_Pos_Torque_9 = 50.00 % |

With this configurations there are three change of speed (**PrfPP_Pos_NrPrfSpd** = 3), starting from PrfPP_Pos_PosChgSpd_6 (6 = **PrfPP_Pos_IndTrgPos** =9 - **PrfPP_Pos_NrPrfSpd** = 3). The three speeds will be 6,7,8,9. There will be also nine change of positive torque limit (**PrfPP_Pos_NrPrfTrq** = 9). The nine positive torque limits will be 0,1,2,3,4,5,6,7,8,9.

**Fig. 9** and **Errore. L'origine riferimento non è stata trovata.** shows the results when the start positive profile command is given. The blue signal is the speed feed-forward (**sysSpeedPerReference**), the red signal is the positive torque limit (**sysMaxPositiveTorque**).
**Fig. 9** shows the steps of torque and speed, **Errore. L'origine riferimento non è stata trovata.** shows the position points for change speed and torque limit.

In this example accelerations have the same value and torque limit is not ramp.



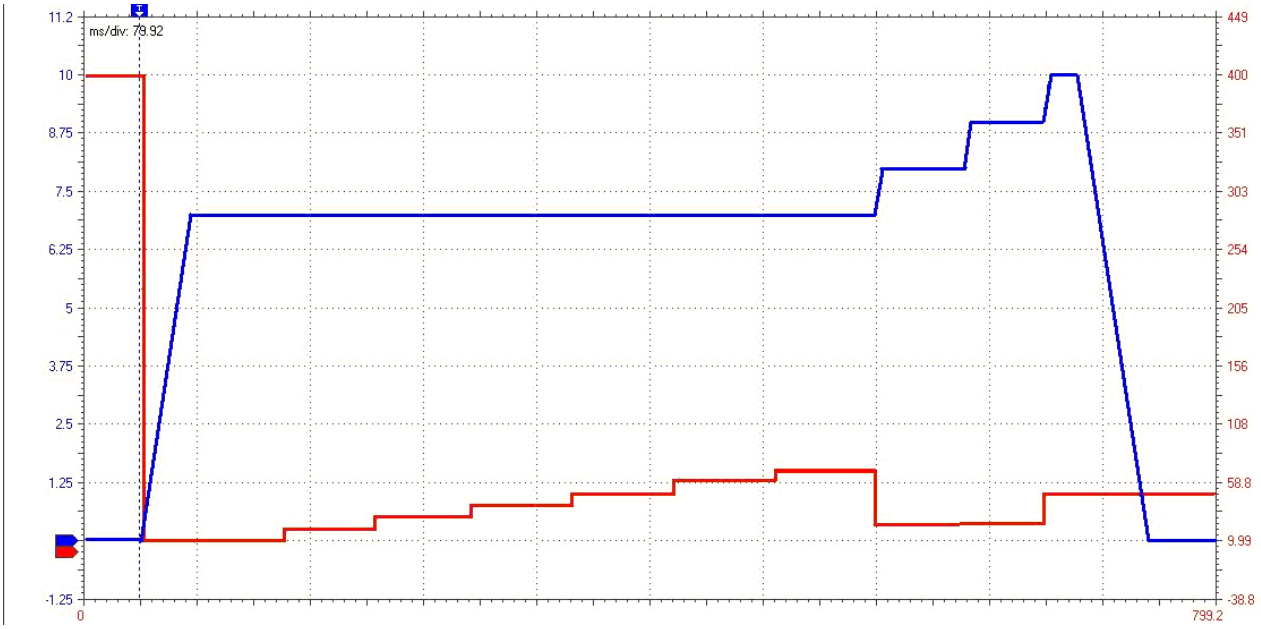



**Fig. 9-Torque limit and speed reference**

Example 2: **Multi-profile Positive**.

Parameters:

**pPOS_FRAC** = 16 bit (1 turn = 65536 ie),
**PrfPP_Pos_NrPrfSpd** = 2,
**PrfPP_Pos_IndTrgPos** =2,
**PrfPP_Pos_NrPrfTrq** = 2.

**pTRQ_POS_RAMPS** = 200.0 ms

| | |
|---|---|
| PrfPP_Pos_PosChgSpd_0 = 16384 ie | PrfPP_Pos_Speed_0 = 16384 ie/s |
| PrfPP_Pos_PosChgSpd_1 = 65536 ie | PrfPP_Pos_Speed_1 = 65536 ie/s |
| PrfPP_Pos_PosChgSpd_2 = 196605 ie | PrfPP_Pos_Speed_2 = 196605 ie/s |
| ..... | |
| PrfPP_Pos_Acc_Dec_0 = 163840 ie/s$^2$ | |
| PrfPP_Pos_Acc_Dec_1 = 655360 ie/s$^2$ | |
| PrfPP_Pos_Acc_Dec_2 = 3932100 ie/s$^2$ | |

| | |
|---|---|
| PrfPP_Pos_PosChgTrq_0 = 32768 ie | PrfPP_Pos_Torque_0 = 70.0 % |
| PrfPP_Pos_PosChgTrq_1 =98304 ie | PrfPP_Pos_Torque_1 = 140.0 % |
| | PrfPP_Pos_Torque_2 = 50.0 % |

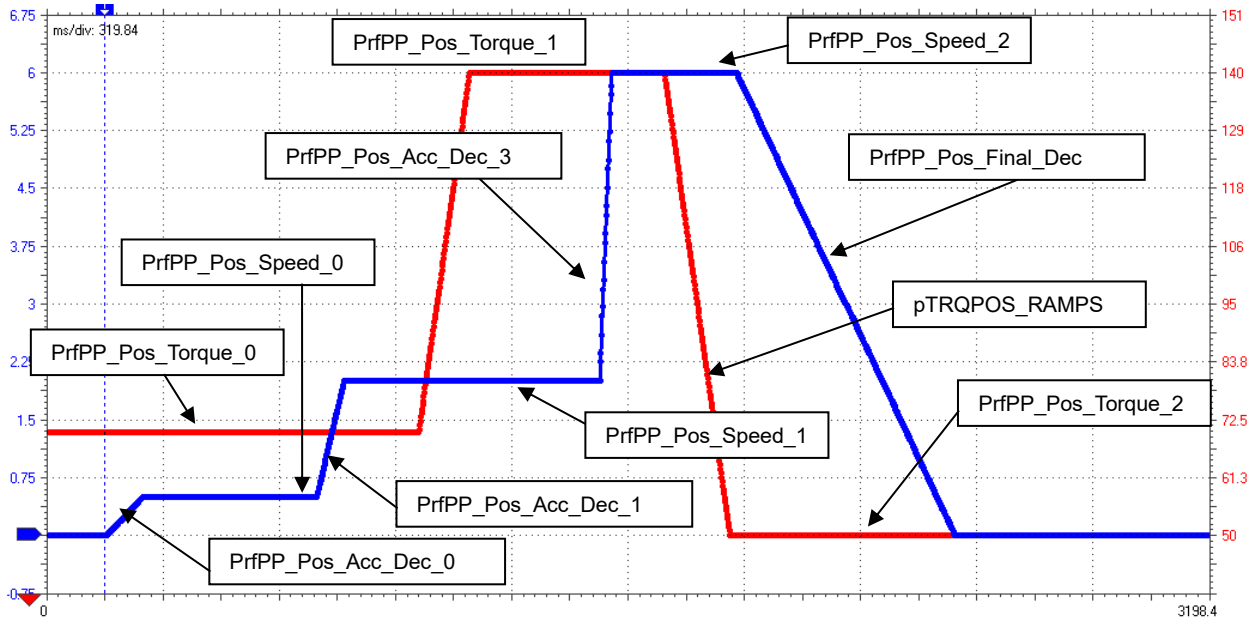
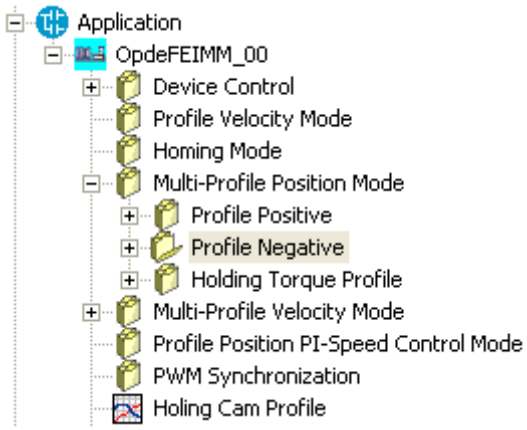



**Fig. 10-Multi-Profile positive Example**

Example 2 shows a Multi-profile positive reference where accelerations have different value, depending on the actual value of index.
The blue signal is the speed feed-forward (**sysSpeedPercReference),** the red one is the positive limit (**sysMaxPositiveTorque**).
The torque limit is ramps with parameter **pTRQPOS_RAMPS.** The value in ms is referred to 100.00% of nominal torque.

## 2.6.2 PROFILE NEGATIVE



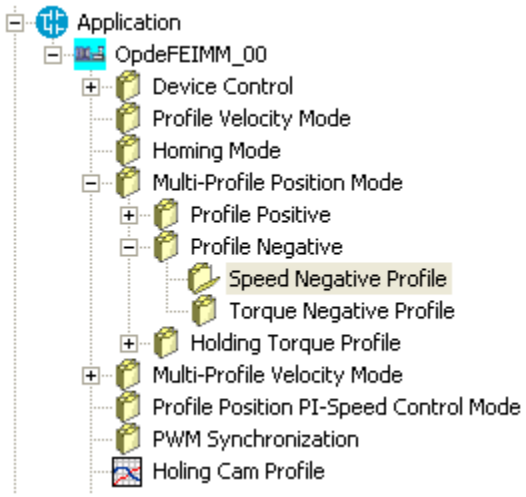

Profile Negative works in the same way of Profile Positive, the references refer to decreasing position (negative speed) and negative torque limit.
Multi Profile Position Negative can be enabled with bit 11 of control word **Fig. 1**, **Tab. 2** or with logical input **I12 – Profile negative start enable**.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN:** 0x6040 | UNSIGNED16 | R/W |
| | | | | | | | **MODBUS:** 0x2000 | | |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16<br>INTEGER16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Automation | | | | | | <br>0x2001 | | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 1-Profile Position Mode<br>2 2-Multi Profile Position Mode<br>3 3-Profile Velocity Mode<br>4 4-Profile Velocity Mode with PI control<br>6 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | | 0x6061<br>0x03C1 | INTEGER8 | R |
| PrfPP_Neg_PosTrg | E704 - 705 - Profile Negative Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3016<br>0x225C – 0x225d | INTEGER32 | R |
| PrfPP_Neg_Sel_End_Trq | E749 - Profile Negative - Type Switch mode | Range<br>0 0 - None<br>1 1 – Target reach locking<br>2 2 – Target reach holding start CAM profile<br>3 3 - Pos start holding CAM profile<br>4 4 – Pos and trq start holding CAM profile<br>5 5 – Pos and AI start holding CAM profile<br>6 6- Pos and DI start holding cam profile | | | | 1 | 0x301C sub 0x04<br>0x2289 | INTEGER8 | R/W |
| PrfPP_Neg_EndSpdRef | E706 - 707 - Profile Negative End Speed Open Loop | 0 | 2147483647 | 0 | ie/s | 1 | 0x3017<br>0x225E – 0x225F | INTEGER32 | R/W |
| PrfPP_Neg_SelType_HoldCam | E750 - Profile Neg. Holding Cam Profile Interpolation Type | Range<br>0 0 - Linear<br>1 1 – S - Ramps<br>2 2 – Cubic Spline<br>3 3 - Bezier | | 0 | | | 0x301C sub 0x05<br>0x228A | INTEGER8 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | 1 | 0x200F sub 0x48<br>0x03C8 – 0x3C9 | INTEGER32 | R |
| PrfPP_Neg_PosLimit | E676 – 677 - PrfPP_Neg_PosLimit | -2147483648 | 2147483647 | 0 | ie | | 0x3013 sub 0x09<br>0x2240 – 0x2241 | INTEGER32 | R/W |
| MSX_SPEED_NEG | E202-203 – Maximum negative speed | | | | ie/s | | 0x3100 sub 0x0d<br>0x2066 – 0x2067 | INTEGER32 | |

**Tab. 13- Multi-profile Negative parameters and Objects**

### 2.6.2.0 Speed Negative Profile



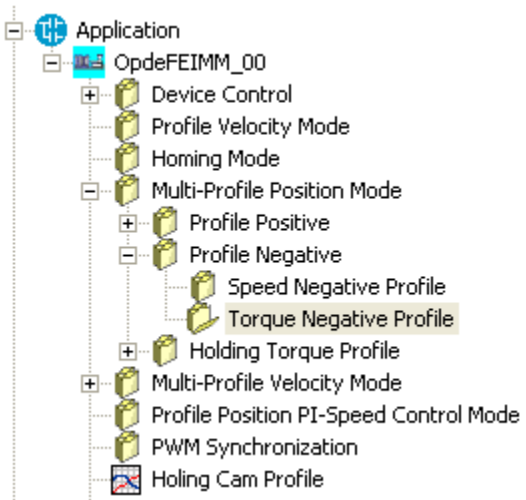

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_Pos ChgSpd_0 | E612 - 613 - 0 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3010 sub 0x00<br>**MODBUS**: 0x2200 – 0x2201 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_1 | E614 - 615 - 1 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x01<br>0x2202 – 0x2203 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_2 | E616 - 617 - 2 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x02<br>0x2204 – 0x2205 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_3 | E618 - 619 - 3 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x03<br>0x2206 – 0x2207 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_4 | E620 - 621 - 4 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x04<br>0x2208 – 0x2209 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_5 | E622 - 623 - 5 - Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x05<br>0x220A – 0x220B | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_6 | E624 - 625 - 6 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x06<br>0x220C – 0x220D | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_7 | E626 - 627 - 7 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x07<br>0x220E – 0x220F | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_8 | E628 - 629 - 8 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x08<br>0x2210 – 0x2211 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos | E630 - 631 - 9 - Negative | - | 2147483 | 0 | ie | 1 | 0x3010 sub | INTEGER | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| ChgSpd_9 | Profile Position Targhet/Change Speed | 2147483648 | 647 | | | | 0x09<br>0x2212 – 0x2213 | 32 | |
| PrfPP_Neg_Speed_0 | E634 - 635 - 0 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x00<br>0x2216 – 0x2217 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_1 | E636 - 637 - 1 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x01<br>0x2218 – 0x2219 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_2 | E638 - 639 - 2 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x02<br>0x221A – 0x221B | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_3 | E640 - 641 - 3 – Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x03<br>0x221C – 0x221D | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_4 | E642 - 643 - 4 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x04<br>0x221E – 0x221F | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_5 | E644 - 645 - 5 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x05<br>0x2220 – 0x2221 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_6 | E646 - 647 - 6 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x06<br>0x2222 – 0x2223 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_7 | E648 - 649 - 7 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x07<br>0x2224 – 0x2225 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_8 | E650 - 651 - 8 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x08<br>0x2226 – 0x2227 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_9 | E652 - 653 - 9 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x09<br>0x2228 – 0x2229 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_0 | E510 – 511 – Negative Profile Acc Dec 0 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x00<br>0x229a-0x229b | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_1 | E512 – 513 – Negative Profile Acc Dec 1 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x01<br>0x229c – 0x229d | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_2 | E514 – 515 – Negative Profile Acc Dec 2 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x02<br>0x229e – 0x229f | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_3 | E516 – 517 – Negative Profile Acc Dec 3 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x03<br>0x22a0 – 0x22a1 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_4 | E518 – 519 – Negative Profile Acc Dec 4 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x04<br>0x22a2 – 0x22a3 | INTEGER 32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_Acc_Dec_5 | E520 – 521 – Negative Profile Acc Dec 5 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x05<br>0x22a4 – 0x22a5 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_6 | E522 – 523 – Negative Profile Acc Dec 6 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x06<br>0x22a6 – 0x22a7 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_7 | E524 – 525 – Negative Profile Acc Dec 7 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x07<br>0x22a8 – 0x22a9 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_8 | E526 – 527 – Negative Profile Acc Dec 8 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x08<br>0x22aa-0x22ab | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_9 | E528 – 529 – Negative Profile Acc Dec 9 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x09<br>0x22ac – 0x22ad | INTEGER 32 | R/W |
| PrfPP_Neg_Final_Dec | E530 – 531 – Negative Profile Final Deceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x0a<br>0x22ae – 0x22af | INTEGER 32 | R/W |
| PrfPP_Neg_NrPrfSpd | E656 - Negative Profile Nr. Change Speed | 0 | 8 | 0 | | 1 | 0x301C sub 0x01<br>0x222C | INTEGER 8 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |
| PrfPP_Neg_IndTrgPos | E657 - Index of Negative Profile Position Target | 0 | 9 | 9 | | 1 | 0x301C sub 0x00<br>0x222D | INTEGER 8 | R/W |

**Tab. 14- Multi-profile Negative Speed parameters and Objects**

### 2.6.2.1 Torque negative profile



| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_PosChgTrq_0 | E658 - 659 - 0 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3013 sub 0x00<br>**MODBUS**: 0x222E – 0x222F | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_1 | E660 - 661 - 1 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x01<br>0x2230 – 0x2231 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_2 | E662 - 663 - 2 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x02<br>0x2232 – 0x2233 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_3 | E664 - 665 - 3 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x03<br>0x2234 – 0x2235 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_4 | E666 - 667 - 4 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x04<br>0x2236 – 0x2237 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_5 | E668 - 669 - 5 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x05<br>0x2238 – 0x2239 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_6 | E670 - 671 - 6 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x06<br>0x223A – 0x223B | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_7 | E672 - 673 - 7 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x07<br>0x223C – 0x223D | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_8 | E674 - 675 - 8 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x08<br>0x223E – 0x223F | INTEGER 32 | R/W |
| PrfPP_Neg_Torque_0 | E681 - 0 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x00<br>0x2245 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_1 | E682 - 1 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x01<br>0x2246 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_2 | E683 - 2 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x02<br>0x2247 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_3 | E684 - 3 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x03<br>0x2248 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_4 | E685 - 4 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x04<br>0x2249 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_5 | E686 - 5 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x05<br>0x224A | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_6 | E687 - 6 – Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x06<br>0x224B | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torq | E688 - 7 - Profile Negative | 0.00 | 400.00 | 0.00 | % | 100 | 0x3014 | UNSIGNED | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| ue_7 | Limit Torque | | | | MOT_T_NOM | | sub 0x07<br>0x224C | 16 | |
| PrfPP_Neg_Torque_8 | E689 - 8 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x08<br>0x224D | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_9 | E690- 9 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x09<br>0x224E | UNSIGNED 16 | R/W |
| PrfPP_Neg_NrPrfTrq | E703 - Negative Profile Nr. Change Limit Torque | 0 | 8 | 0 | | 1 | 0x301C sub 0x02<br>0x225B | INTEGER 8 | R/W |

**Tab. 15- Torque Negative Profile parameters and Objects**

Example: **Multi-profile Negative**.

Parameters:

**pPOS_FRAC** = 16 bit (1 turn = 65536 ie),
**PrfPP_Neg_NrPrfSpd** = 2,
**PrfPP_Neg_IndTrgPos** =9,
**PrfPP_Neg_NrPrfTrq** = 2.
**pTRQ_POS_RAMPS** = 20.0 ms

| | |
|---|---|
| PrfPP_Neg_PosChgSpd_7 = 638966 ie | PrfPP_Neg_Speed_7 = 589815 ie/s |
| PrfPP_Neg_PosChgSpd_8 = 393210 ie | PrfPP_Neg_Speed_8 = 983020 ie/s |
| PrfPP_Neg_PosChgSpd_9 (TARGET) = -196605 ie | PrfPP_Neg_Speed_9 = 589810 ie/s |
| ..... | ..... |
| PrfPP_Neg_Acc_Dec_7 = 3932100 ie/s$^2$ | |
| PrfPP_Neg_Acc_Dec_8 = 2949075 ie/s$^2$ | |
| PrfPP_Neg_Acc_Dec_8 = 1966050 ie/s$^2$ | |
| PrfPP_Neg_Final_Dec = 9830250 ie/s$^2$ | |

| | |
|---|---|
| PrfPP_Neg_PosChgTrq_7 = 2097152 ie | PrfPP_Neg_Torque_7 = 141.75 % |
| PrfPP_Neg_PosChgTrq_8 = 4194304 ie | PrfPP_Neg_Torque_8 = 96.43 % |
| PrfPP_Neg_PosChgTrq_9 = 6291456 ie | PrfPP_Neg_Torque_9 = 48.21 % |

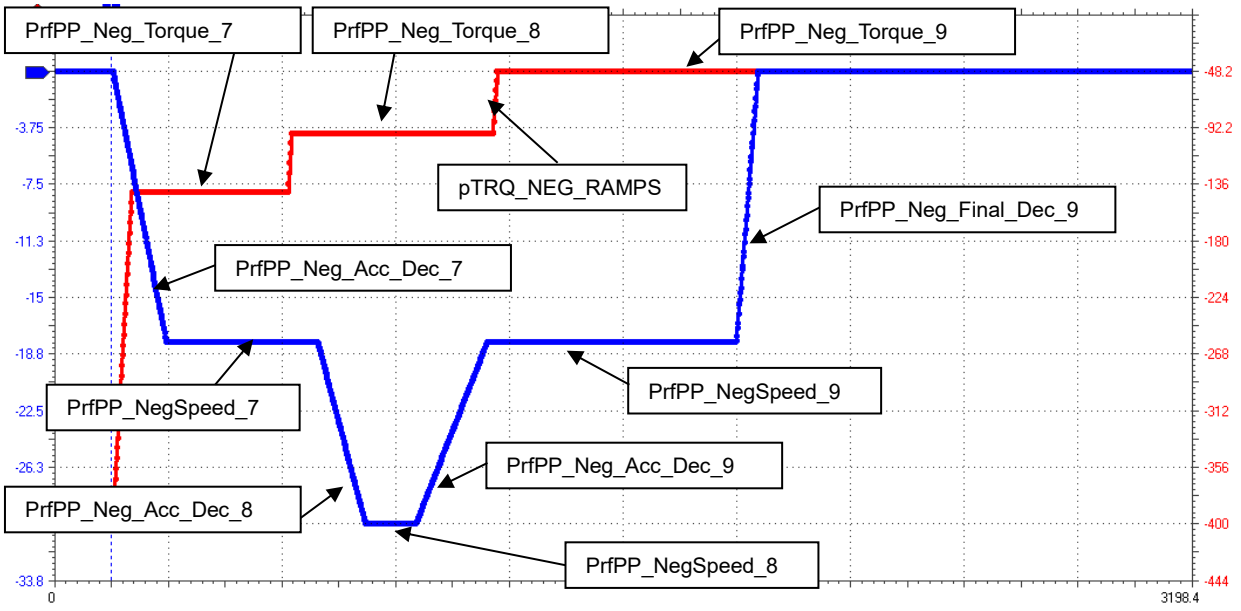



**Fig. 11- Multi-profile Negative Example**

### 2.6.2.2 Software limits (Safe stop zone )

In Multi-Profile position zone, the actual position is checked in order to don't exceed the safe stop zone. Parameters **E40-41 – pSWLIMITMIN** and **E42-43 pSWLIMITMAX** define the safe stop zone. If the negative profile is enabled and actual position is less than **pSWLIMITMIN** or if profile positive is enabled and actual position is greater than **pSWLIMITMAX** a deceleration ramp of **E08-09 – pQSEDEC** is enabled and the motor is stopped at zero speed.

If these limits are applied in Injection axis, the system can Interrupt the Holding Profile (if enabled) and apply directly the quick stop ramp.

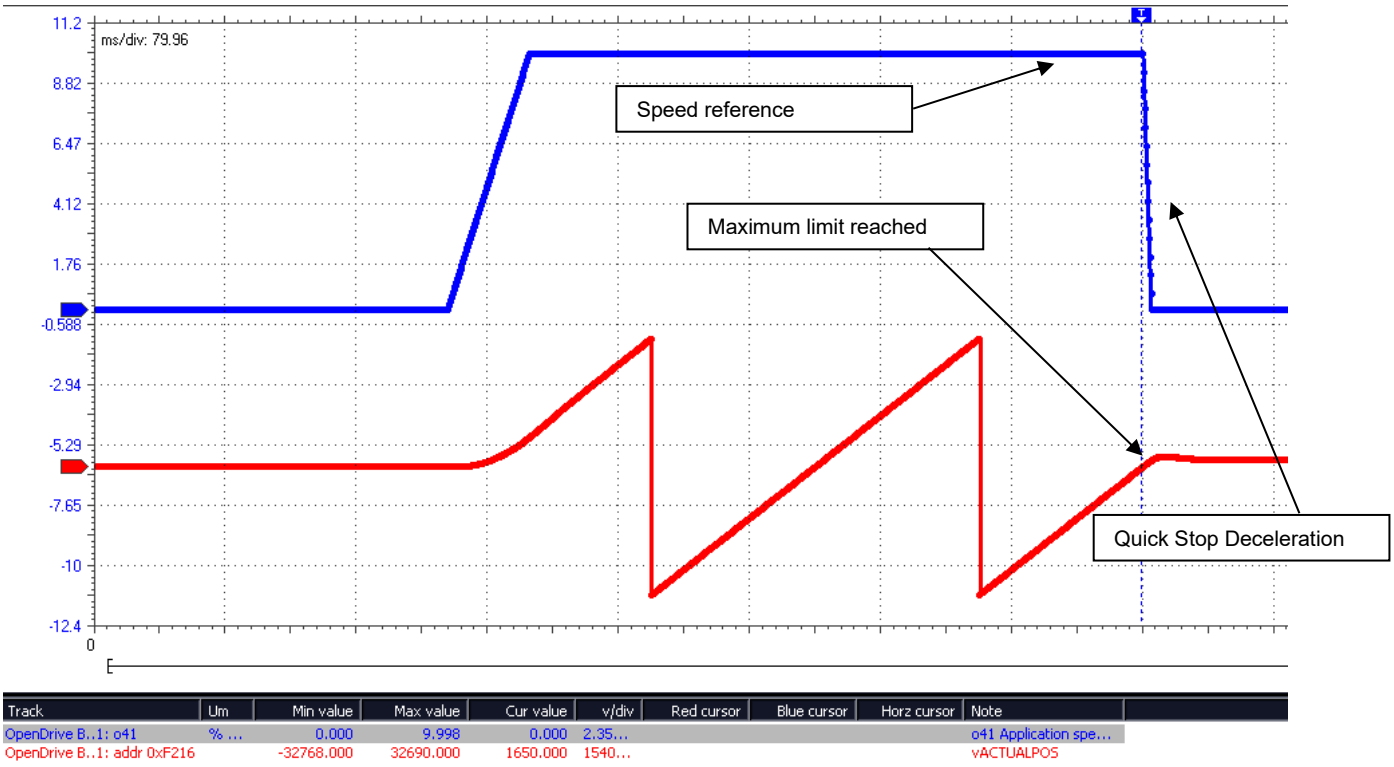
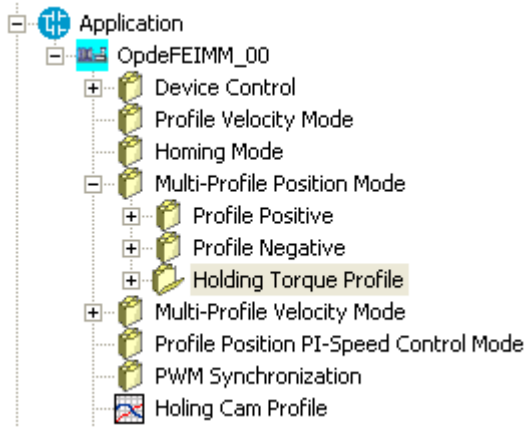


**Fig. 12- Software limits**

### 2.6.3 HOLDING TORQUE PROFILE




Holding Torque Profile is enabled at the end or during the Multi-Profile Position Negative, which control the Injection axes.
User can chose in the HMI up to ten points, start point, interpolation type and much more.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_StartTrqCam | E716 - Profile Negative Initial Torque Holding Cam Profile | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | **CAN**: 0x3018 sub 0x00<br>**MODBUS**: 0x2268 | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_0 | E717 - 0 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x01<br>0x2269 | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_1 | E718 - 1 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x02<br>0x226A | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_2 | E719 - 2 – Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x03<br>0x226B | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_3 | E720 - 3 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x04<br>0x226C | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_4 | E721 - 4 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x05<br>0x226D | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_5 | E722 - 5 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x06<br>0x226E | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_6 | E723 - 6 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x07<br>0x226F | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_7 | E724 - 7 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x08<br>0x2270 | UNSIGNED 16 | R/W |
| PrfPP_EndTrqRef_8 | E725 - 8 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x09<br>0x2271 | UNSIGNED 16 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_EndTrqRef_9 | E726 - 9 - Profile Negative End Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3018 sub 0x0A<br>0x2272 | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_0 | E736 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x00<br>0x227C | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_1 | E737 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x01<br>0x227D | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_2 | E738 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x02<br>0x227E | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_3 | E739 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x03<br>0x227F | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_4 | E740 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x04<br>0x2280 | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_5 | E741 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x05<br>0x2281 | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_6 | E742 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x06<br>0x2282 | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_7 | E743 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x07<br>0x2283 | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_8 | E744 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x08<br>0x2284 | UNSIGNED 16 | R/W |
| PrfPP_TimeEndTrq_9 | E745 - Profile Negative -Set Time of End Limit Torque 0 | 0 | 65535 | 0 | ms | 1 | 0x3019 sub 0x09<br>0x2285 | UNSIGNED 16 | R/W |
| PrfPP_NrPrfEndTrq | E748 - Nr of Profile Negative Limit Torque | 0 | 10 | 0 | | 1 | 0x301C sub 0x03<br>0x2288 | INTEGER 8 | R/W |
| PrfPP_SelType_HoldCam | E750 – Profile Holding Cam Profile Interpolation Type | Range<br>0 0-Linear<br>1 1-S-Ramps<br>2 2-Cubic Spline<br>3 3-Bezier | | 0 | | 1 | 0x301C sub 0x05<br>0x228A | INTEGER 8 | R/W |
| PrfPP_SRamps_HoldCamTime | E751 - Profile S-Ramps Time Holding Cam Profile | 0 | 30000 | 0 | ms | 1 | 0x3019 sub 0x0A<br>0x228B | UNSIGNED 16 | R/W |
| PrfPP_Acc_HoldCam | E788-789 – Profile Holding Cam Acceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | | 0x301a sub 0x0b<br>0x22b1 – 0x22b2 | UNSIGNED32 | R/W |
| PrfPP_Dec_HoldCam | E790-791 – Profile Holding Cam Deceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | | 0x301a sub 0x0c<br>0x22b3 – 0x22b4 | UNSIGNED 32 | R/W |
| PrfPP_TrqLim_StartHoldCam | E691 - Profile Negative Torque Limit Start Holding Cam Profile | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x0a<br>0x224f | UNSIGNED 16 | R/W |
| PrfPP_Neg_Sel_End_Trq | E749 – Profile Negative – Type switch mode | Range<br>0 0 - None<br>1 1 – Target Reach Locking<br>2 2 – Target Reach Start Holding Cam | | 0 | | 1 | 0x301C sub 0x04 | UNSIGNED 8 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | Profile | | | | | | | |
| | | 3 | 3 – Pos start Holding Cam Profile | | | | | | |
| | | 4 | 4 –Pos and trq start Holding Cam Profile | | | | 0x2289 | | |
| | | 5 | 5 – Pos and AI start Holding Cam Profile | | | | | | |
| | | 6 | 6 – Pos and DI start Holding Cam Profiel | | | | | | |
| | | 7 | 7 – Pos and time start Holding Cam Profile | | | | | | |
| PrfPP_Neg_Trq_Lim_Start_HoldCam | E691 – Profile Negative Torque Limit Start Holding Cam Profile | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 40.96 | 0x3014 sub 0x0a<br>0x224f | INTEGER 16 | R/W |
| PrfPP_SelAI_StartHoldCam | E752 - Profile Neg. AI Selection Start Hoding Cam Profile | Range | | 0 | | 1 | 0x301C sub 0x06<br>0x228C | INTEGER 8 | R/W |
| | | 0 | 0 – Analog input 1 | | | | | | |
| | | 1 | 1 – Analog input 2 | | | | | | |
| | | 2 | 2 – Analog input 3 | | | | | | |
| | | 3 | 3 – Analog input 4 | | | | | | |
| PrfPP_Time_StartHoldCam | E753 - PrfPP_Neg_Time_StartHoldCam | 0 | 30000 | 0 | ms | 1 | 0x3019 sub 0x0B<br>0x228D | UNSIGNED 16 | R/W |
| PrfPP_AILim_StartHoldCam | E754 - Profile Negative AI Limit Start Holding Cam Profile | 0.00 | 400.00 | 0.00 | % | 100 | 0x3018 sub 0x0B<br>0x228E | UNSIGNED 16 | R/W |
| PrfPPNeg_PosLimit | E676 – 677 – Profile Negative Position Start Cam Profile | -2147483648 | 2147483647 | 0 | ie | | | | |
| pSWLIMITMIN | E40 – 41 – Min Position Limit | -2147483647 | 2147483648 | 0 | ie | 1 | 0x3102 sub 0x20<br>0x0154 – 0x0155 | INTEGER 32 | R/W |
| pSWLIMITMAX | E42 – 43 – Max Position Limit | -2147483647 | 2147483648 | 0 | ie | 1 | 0x3102 sub 0x22<br>0x0156 – 0x0157 | INTEGER 32 | R/W |
| MAX_POS_HOLD_CAM | E208 – 209 – Maximum position in Holding Cam Profile | | | | | 1 | 0x3100 sub 0x04<br>0x2072 – 0x2073 | INTEGER 32 | R |
| MIN_POS_HOLD_CAM | E210 – 211 – Minimum position in Holding Cam Profile | | | | | 1 | 0x3100 sub 0x05<br>0x2074 – 0x2075 | INTEGER 32 | R |

**Tab. 16- Holding Negative Profile parameters and Objects**

Example 2: Holding End Cam profile.

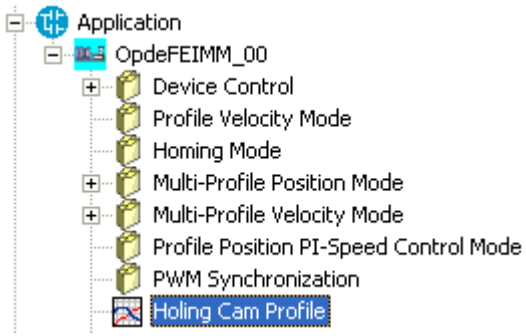
Suppose to enable the End Holding Cam profile at the end of Multi-profile position.

PrfPP_Pos_NrPrfEndTrq =11,
**Tab. 17** shows the End Holding Positive Cam Profile for this example.

| | |
|---|---|
| PrfPP_Pos_StartTrqCam = 40.00% | |
| PrfPP_Pos_EndTrqRef_0 = 10.00% | PrfPP_Pos_TimeEndTrq_0 = 80 ms |
| PrfPP_Pos_EndTrqRef_1 = 10.00% | PrfPP_Pos_TimeEndTrq_1 = 400 ms |
| PrfPP_Pos_EndTrqRef_2 = 77.14% | PrfPP_Pos_TimeEndTrq_2 = 80 ms |
| PrfPP_Pos_EndTrqRef_3 = 77.14% | PrfPP_Pos_TimeEndTrq_3 = 400 ms |
| PrfPP_Pos_EndTrqRef_4 = 38.57% | PrfPP_Pos_TimeEndTrq_4 = 80 ms |
| PrfPP_Pos_EndTrqRef_5 = 38.57% | PrfPP_Pos_TimeEndTrq_5 = 400 ms |
| PrfPP_Pos_EndTrqRef_6 = 77.14% | PrfPP_Pos_TimeEndTrq_6 = 80 ms |
| PrfPP_Pos_EndTrqRef_7 = 77.14% | PrfPP_Pos_TimeEndTrq_7 = 400 ms |
| PrfPP_Pos_EndTrqRef_8 = 19.28% | PrfPP_Pos_TimeEndTrq_8 = 80 ms |
| PrfPP_Pos_EndTrqRef_9 = 19.28% | PrfPP_Pos_TimeEndTrq_9 = 100 ms |

**Tab. 17- End Holding Positive Cam Profile**

Next picture shows the result: at the end of Multi-Profile Position, the End Holding Cam-profile is enabled. The red signal is the Injection Holding Cam Profile (seen in the drive in torque reference). After the Injection cycle (if closed loop is enabled) is possible to read the feed-back signal captured from the load cell.




Graph shows directly the Holding Cam Profile set-point.

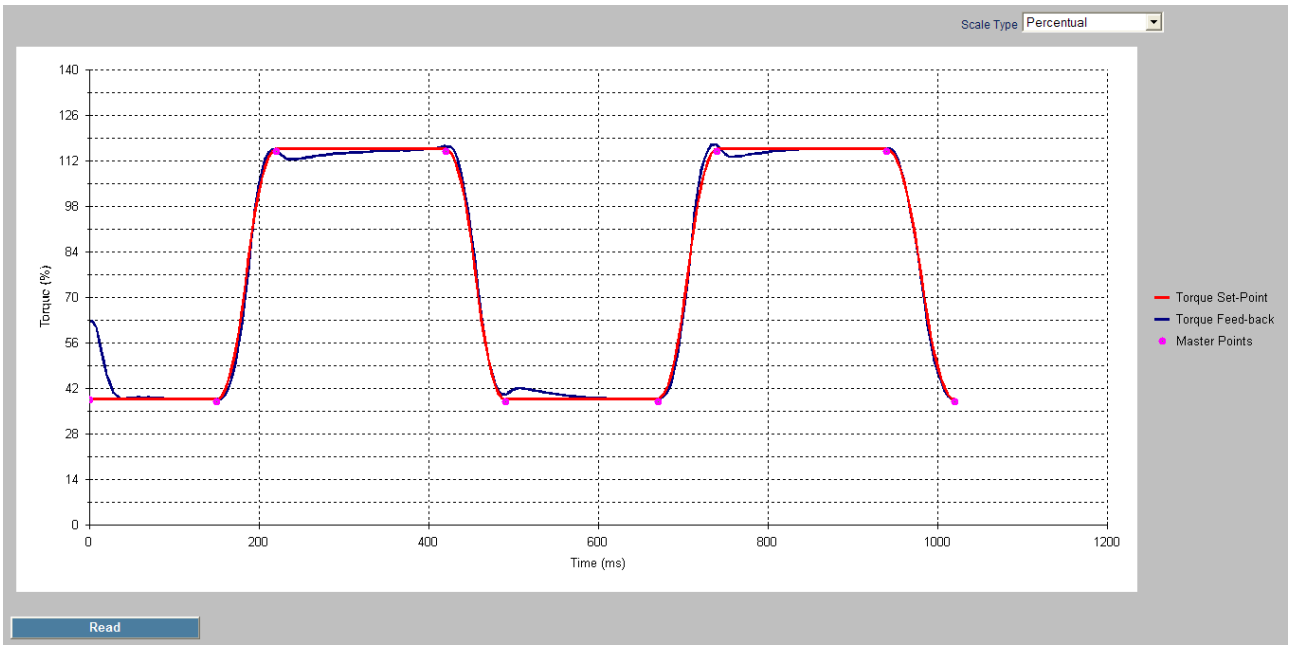


**Fig. 13- Holding End Cam profile Graph example**

If one of the points or interpolation type are changed all the Cam points are re-calculate. Is possible to refresh the graph with “Read” button.

Internal Cam point are available in with some Modbus address starting from 0x2384 (9092). There are three arrays of 257 values **X[0...256]** and **Y[0...256**] and **Y’[0...256]** where the user can read the reference points and the feed-back

| Name | Type | Modbus Address |
|---|---|---|
| X[0] | UNSIGNED 16 | 0x2384 (9092) |
| Y[0] | INTEGER 16 | 0x2385 (9093) |
| Y’[0] | INTEGER 16 | 0x2386 (9094) |
| X[1] | UNSIGNED 16 | 0x2387 (9095) |
| Y[1] | INTEGER16 | 0x2388 (9096) |
| Y’[1] | INTEGER16 | 0x2388 (9097) |
| | | |
| ..... | | |
| X[256] | UNSIGNED 16 | 0x2684 (9860) |
| Y[256] | INTEGER 16 | 0x2685 (9861) |
| Y’[256] | INTEGER 16 | 0x2686 (9862) |

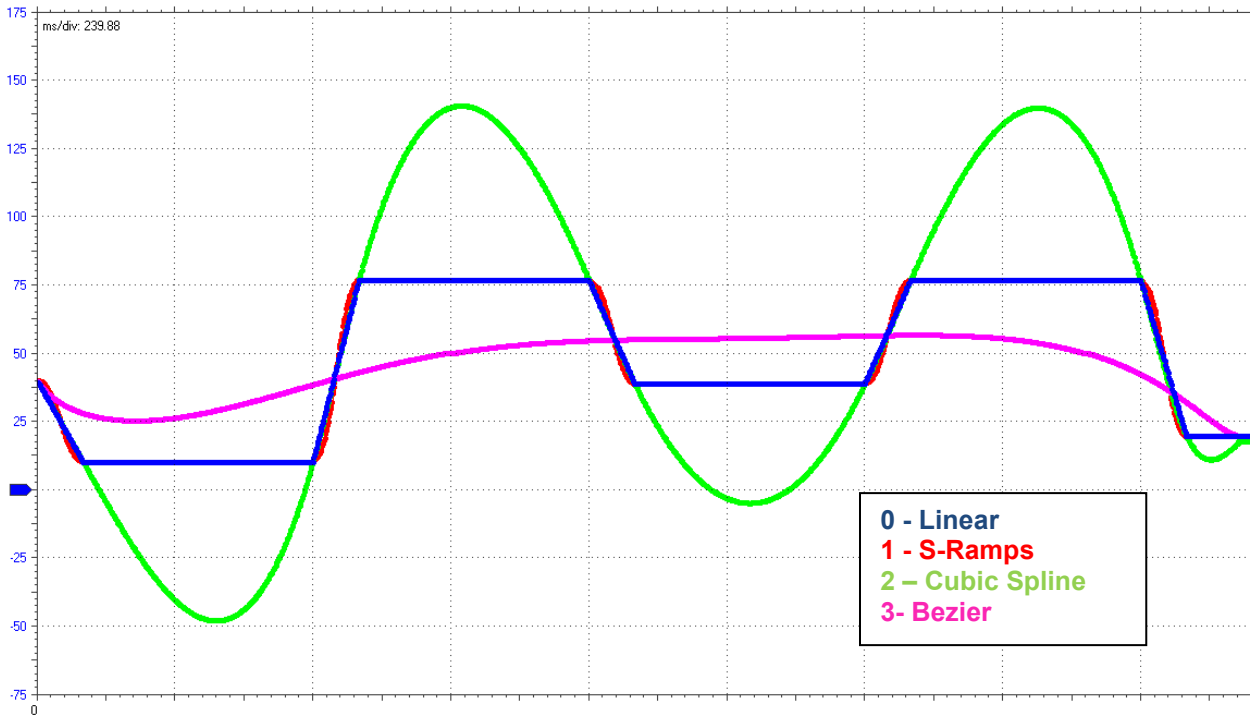



**Fig. 14- Holding End Cam profile Interpolation Type**

### 2.6.3.0 Step Line

Is possible also to enable e step linear interpolation setting the parameter **E750 – PrfPP_SelType_HoldCam** = 4 – Step Linear. In this way the points are used to create the steps for Injection Reference.
The start point is not used in this modality.

**Example of 4 step:**

| | |
|---|---|
| E716 – PrfPP_StartTrqCam = 10% (doesn't care) | / |
| E717 – PrfPP_EndTrqRef_0 = 20% | E736 – PrfPP_TimeEndTrq_0 = 100 ms |
| E718 – PrfPP_EndTrqRef_1 = 30% | E737 – PrfPP_TimeEndTrq_1 = 200 ms |
| E719 – PrfPP_EndTrqRef_2 = 40% | E738 – PrfPP_TimeEndTrq_2 = 50 ms |
| E720 – PrfPP_EndTrqRef_3 = 25% | E739 – PrfPP_TimeEndTrq_3 = 300 ms |
| ..... | |
| E748 – PrfPP_NrPrfEndTrq = 4 | |

**Tab. 18- Step Line Example**

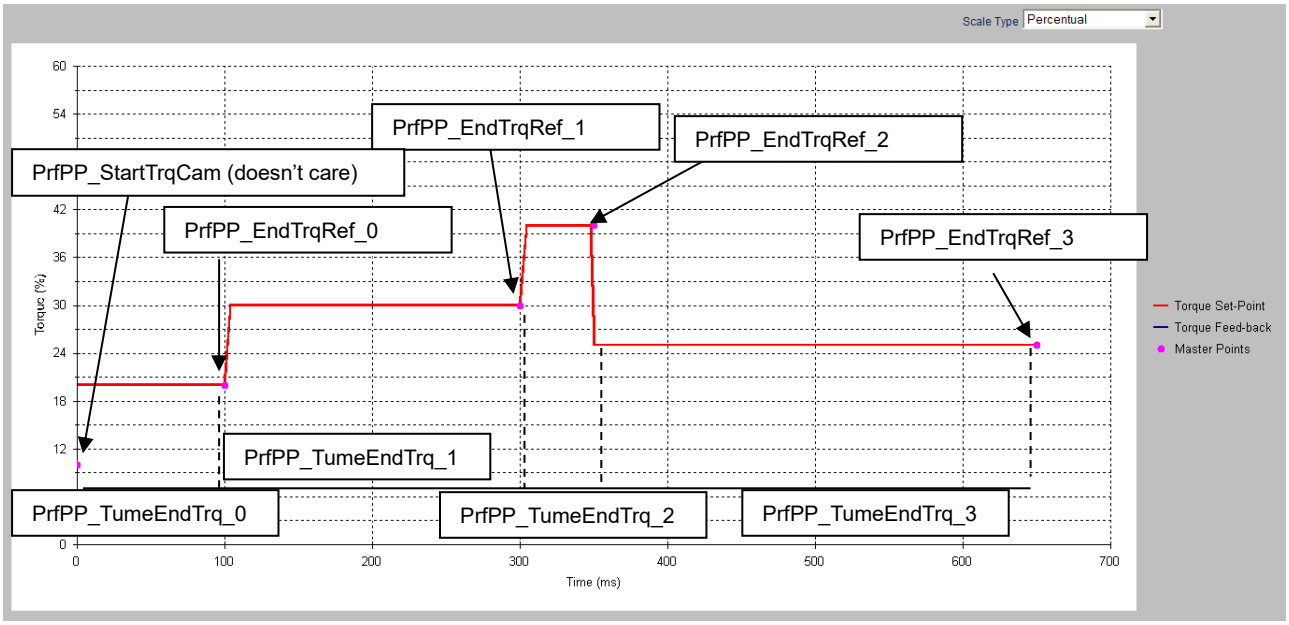



**Fig. 15- Step Line Interpolation**

### 2.6.3.1 Switch Holding Type

There are many ways to enable or not the Holding Positive Cam-profile. Parameters **PrfPP_Pos_Sel_End_Trq** show the options:

**0- None,**
Multi profile position ends without End Holding Cam profile.

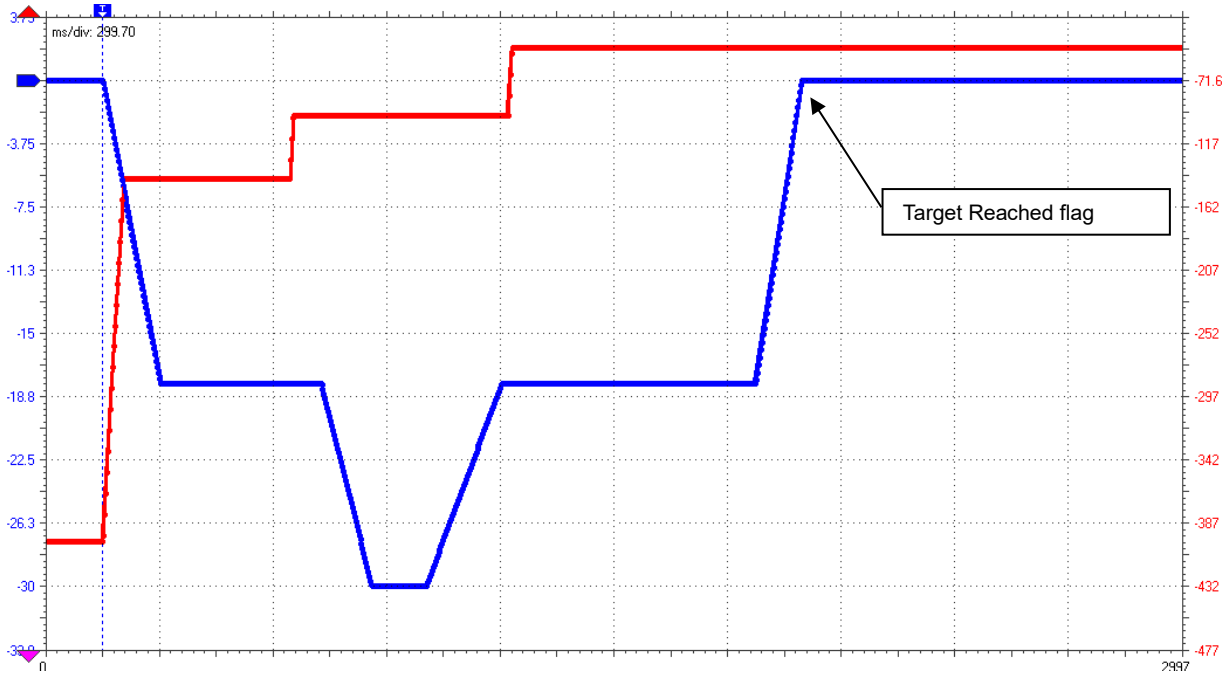



**Fig. 16- None**

### 1-Target reached locking

Multi profile position ends without End Holding Cam profile. When positioning ends (internal flag **Target reached** is enabled) a final speed reference of **PrfPP_Pos_EndSpdRef** is applied until the start positive profile command is enabled, and the positive torque limit is set to **PrfPP_Pos_StartTrqCam.**

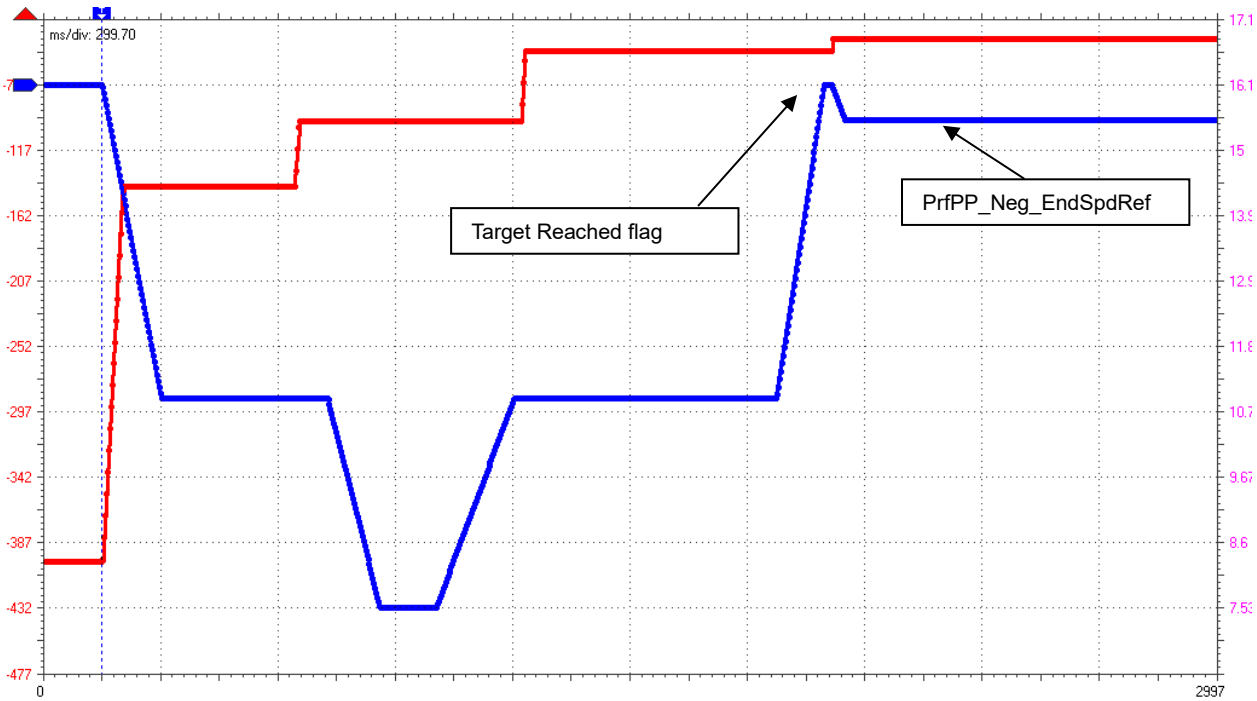


**Fig. 17- Target reach locking**

### 2-Target reached start Holding Cam Profile

When Multi-Profile position mode ends (**Target Reached** is enabled), Holding Cam Profile start. Torque positive and negative are opened and, if Closed Loop is not enabled, only a Derivative Feed-Forward is applied as speed reference.

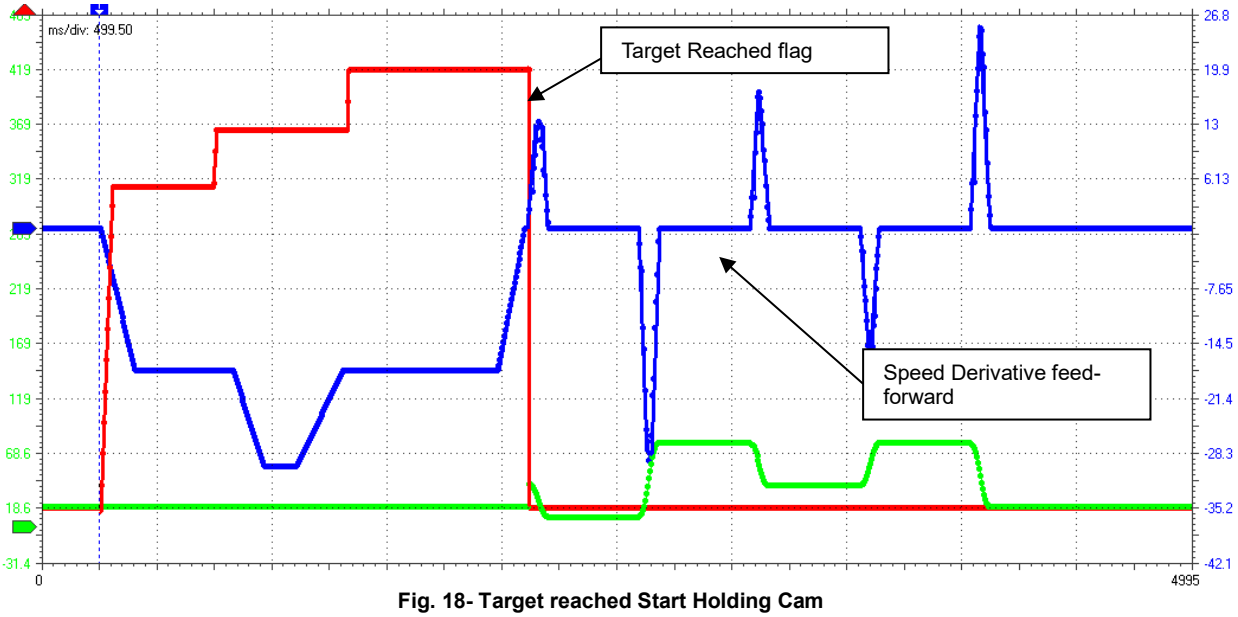



**Fig. 18- Target reached Start Holding Cam**

### 3-Position start Holding Cam Profile

When position reaches the value of **PrfPP_Neg_PosLimit** the Holding Cam Profile is automatically enabled without ending the positioning. If the multi-profile position end without reach the position **PrfPP_Neg_PosLimit,** the device does not enable the Holding Cam Profile.

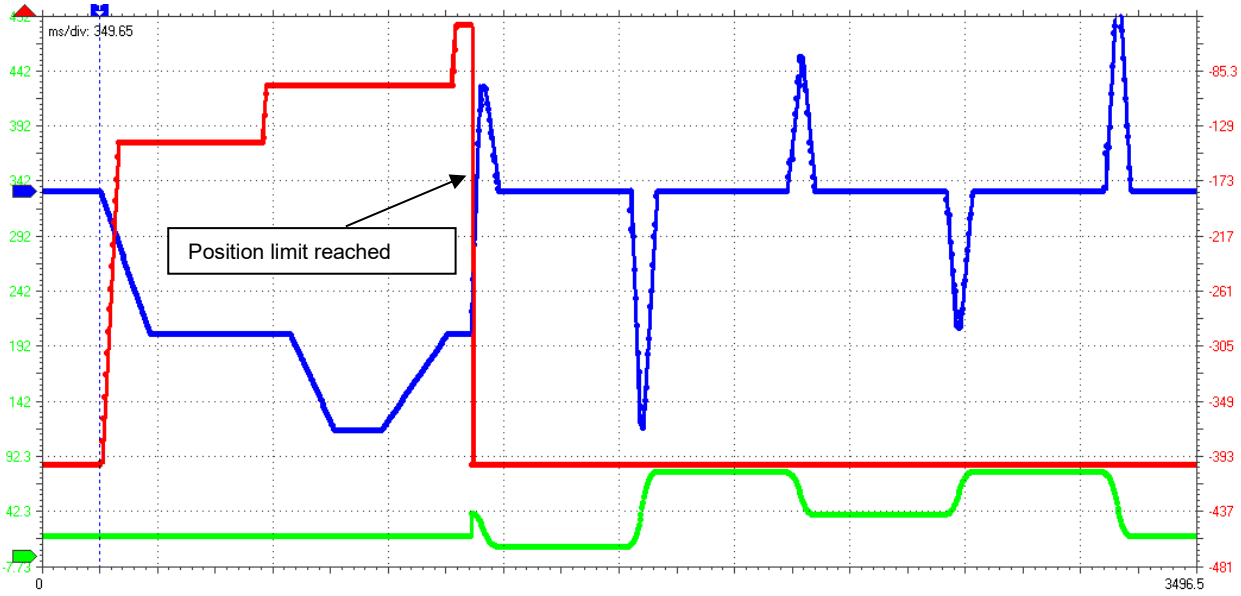



**Fig. 19- Position Limit Start holding Cam**

When Holding Cam Profile is enabled, speed reference is ramped with a parameter selectable in **PrfPP_AccHoldCam / PrfPP_DecHoldCam.** During all Injection Holding profile, speed references are ramped.

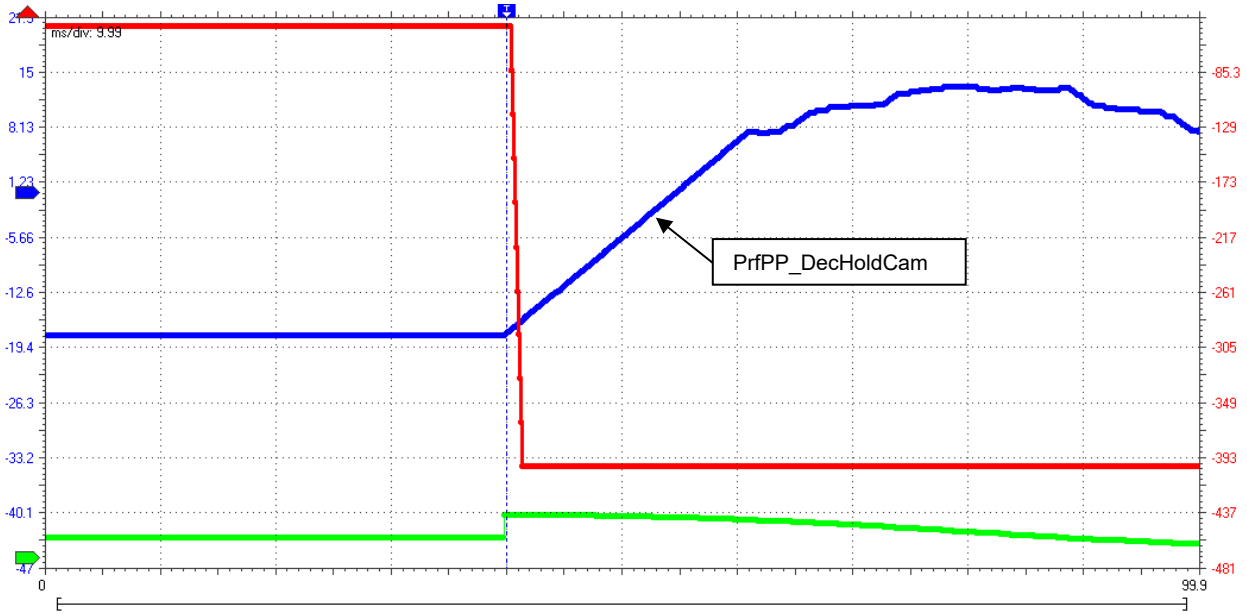



**Fig. 20- Deceleration at the start of Holding Cam profile**

**4-Position and Torque start Holding Cam Profile**

This function is very similar to the previous, the device enables the Start Holding Cam Profile when position **PrfPP_PosLimit** is reached and if the actual torque producer is greater than **PrfPP_Pos_TrqLim_StartHoldCam.**

**5- Time start Holding Cam Profile**

This function is very similar to mode 3 but the device enables the Start Holding Cam Profile when time set in **PrfPP_Time_StartHoldCam** is reached. The timer is enabled at start of Profile Negative.

**6- Digital Input 7 start Holding Cam Profile**

This function is very similar to mode 3 but the device enable the Start Holding Cam Profile when logical input 7 is enabled.

### 2.6.3.2 Manufacturer specific bits

When Holding Cam Profile is enabled**, manufacturer specific bit 0** (bit 14 of status word) goes to high level. When Holding Cam Profile ends **manufacturer specific bit 1** (bit 15 of status word) is enabled.

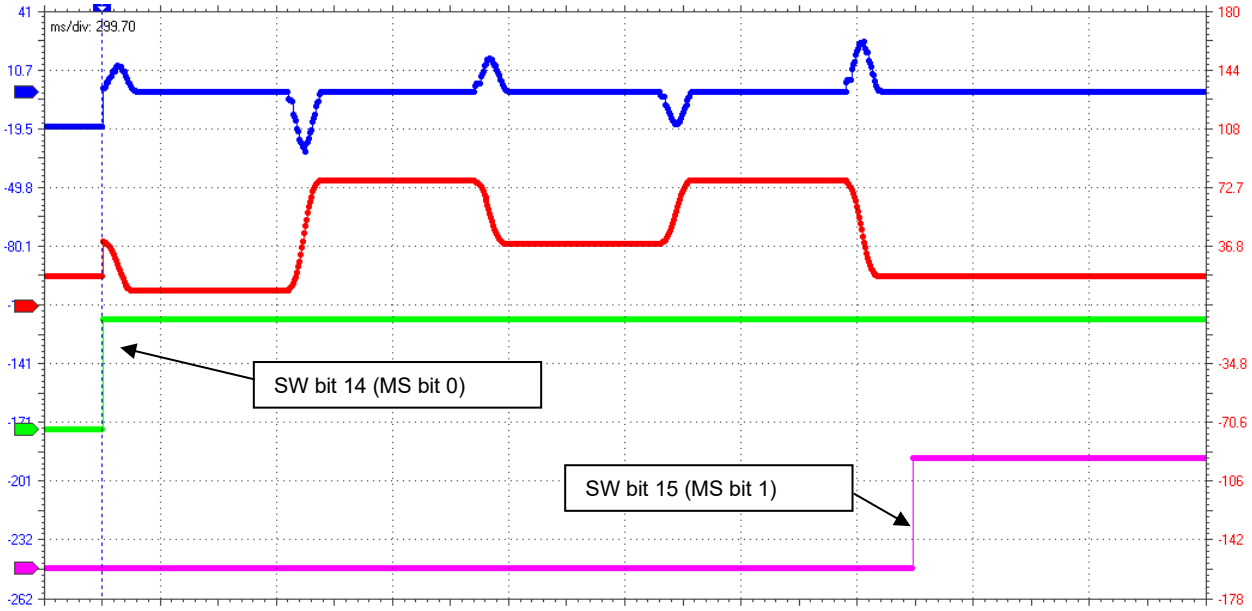
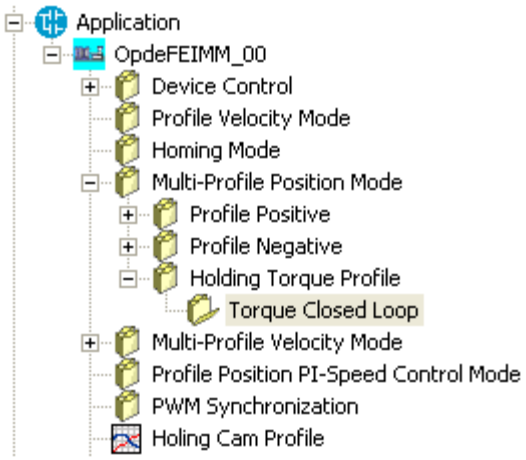



**Fig. 21- STATUS WORD bit 14 and 15**

When Holding Cam Profile is enabled, position loop is disabled but the actual position **D66-67 – ACTUALPOS** is check continuously.
If the position becomes greater than **E42 – 43 – pSWLIMITMAX** or lower than **E40-41 pSWLIMITMIN**, the speed is automatically decelerated with ramp selectable in **E08 – 09 - pQSDEC**.

If Cam Profile is aborted, user will see only **manufacturer specific bit 0** will be at high level.

### 2.6.3.3 Torque closed loop




This function allows to close the torque closed loop on the Load Cell, connected directly with the Analog Input of OPDE. During the Injection-phase of the machine the set point-pressure is applied and a particular PI controller regulate the feed-back.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| pEN_TRQ_LOOP | E65 – Enable close loop for negative holding cam profile | 0 | 1 | 0 | | | **CAN**: 0x3102 sub 0x20 (16 lsb)<br>**MODBUS:** 0x016d | INTEGER 32 | R/W |
| PrfPP_Neg_Sel AI_StartHoldCam | E752 - Profile Neg. AI Selection Start Hoding Cam Profile | Range<br>0 – 0 – Analog input 1<br>1 – 1 – Analog input 2<br>2 – 2 – Analog input 3<br>3 – 3 – Analog input 16 | | 0 | | 1 | 0x301C sub 0x06<br>0x228C | INTEGER 8 | R/W |
| PRESSURE_MAX | E755 - Maximum pressure | | | | MPa | | **MODBUS:** 0x228f | INTEGER 16 | R |
| PRESSURE_NOM | E756 - Pressure at motor Nominal Torque | | | | MPa | | 0x2290 | INTEGER 16 | R |
| PRESSURE_MAX_LCELL | E757 - Maximum full-scale Load Cell Pressure | | | | MPa | | 0x2291 | INTEGER 16 | R |
| PrfPP_AccHold Cam | E788 – 789 – Profile Holding Cam Acceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | **CAN**: 0x301a sub 0x0b<br>**MODBUS:** 0x22b0 – 0x22b1 | UNSIGNED 16 | R/W |
| PrfPP_DecHold Cam | E790 – 791 – Profile Holding Cam Deceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301a sub 0x0b<br>0x22b2 – 0x22b3 | UNSIGNED 16 | R/W |
| pTRQ_KP | E66 – KpV Torque PI proportional gain | 300.00 | -300.00 | 6.00 | | | 0x3102 sub 0x21 (16 lsb)<br>0x016e | INTEGER 32 | R/W |
| pTRQ_TI | E67 – TiV Torque PI lead time constant | 0.1 | 3000.0 | 30.0 | ms | 1 | 0x3102 sub 0x21 (16 msb)<br>0x016f | INTEGER 32 | R/W |
| pTRQ_TF | E68 – TfV Profile Torque PI (filter) constant | 0.0 | 25.0 | 0.4 | ms | | 0x3102 sub 0x22 (16 lsb)<br>0x0170 | INTEGER 32 | R/W |
| pKP_PV_PI | E71 – Scaling Kp value of feedback PI | -300.00 | 300.00 | 0.00 | % | | 0x3102 sub 0x23 (16 msb)<br>0x0173 | INTEGER 32 | R/W |
| pTD_PI | E72 – TD PI Derivative Time | 0 | 19999 | 0 | ms | | 0x3102 sub 0x24 (16 lsb)<br>0x0174 | INTEGER 32 | R/W |
| pTD_OUT_FLT | E73 – Derivative Output Filter | 0.1 | 3000.0 | 2.0 | ms | | 0x3102 sub 0x24 (16 msb)<br>0x0175 | INTEGER 32 | R/W |
| pENTRQFDW_CL_LOOP | E74 - Enable Torque FFW on closed loop | 0 | 1 | | | | 0x3102 sub 0x25 (16 lsb)<br>0x0176 | INTEGER 32 | R/W |
| pKP_TRQ_FFW | E75 – Scaling Kp value of torque FFW | 0.00 | 300.00 | 0.00 | % | | 0x3102 sub 0x25 (16 msb)<br>0x0177 | INTEGER 32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| pCLOSED_LOOP_BW | E77 – Closed Loop Bandwith | 0.1 | 100.0 | 25.0 | Hz | | 0x3102 sub 0x26 (16 msb) | INTEGER 32 | R/W |
| | | | | | | | 0x0179 | | |
| pSP_PV_TF | E78 – SP – PV junction filter time constant | 0.0 | 100.0 | 5.0 | ms | | 0x3102 sub 0x27 (16 msb) | INTEGER 32 | R/W |
| | | | | | | | 0x017a | | |
| ACT_SP_PID | D78 - Actual SP of Profile Vel. PI | | | | | | 0x200F sub 0x4E | | |
| | | | | | | | 0x03ce | | |
| ACT_PV_PID | D79 - Actual PV Proces Varieble of Profile Vel. PI | | | | | | 0x200F sub 0x4F | | |
| | | | | | | | 0x03cf | | |
| ACT_COM_P_PID | D80 – Actual P component of Profile PI | | | | % | | 0x200F sub 0x50 | INTEGER 16 | R |
| | | | | | | | 0x03d0 | | |
| ACT_COM_I_PID | D81 – Actual I component of Profile PI | | | | % | | 0x200F sub 0x51 | INTEGER 16 | R |
| | | | | | | | 0x03d1 | | |
| ACT_COM_ERR_PID | D82 – Actual Error SP-PV component of Profile PI | | | | % | | 0x200F sub 0x52 | INTEGER 16 | R |
| | | | | | | | 0x03d2 | | |
| ACT_OUT_PID | D83 – Actual Output of Profile PI | | | | % | | 0x200F sub 0x52 | INTEGER 16 | R |
| | | | | | | | 0x03d3 | | |
| START_SPEED_HOLD_CAM | E204 - 205 - Start speed in Holding Cam Profile | | | | ie/s | | 0x3100 sub 0x0e | INTEGER 16 | R |
| | | | | | | | 0x2068-0x2069 | | |
| MAX_POS_HOLD_CAM | E206 - 207 - Maximum pos in Holding Cam Profile | | | | ie | | 0x3100 sub 0x04 | INTEGER 32 | R |
| | | | | | | | 0x206a-0x206b | | |
| MIN_POS_HOLD_CAM | E208 - 209 - Minimum pos in Holding Cam Profile | | | | ie | | 0x3100 sub 0x05 | INTEGER 32 | R |
| | | | | | | | 0x206c-0x206d | | |
| START_POS_HOLD_CAM | E210 - 211 - Start position in Holding Cam Profile | | | | ie | | 0x3100 sub 0x06 | INTEGER 32 | |
| | | | | | | | 0x206e-0x206f | | |
| PV_START_HOLD_CAM | E212 - 213 - PV value in Start Holding Cam Profile | | | | % MOT_T_NOM | 100 | 0x3100 sub 0x07 | INTEGER 32 | R |
| | | | | | | | 0x2070-0x2071 | | |
| ACT_TIME_HOLDING | E218-219- Injection Holding Time | | | | ms | 1 | 0x3100 sub 0x0f | INTEGER 32 | R |
| | | | | | | | 0x2076 – 0x2077 | | |

**Tab. 19- End Holding Positive Cam Profile**

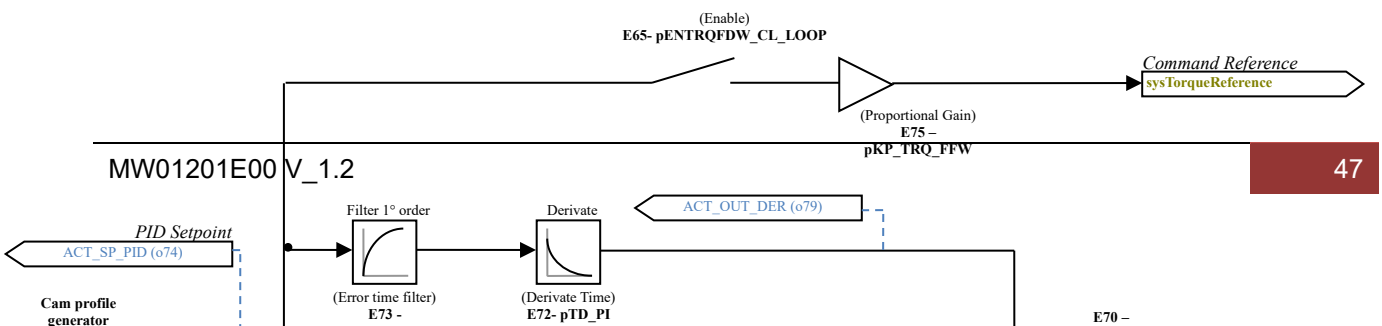


**Fig. 22- Torque Closed Loop Scheme**

Cam generator profile realizes the pressure-profile set by user Master points (time and torque).
When Holding Cam profile is enabled, a second order filter (**E78 – pSP_PV_TF**) freezes the actual PV value and realize a soft junction between SP and PV. Otherwise a big PI Output could happen which could create a step speed reference. When PV reaches the SP the filter effect is gradually disabled.
The SP is applied to PI regulator. The SP is also filtered (**E73 – pTD_IN_FLT**), and derivate (**E72 – pTD_PI**) in order to create a Speed Feed – Forward is sum to the PI Output.

When PI-controller is disabled the integral part it updated with the value of actual speed. In this case, when PI is enable, output (speed reference) starts from actual speed value and not from zero, in order to avoid speed inversions.

User can control the PI with these parameters: proportional gain **E66 – pTRQ_KP**, integral time **E67 – pTRQ_TI**, and filter **E68 – pTRQ_TF**. PI Output with derivative feed-forward can be limit with parameter **E70 – pTRQ_LMN_MAX** and **E69 – pTRQ_LMN_MIN.**

User can also enable a Torque Feed-Forward with parameter **E65 – pENTRQ_CL_LOOP**. The effect of this feed-forward can be scaled with parameter **E75 – pKP_TRQ_FFW**.

**Fig. 23** shows an example of closed loop applied on a real FEIMM during an Injection-profile with polypropylene.

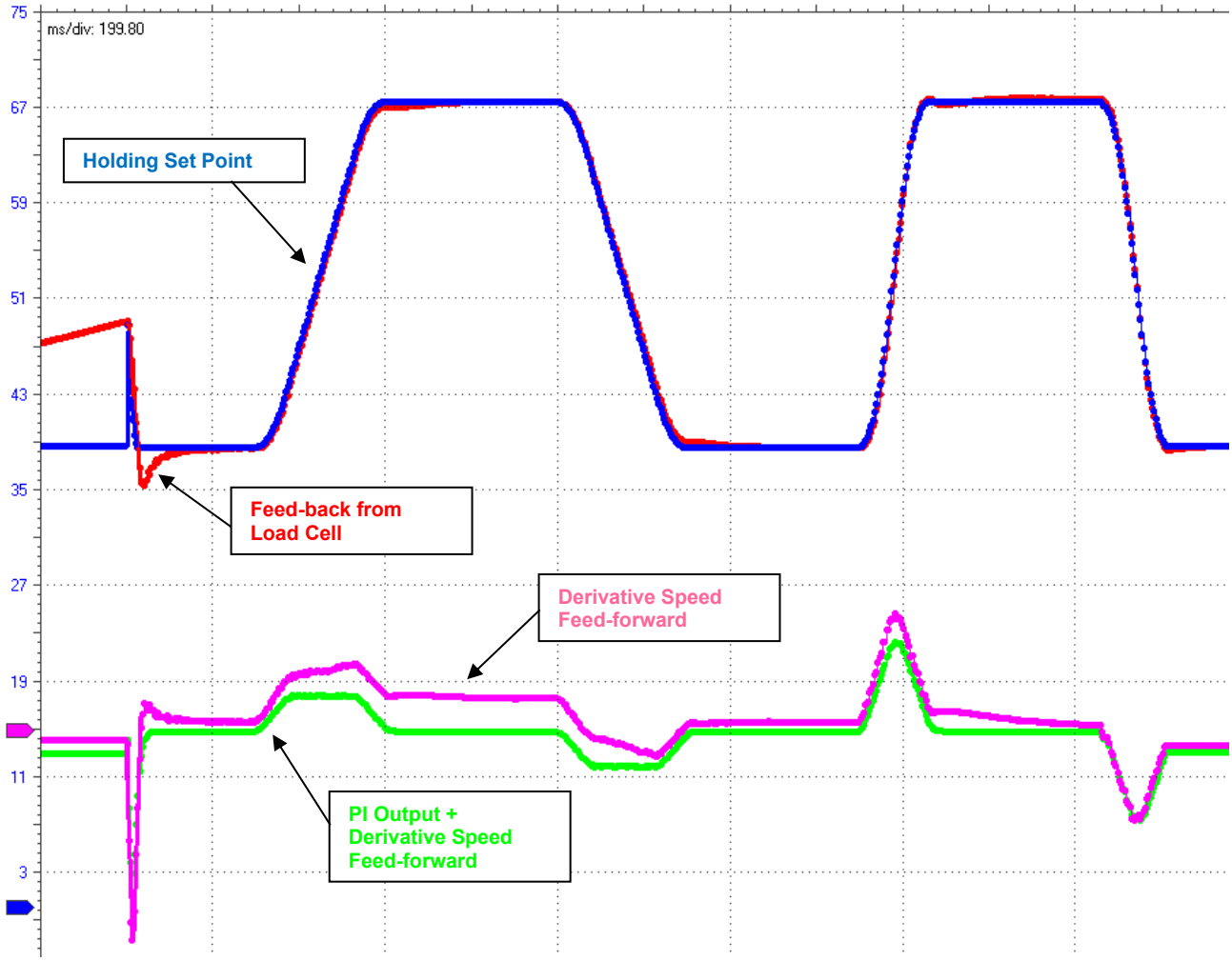



**Fig. 23- Exemple of Injection Profile with torque closed loop enabled**

If a Step – set point pressure is given, at the start of Holding Cam Profile, the SP is automatically filtered with start point equal to start PV and filter time constant (second order's filter) selectable in **E78 – pSP_PV_TF.**
**Fig. 24** shows the result.

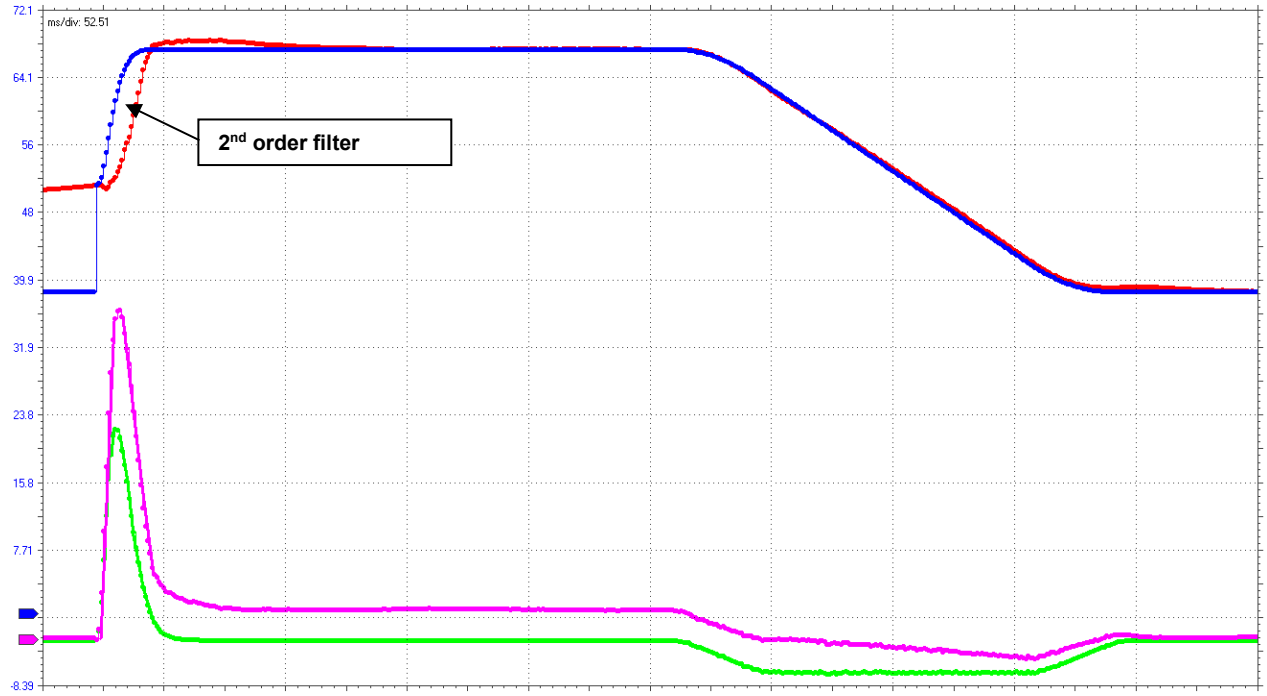



**Fig. 24- Exemple of Injection Profile with start Step pressure reference**

### 2.6.3.3.0 Scaling of pressure and torque

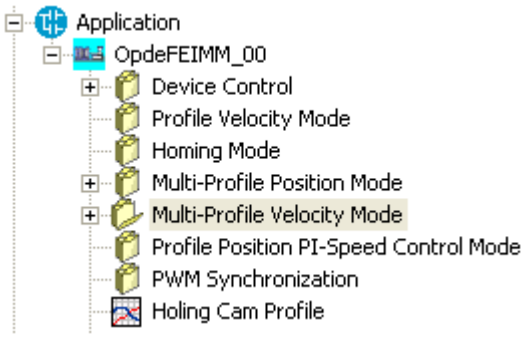
There are some parameters which represent the scaling pressure-torque for the Injection Moulding Machine size.
**E755 – PRESSURE_MAX** is the maximum pressure of the machine,
**E756 – PRESSURE_NOM** is the pressure at nominal torque of the motor,
**E757 – PRESSURE_MAX_LCELL** is the full-scale pressure of load cell (at 10V).

Example for 170 Ton Injection Multi Machine:

- **E755 – PRESSURE_MAX** = 147,2 MPa,
- **E756- PRESSURE_NOM** = 103,07 Mpa,
- **E757 – PRESSURE_MAX_LCELL** = 176,05 MPa.

The scaling of analogue input must be calculated **E71 – pKP_PV_PI = PRESSURE_MAX_LCELL / PRESSURE_NOM** = 169,77%.

## 2.7 MULTI-PROFILE VELOCITY MODE




Multi-Profile Velocity mode allows realizing a multi step-speed profile with up to 10 different speeds, the change of the speed depends on the position of the motor or the position received from the CAN2.
The user can also choose different steps of limit torque. Position Loop is not enabled, the system works only in speed mode.

The structure of Multi-Profile Velocity Mode is similar to Multi-Profile Position. There is the possibility to choose a positive profile or a negative profile.
The position to change speed, torque, speeds references, torque references, accelerations are the same of Multi-Profile Position.

In the FEIMM this operative method can control the Screw Axes during Dosing: Injection Axes after suck-back jump in Profile Position PI-Speed Control mode and send the position to screw by CAN2 communication. Screw Axes changes speed and torque depending on the position received.

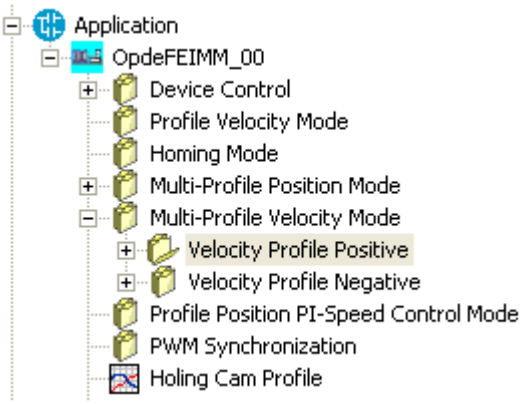
| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN:** 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 – 1-Profile Position Mode<br>2 – 2-Multi Profile Position Mode<br>3 – 3-Profile Velocity Mode<br>4 – 4-Profile Velocity Mode with PI control<br>6 – 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | 1 | 0x6061<br>0x03C1 | INTEGER8 | R |
| pQSDEC | E08 – 09 – Quick stop deceleration | 10223 | 2147483647 | 1638400 | ie/s$^2$ | 1 | 0x3102 sub 0x04<br>0x0134 – 0x0135 | INTEGER32 | R/W |
| pQSOPTC | E38 – Quick Stop Option Code | Range<br>0<br>2 – Switch On Disabled<br>6 – Stay in | | | | 1 | 0x3102 sub 0x13 (16 lsb) | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | Quick Stop | | | | | 0x0152 | | |
| | | 8 | | | | | | | |
| pTHRVEL | E18 - Velocity threshold | 100 | 65535 | 10000 | ie/s | 1 | 0x3102 sub 0x09 (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x013E | | |
| pTIMEVEL | E20 - Velocity threshold time | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0A (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0140 | | |
| pWINVEL | E22 - Velocity window | 0 | 65535 | 0 | ie/s | 1 | 0x3102 sub 0x0B (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0142 | | |
| pWTIMEVEL | E24 - Velocity window time-out | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0C (16 lsb) | NTEGER32 | R/W |
| | | | | | | | 0x0144 | | |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | 1 | 0x6064 | INTEGER 32 | R |
| | | | | | | | 0x03C2 - 0x03C3 | | |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | 1 | 0x606C | INTEGER32 | R |
| | | | | | | | 0x03C4 - 0x03C5 | | |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | 1 | 0x200F sub 0x48 | INTEGER32 | R |
| | | | | | | | 0x03C8 – 0x03C9 | | |
| pENSPDFDW | E36 - Enable Speed Feed-forward | 0 | 1 | 1 | | 1 | 0x3102 sub 0x12 (16 lsb) | INTEGER32 | R/W |
| | | | | | | | 0x0150 | | |
| pENTRQFDW | E37 - Enable Torque Feed-forward | 0 | 1 | 1 | | 1 | 0x3102 sub 0x12 (16 msb) | INTEGER32 | R/W |
| | | | | | | | 0x0151 | | |
| PrfPP_Pos_PosTrg | E448 - 449 - Positive Profile Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3006 sub 0x00 | INTEGER32 | R |
| | | | | | | | 0x215C – 0x215d | | |
| PrfPP_Neg_PosTrg | E704 - 705 – Negative Profile Position Target | -2147483648 | 2147483647 | 0 | ie | | 0x3016 sub 0x00 | INTEGER32 | R |
| | | | | | | | 0x225C – 0x225D | | |
| Can2_Selection | E899 - Position selection in Multi-Profile Position Mode | Range | | | | 1 | **MODBUS:** 0x231F | NTEGER32 | R/W |
| | | 0 | 0 - Use motor position | | | | | | |
| | | 1 | 1 - Send Pos by CAN 2 | | | | | | |
| | | 2 | 2 - Receive position by CAN 2 | | | | | | |
| | | 3 | 3 - Send Torque and position by SPI (Master) | | | | | | |
| | | 4 | 4 - Receive Pos by SPI (Slave) | | | | | | |
| Can2_Tx_COB_ID | E900 - Transmitter COB-ID | 0 | 127 | 0 | | 1 | 0x2400 | INTEGER16 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| Can2_Rx_COB_ID | E901 - Receiver COB-ID | 0 | 127 | 0 | | 1 | 0x2401 | INTEGER16 | R/W |
| ACTUALPOS_CAN2 | d75 - d76 - Position received from CAN2 | | | | ie | 1 | 0x200F sub 0x4B<br>0x03CB – 0x03CC | NTEGER32 | R |
| STATUS_WORD2 | d74 - STATUS_WORD2 | | | 0x000 | | 1 | 0x200F sub 0x4A<br>0x03CA | UNSIGNED16 | R |

**Tab. 20- Multi-Profile Velocity Mode**

### 2.7.1 VELOCITY PROFILE POSITIVE

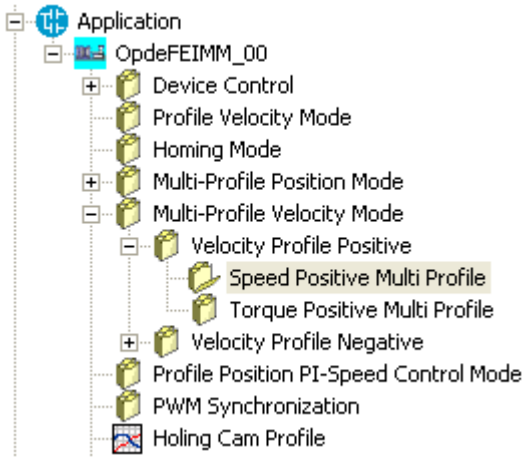



| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN:** 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 1-Profile Position Mode<br>2 2-Multi Profile Position Mode<br>3 3-Profile Velocity Mode<br>4 4-Profile Velocity Mode with PI control<br>6 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | 1 | 0x6061<br>0x03C1 | INTEGER8 | R |
| ACTUALPOS | d66-67 – Position actual | | | | ie | 1 | 0x6064 | INTEGER | R |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | value | | | | | | | 32 | |
| | | | | | | | 0x03C2 - 0x03C3 | | |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | 1 | 0x606C | INTEGER32 | R |
| | | | | | | | 0x03C4 - 0x03C5 | | |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | 1 | 0x200F sub 0x48 | INTEGER32 | R |
| | | | | | | | 0x03C8 – 0x03C9 | | |
| PrfPP_Pos_PosTrg | E448 - 449 - Positive Profile Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3006 sub 0x00 | INTEGER32 | R |
| | | | | | | | 0x215C – 0x215d | | |

**Tab. 21- Velocity Positive Profile**

### 2.7.1.0 Speed Positive Multi Profile



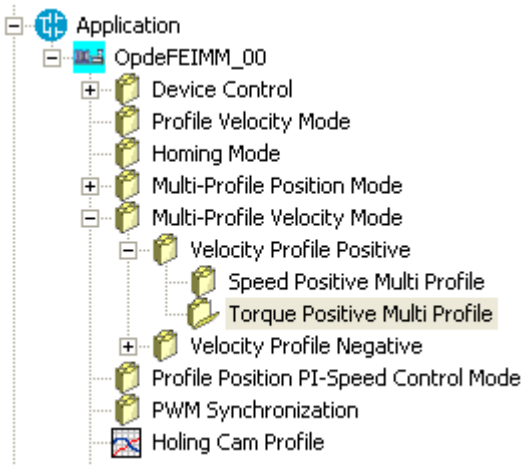

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Pos_PosChgSpd_0 | E356 - 357 - 0 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3000 sub 0x00 | INTEGER32 | R/W |
| | | | | | | | **MODBUS**: 0x2100-0x2101 | | |
| PrfPP_Pos_PosChgSpd_1 | E358 - 359 - 1 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x01 | INTEGER32 | R/W |
| | | | | | | | 0x2102-0x2103 | | |
| PrfPP_Pos_PosChgSpd_2 | E360 - 361 - 2 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x02 | INTEGER32 | R/W |
| | | | | | | | 0x2104-0x2105 | | |
| PrfPP_Pos_PosChgSpd_3 | E362 - 363 - 3 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x03 | INTEGER32 | R/W |
| | | | | | | | 0x2106- | | |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0x2107 | | |
| PrfPP_Pos_Pos ChgSpd_4 | E364 - 365 - 4 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x04<br>0x2108-0x2109 | INTEGER32 | R/W |
| PrfPP_Pos_Pos ChgSpd_5 | E366 - 367 - 5 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x05<br>0x210A-0x210B | INTEGER32 | R/W |
| PrfPP_Pos_Pos ChgSpd_6 | E368 - 369 - 6 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x06<br>0x210C-0x210D | INTEGER32 | R/W |
| PrfPP_Pos_Pos ChgSpd_7 | E370 - 371 - 7 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x07<br>0x210E-0x210F | INTEGER32 | R/W |
| PrfPP_Pos_Pos ChgSpd_8 | E372 - 373 - 8 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x08<br>0x2110-0x2111 | INTEGER32 | R/W |
| PrfPP_Pos_Pos ChgSpd_9 | E374 - 375 - 9 - Positive Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3000 sub 0x08<br>0x2112-0x2113 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_0 | E378 - 379 - 0 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x00<br>0x2116-0x2117 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_1 | E380 - 381 - 1 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x01<br>0x2118-0x2119 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_2 | E382 - 383 - 2 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x02<br>0x211A-0x211B | INTEGER32 | R/W |
| PrfPP_Pos_Speed_3 | E384 - 385 - 3 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x03<br>0x211C-0x211D | INTEGER32 | R/W |
| PrfPP_Pos_Speed_4 | E386 - 387 - 4 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x04<br>0x211E-0x211F | INTEGER32 | R/W |
| PrfPP_Pos_Speed_5 | E388 - 389 - 5 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x05<br>0x2120-0x2121 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_6 | E390 - 391 - 6 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x06<br>0x2122-0x2123 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_7 | E392 - 393 - 7 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x07<br>0x2124-0x2125 | INTEGER32 | R/W |
| PrfPP_Pos_Speed_8 | E394 - 395 - 8 - Profile Positive Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3001 sub 0x08<br>0x2126-0x2127 | INTEGER32 | R/W |
| PrfPP_Pos_Spe | E396 - 397 - 9 - Profile | 0 | 2147483 | 0 | ie/s | 1 | 0x3001 sub | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| ed_9 | Positive Speed | | 647 | | | | 0x09<br>0x2128-0x2129 | | |
| PrfPP_Pos_Acc_Dec_0 | E510 – 511 – Positive Profile Acc Dec 0 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x00<br>0x219a – 0x219b | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_1 | E512 – 513 – Positive Profile Acc Dec 1 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x01<br>0x219c – 0x219d | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_2 | E514 – 515 – Positive Profile Acc Dec 2 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x02<br>0x219e – 0x219f | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_3 | E516 – 517 – Positive Profile Acc Dec 3 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x03<br>0x21a0 – 0x21a1 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_4 | E518 – 519 – Positive Profile Acc Dec 4 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x04<br>0x21a2 – 0x21a3 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_5 | E520 – 521 – Positive Profile Acc Dec 5 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x05<br>0x21a4 – 0x21a5 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_6 | E522 – 523 – Positive Profile Acc Dec 6 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x06<br>0x21a6 – 0x21a7 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_7 | E524 – 525 – Positive Profile Acc Dec 7 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x07<br>0x21a8 – 0x21a9 | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_8 | E526 – 527 – Positive Profile Acc Dec 8 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x08<br>0x21aa – 0x21ab | INTEGER32 | R/W |
| PrfPP_Pos_Acc_Dec_9 | E528 – 529 – Positive Profile Acc Dec 9 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x09<br>0x21ac – 0x21ad | INTEGER32 | R/W |
| PrfPP_Pos_Final_Dec | E530 – 531 – Positive Profile Acc Dec 4 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x300a sub 0x0a<br>0x21ae – 0x21af | | R/W |
| PrfPP_Pos_NrPrfSpd | E400 - Positive Profile Nr. Change Speed | 0 | 8 | 0 | | 1 | 0x300C sub 0x01<br>0x212C | INTEGER 8 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C9 – 0x03C9 | | R |
| PrfPP_Pos_IndTrgPos | E401 - Index of Positive Profile Position Targhet | 0 | 9 | 9 | | 1 | 0x300C sub 0x00<br>0x212D | INTEGER 8 | R/W |

**Tab. 22- Speed Positive Multi-Profile**

### 2.7.1.1 Torque Positive Multi Profile

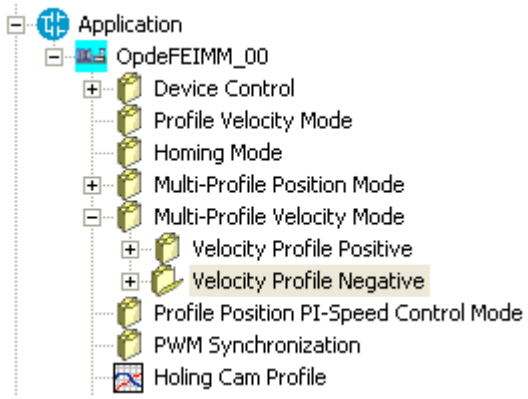



| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_PosChgTrq_0 | E658 - 659 - 0 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3013 sub 0x00<br>**MODBUS**: 0x222E – 0x222F | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_1 | E660 - 661 - 1 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x01<br>0x2230 – 0x2231 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_2 | E662 - 663 - 2 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x02<br>0x2232 – 0x2233 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_3 | E664 - 665 - 3 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x03<br>0x2234 – 0x2235 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_4 | E666 - 667 - 4 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x04<br>0x2236 – 0x2237 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_5 | E668 - 669 - 5 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x05<br>0x2238 – 0x2239 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_6 | E670 - 671 - 6 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x06<br>0x223A – 0x223B | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_7 | E672 - 673 - 7 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x07<br>0x223C – 0x223D | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_8 | E674 - 675 - 8 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x08<br>0x223E – 0x223F | INTEGER 32 | R/W |
| PrfPP_Neg_Torque_0 | E681 - 0 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_N | 100 | 0x3014 | UNSIGNED 16 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | OM | | sub 0x00 | | |
| | | | | | | | 0x2245 | | |
| PrfPP_Neg_Torque_1 | E682 - 1 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x01 | UNSIGNED 16 | R/W |
| | | | | | | | 0x2246 | | |
| PrfPP_Neg_Torque_2 | E683 - 2 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x02 | UNSIGNED 16 | R/W |
| | | | | | | | 0x2247 | | |
| PrfPP_Neg_Torque_3 | E684 - 3 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x03 | UNSIGNED 16 | R/W |
| | | | | | | | 0x2248 | | |
| PrfPP_Neg_Torque_4 | E685 - 4 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x04 | UNSIGNED 16 | R/W |
| | | | | | | | 0x2249 | | |
| PrfPP_Neg_Torque_5 | E686 - 5 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x05 | UNSIGNED 16 | R/W |
| | | | | | | | 0x224A | | |
| PrfPP_Neg_Torque_6 | E687 - 6 – Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x06 | UNSIGNED 16 | R/W |
| | | | | | | | 0x224B | | |
| PrfPP_Neg_Torque_7 | E688 - 7 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x07 | UNSIGNED 16 | R/W |
| | | | | | | | 0x224C | | |
| PrfPP_Neg_Torque_8 | E689 - 8 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x08 | UNSIGNED 16 | R/W |
| | | | | | | | 0x224D | | |
| PrfPP_Neg_Torque_9 | E690- 9 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x09 | UNSIGNED 16 | R/W |
| | | | | | | | 0x224E | | |
| PrfPP_Neg_NrPrfTrq | E703 - Negative Profile Nr. Change Limit Torque | 0 | 8 | 0 | | 1 | 0x301C sub 0x02 | INTEGER 8 | R/W |
| | | | | | | | 0x225B | | |

**Tab. 23- Torque Positive Multi-Profile**

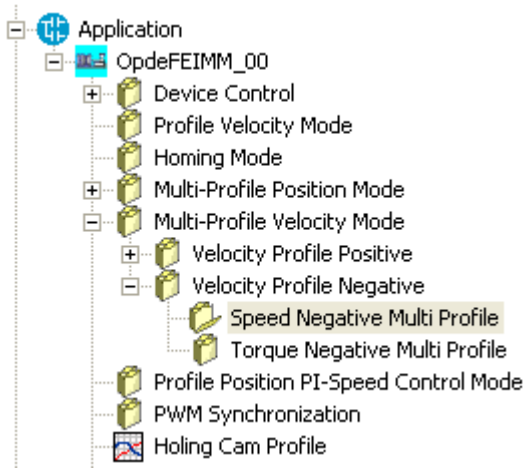
## 2.7.2 VELOCITY PROFILE NEGATIVE




| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN:** 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | <br>0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 1-Profile Position Mode<br>2 2-Multi Profile Position Mode<br>3 3-Profile Velocity Mode<br>4 4-Profile Velocity Mode with PI control<br>6 6-Homing mode | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | 1 | 0x6061<br>0x03C1 | INTEGER8 | R |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | 1 | 0x6064<br>0x03C2 - 0x03C3 | INTEGER32 | R |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | 1 | 0x606C<br>0x03C4 - 0x03C5 | INTEGER32 | R |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | 1 | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |
| PrfPP_Neg_PosTrg | E704 - 705 - Negative Profile Position Target | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3006 sub 0x00<br>0x215C – 0x215d | INTEGER32 | R |

**Tab. 24- Velocity Profile Negative**

### 2.7.2.0 Speed Negative Multi Profile



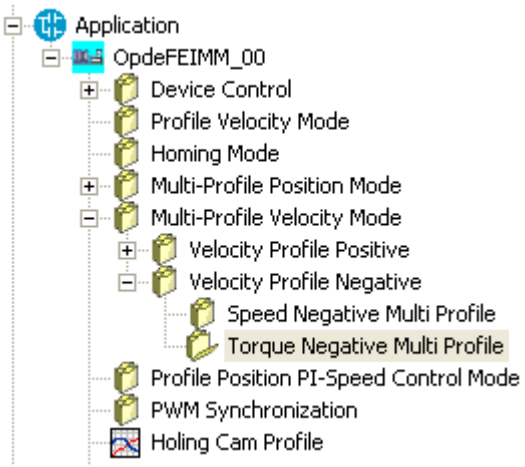

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_Pos ChgSpd_0 | E612 - 613 - 0 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3010 sub 0x00<br>**MODBUS**: 0x2200 – 0x2201 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_1 | E614 - 615 - 1 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x01<br>0x2202 – 0x2203 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_2 | E616 - 617 - 2 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x02<br>0x2204 – 0x2205 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_3 | E618 - 619 - 3 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x03<br>0x2206 – 0x2207 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_4 | E620 - 621 - 4 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x04<br>0x2208 – 0x2209 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_5 | E622 - 623 - 5 - Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x05<br>0x220A – 0x220B | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_6 | E624 - 625 - 6 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x06<br>0x220C – 0x220D | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_7 | E626 - 627 - 7 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x07<br>0x220E – 0x220F | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_8 | E628 - 629 - 8 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x08<br>0x2210 – 0x2211 | INTEGER 32 | R/W |
| PrfPP_Neg_Pos ChgSpd_9 | E630 - 631 - 9 - Negative Profile Position Targhet/Change Speed | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3010 sub 0x09<br>0x2212 – 0x2213 | INTEGER 32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_Speed_0 | E634 - 635 - 0 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x00<br>0x2216 – 0x2217 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_1 | E636 - 637 - 1 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x01<br>0x2218 – 0x2219 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_2 | E638 - 639 - 2 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x02<br>0x221A – 0x221B | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_3 | E640 - 641 - 3 – Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x03<br>0x221C – 0x221D | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_4 | E642 - 643 - 4 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x04<br>0x221E – 0x221F | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_5 | E644 - 645 - 5 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x05<br>0x2220 – 0x2221 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_6 | E646 - 647 - 6 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x06<br>0x2222 – 0x2223 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_7 | E648 - 649 - 7 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x07<br>0x2224 – 0x2225 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_8 | E650 - 651 - 8 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x08<br>0x2226 – 0x2227 | INTEGER 32 | R/W |
| PrfPP_Neg_Speed_9 | E652 - 653 - 9 - Profile Negative Speed | 0 | 2147483647 | 0 | ie/s | 1 | 0x3011 sub 0x09<br>0x2228 – 0x2229 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_0 | E510 – 511 – Negative Profile Acc Dec 0 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x00<br>0x229a-0x229b | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_1 | E512 – 513 – Negative Profile Acc Dec 1 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x01<br>0x229c – 0x229d | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_2 | E514 – 515 – Negative Profile Acc Dec 2 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x02<br>0x229e – 0x229f | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_3 | E516 – 517 – Negative Profile Acc Dec 3 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x03<br>0x22a0 – 0x22a1 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_4 | E518 – 519 – Negative Profile Acc Dec 4 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x04<br>0x22a2 – 0x22a3 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_5 | E520 – 521 – Negative Profile Acc Dec 5 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x05<br>0x22a4 – | INTEGER 32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0x22a5 | | |
| PrfPP_Neg_Acc_Dec_6 | E522 – 523 – Negative Profile Acc Dec 6 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x06<br>0x22a6 – 0x22a7 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_7 | E524 – 525 – Negative Profile Acc Dec 7 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x07<br>0x22a8 – 0x22a9 | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_8 | E526 – 527 – Negative Profile Acc Dec 8 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x08<br>0x22aa-0x22ab | INTEGER 32 | R/W |
| PrfPP_Neg_Acc_Dec_9 | E528 – 529 – Negative Profile Acc Dec 9 | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x09<br>0x22ac – 0x22ad | INTEGER 32 | R/W |
| PrfPP_Neg_Final_Dec | E530 – 531 – Negative Profile Final Deceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x301A sub 0x0a<br>0x22ae – 0x22af | INTEGER 32 | R/W |
| PrfPP_Neg_NrPrfSpd | E656 - Negative Profile Nr. Change Speed | 0 | 8 | 0 | | 1 | 0x301C sub 0x01<br>0x222C | INTEGER 8 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |
| PrfPP_Neg_IndTrgPos | E657 - Index of Negative Profile Position Target | 0 | 9 | 9 | | 1 | 0x301C sub 0x00<br>0x222D | INTEGER 8 | R/W |

**Tab. 25- Speed Negative Multi-profile**

### 2.7.2.1 Torque Negative Multi Profile

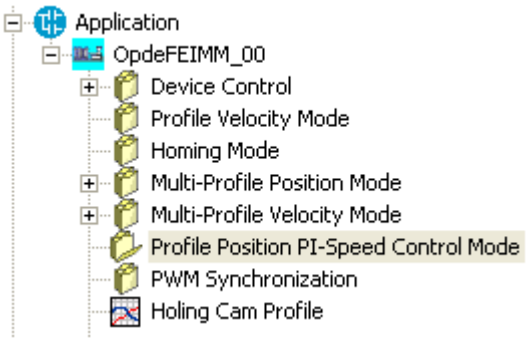


| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfPP_Neg_PosChgTrq_0 | E658 - 659 - 0 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | **CAN**: 0x3013 sub 0x00<br>**MODBUS**: 0x222E – 0x222F | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_1 | E660 - 661 - 1 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x01<br>0x2230 – 0x2231 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_2 | E662 - 663 - 2 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x02<br>0x2232 – 0x2233 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_3 | E664 - 665 - 3 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x03<br>0x2234 – 0x2235 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_4 | E666 - 667 - 4 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x04<br>0x2236 – 0x2237 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_5 | E668 - 669 - 5 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x05<br>0x2238 – 0x2239 | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_6 | E670 - 671 - 6 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x06<br>0x223A – 0x223B | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_7 | E672 - 673 - 7 - Profile Negative Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x07<br>0x223C – 0x223D | INTEGER 32 | R/W |
| PrfPP_Neg_PosChgTrq_8 | E674 - 675 - 8 - Profile Positive Position Change Torque | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3013 sub 0x08<br>0x223E – 0x223F | INTEGER 32 | R/W |
| PrfPP_Neg_Torque_0 | E681 - 0 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x00<br>0x2245 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_1 | E682 - 1 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x01<br>0x2246 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_2 | E683 - 2 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x02<br>0x2247 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_3 | E684 - 3 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x03<br>0x2248 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_4 | E685 - 4 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x04<br>0x2249 | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_5 | E686 - 5 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x05<br>0x224A | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_6 | E687 - 6 – Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x06<br>0x224B | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_7 | E688 - 7 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_N | 100 | 0x3014 sub 0x07 | UNSIGNED 16 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | OM | | 0x224C | | |
| PrfPP_Neg_Torque_8 | E689 - 8 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x08<br>0x224D | UNSIGNED 16 | R/W |
| PrfPP_Neg_Torque_9 | E690- 9 - Profile Negative Limit Torque | 0.00 | 400.00 | 0.00 | % MOT_T_NOM | 100 | 0x3014 sub 0x09<br>0x224E | UNSIGNED 16 | R/W |
| PrfPP_Neg_NrPrfTrq | E703 - Negative Profile Nr. Change Limit Torque | 0 | 8 | 0 | | 1 | 0x301C sub 0x02<br>0x225B | INTEGER 8 | R/W |

**Tab. 26- Torque Negative Multi-profile**

## 2.8 PROFILE VELOCITY PI CONTROL MODE




Profile velocity PI control mode creates a position reference depending on the actual analogue input value selected with **PrfPP_Pos_SelAI_StartHoldCam_PV.** Position reference is created like output from a PI controller.

In the FEIMM this operative method can control the Screw Axes during Dosing.

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| rCONTROL_WORD | E100 – Control Word | | | 0000 | | 1 | **CAN**: 0x6040<br>**MODBUS**: 0x2000 | UNSIGNED16 | R/W |
| STATUS_WORD | d64 – Status Word | | | 0000 | | 1 | 0x6041<br>0x03C0 | UNSIGNED16 | R/W |
| RD_STATE_MACHINE | E101 – Finite State Machine | | | | | 1 | 0x2001 | UNSIGNED16 | R |
| pMODE_OF_OP | E01 – Mode of operations | Range<br>1 1-Profile Position Mode<br>2 2-Multi Profile Position Mode<br>3 3-Profile Velocity Mode<br>4 4-Profile Velocity Mode with PI | | 3 | | 1 | 0x6060<br>0x012D | INTEGER8 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | control<br>6 6-Homing mode | | | | | | | |
| MODE_OF_OP_DIS | d65 – Modes of operation display | | | | | | 0x6061<br>0x03C1 | INTEGER8 | R |
| pTARGETVEL | E02-03 – Target Velocity | -2147483648 | 2147483647 | 32768 | ie/s | | 0x3102 sub 0x01<br>0x012E – 0x012F | INTEGER32 | R/W |
| pPROFACC | E04-E05 - Profile acceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x3102 sub 0x02<br>0x0130 – 0x0131 | INTEGER32 | R/W |
| pPROFDEC | E06-E07 - Profile deceleration | 10223 | 2147483647 | 500000 | ie/s$^2$ | 1 | 0x3102 sub 0x03<br>0x0132 – 0x0133 | INTEGER32 | R/W |
| pQSDEC | E08 – 09 – Quick stop deceleration | 10223 | 2147483647 | 1638400 | ie/s$^2$ | 1 | 0x3102 sub 0x04<br>0x0134 – 0x0135 | INTEGER32 | R/W |
| pQSOPTC | E38 – Quick Stop Option Code | Range<br>0<br>2 2 – Switch On Disabled<br>6 6 – Stay in Quick Stop<br>8 | | | | 1 | 0x3102 sub 0x13<br>0x0152 | INTEGER8 | R/W |
| pTHRVEL | E18 - Velocity threshold | 100 | 65535 | 10000 | ie/s | 1 | 0x3102 sub 0x09 (16 lsb)<br>0x013E | INTEGER32 | R/W |
| pTIMEVEL | E20 - Velocity threshold time | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0A (16 lsb)<br>0x0140 | INTEGER32 | R/W |
| pWINVEL | E22 - Velocity window | 0 | 65535 | 0 | ie/s | 1 | 0x3102 sub 0x0B (16 lsb)<br>0x0142 | INTEGER32 | R/W |
| pWTIMEVEL | E24 - Velocity window time-out | 0 | 65535 | 0 | ms | 1 | 0x3102 sub 0x0C (16 lsb)<br>0x0144 | INTEGER32 | R/W |
| ACTUALPOS | d66-67 – Position actual value | | | | ie | 1 | 0x6064<br>0x03C2 – 0x03C3 | INTEGER32 | R |
| ACTUALVEL | d68-69 – Velocity actual value | | | | ie/s | 1 | 0x606C<br>0x03C4 – 0x03C5 | INTEGER32 | R |
| pVPI_LMN_MIN | E54-55 Profile Vel.PI Limit Min value of output | -2147483648 | 2147483647 | -2147483647 | ie/s | 1 | 0x3102 sub 0x1B<br>0x0162 – 0x0163 | INTEGER32 | R/W |
| pVPI_LMN_MAX | E56-57 Profile Vel.PI Limit Max value of output | -2147483648 | 2147483647 | 2147483647 | ie/s | 1 | 0x3102 sub 0x1C<br>0x0164 – 0x0165 | INTEGER32 | R/W |
| pVPI_KP | E58 KpV Profile Vel.PI proportional gain | -400.0 | 400.0 | 6.0 | | 10 | 0x3102 sub 0x1D | INTEGER32 | R/W |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (16 lsb) | | |
| | | | | | | | 0x0166 | | |
| pVPI_TI | E59 TiV Profile Vel.PI lead time constant | 0.1 | 3000.0 | 30.0 | ms | 10 | 0x3102 sub 0x1D (16 msb) | INTEGER32 | R/W |
| | | | | | | | 0x0167 | | |
| pVPI_TF | E60 TfV Profile Vel.PI (filter) time constant | 0.0 | 25.0 | 0.4 | ms | 10 | 0x3102 sub 0x1E (16 lsb) | INTEGER32 | R/W |
| | | | | | | | 0x0168 | | |
| ACT_COM_P_PID | d80 - Actual P component of Profile Vel. PI | | | | % | 163.84 | 0x200F sub 0x50 | UNSIGNED16 | R |
| | | | | | | | 0x03D0 | | |
| ACT_COM_I_PID | d81 - Actual I component of Profile Vel. PI | | | | % | 163.84 | 0x200F sub 0x51 | UNSIGNED16 | R |
| | | | | | | | 0x03D1 | | |
| ACT_ERR_PID | d82 - Actual Error SP-PV of Profile Vel. PI | | | | % | 163.84 | 0x200F sub 0x52 | UNSIGNED16 | R |
| | | | | | | | 0x03D2 | | |
| ACT_OUT_PID | d83 - Actual Output of Profile Vel. PI | | | | % | 163.84 | 0x200F sub 0x53 | UNSIGNED16 | R |
| | | | | | | | 0x03D3 | | |
| PrfPP_Pos_SelAI_Start HoldCam_PV | E496 - Profile Pos. AI Selection Start Hoding Cam Profile / PV for PVPI mode | | | | | 1 | 0x300C sub 0x06 | INTEGER8 | R/W |
| | | | | | | | 0x218C | | |
| PrfVPI_PosChgSpPI_0 | E868 - 869 - 0 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x00 | INTEGER32 | R/W |
| | | | | | | | 0x2300 - 0x2301 | | |
| PrfVPI_PosChgSpPI_1 | E870 - 871 - 1 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x01 | INTEGER32 | R/W |
| | | | | | | | 0x2302 - 0x2303 | | |
| PrfVPI_PosChgSpPI_2 | E872 - 873 - 2 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x02 | INTEGER32 | R/W |
| | | | | | | | 0x2304 - 0x2305 | | |
| PrfVPI_PosChgSpPI_3 | E874 - 875 - 3 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x03 | INTEGER32 | R/W |
| | | | | | | | 0x2306 - 0x2307 | | |
| PrfVPI_PosChgSpPI_4 | E876 - 877 - 4 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x04 | INTEGER32 | R/W |
| | | | | | | | 0x2308 - 0x2309 | | |
| PrfVPI_PosChgSpPI_5 | E878 - 879 - 5 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x05 | INTEGER32 | R/W |
| | | | | | | | 0x230A - 0x230B | | |
| PrfVPI_PosChgSpPI_6 | E880 - 881 - 6 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x06 | INTEGER32 | R/W |
| | | | | | | | 0x230C - 0x230D | | |
| PrfVPI_PosChgSpPI_7 | E882 - 883 - 7 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x07 | INTEGER32 | R/W |
| | | | | | | | 0x230E - 0x230F | | |
| PrfVPI_PosChgSpPI_8 | E884 - 885 - 8 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0 | ie | 1 | 0x3020 sub 0x08 | INTEGER32 | R/W |
| | | | | | | | 0x2310 - 0x2311 | | |

| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| PrfVPI_PosChgSpPI_9 | E886 - 887 - 9 - Profile PI Control Speed- Pos. Change Setpoint | -2147483648 | 2147483647 | 0.00 | ie | 1 | 0x3020 sub 0x09<br>0x2312 - 0x2313 | INTEGER32 | R/W |
| PrfVPI_SpCtrlPI_0 | E888 - 0 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x00<br>0x2314 | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_1 | E889 - 1 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x01<br>0x2315 | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_2 | E890 - 2 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x02<br>0x2316 | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_3 | E891 - 3 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x03<br>0x2317 | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_4 | E892 - 4 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x04<br>0x2318 | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_5 | E893 - 5 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x05<br>0x2319 | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_6 | E894 - 6 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x06<br>0x231A | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_7 | E895 - 7 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x07<br>0x231B | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_8 | E896 - 8 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x08<br>0x231C | UNSIGNED 16 | R/W |
| PrfVPI_SpCtrlPI_9 | E897 - 9 - Profile PI Control Speed- Setpoint | -200.00 | 200.00 | 0.00 | % | 100 | 0x3021 sub 0x09<br>0x231D | UNSIGNED 16 | R/W |
| PrfVPI_NrPrfCtrlPI | E898 - Nr of Profile PI Control Speed | 0 | 9 | 0 | | | 0x3022 sub 0x00<br>0x231E | INTEGER 8 | R/W |
| MAX_SPEED_IE | d72-73 – Speed Max [ie] (P65 – MOT_MAX_SPEED) | | | | ie/s | | 0x200F sub 0x48<br>0x03C8 – 0x03C9 | INTEGER32 | R |

**Tab. 27- Profile Velocity PI control mode**

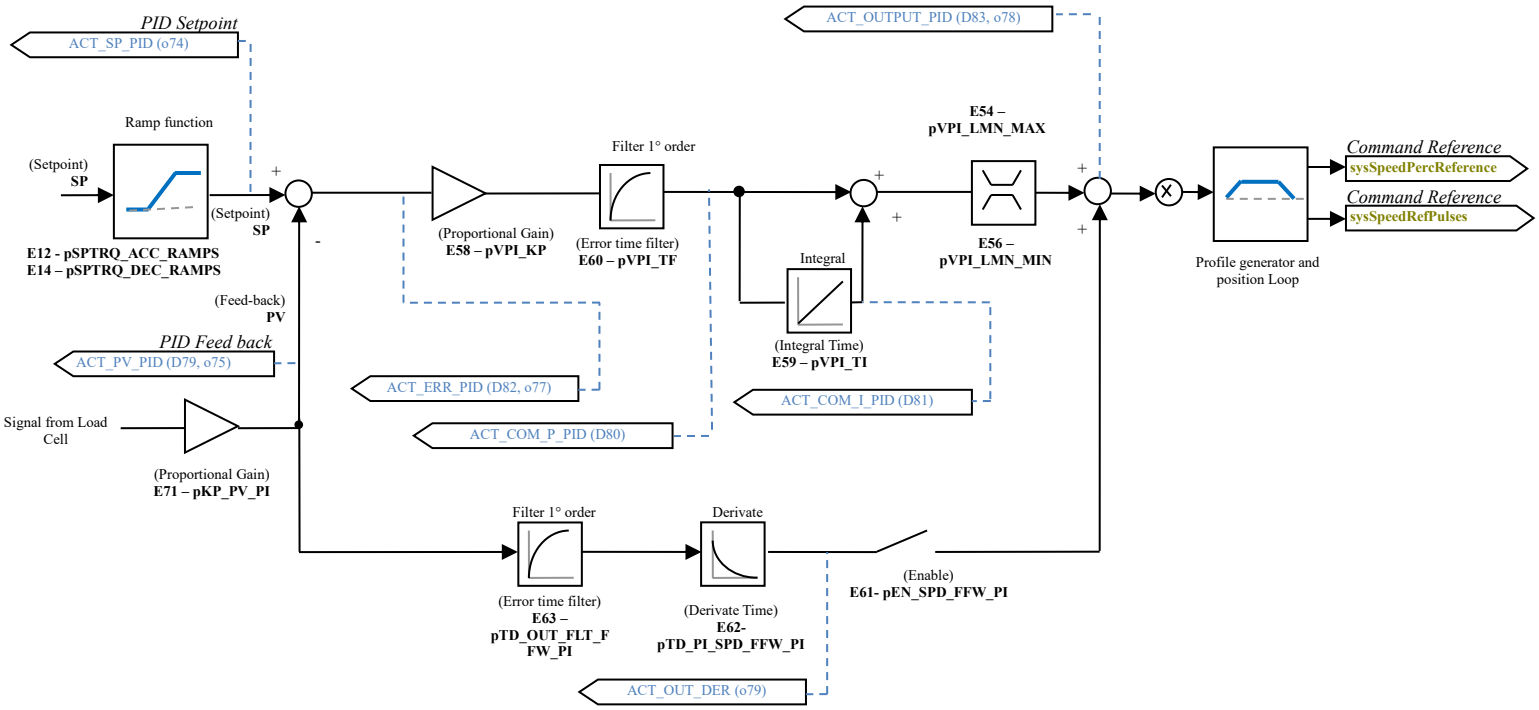



**Fig. 25- Profile PI Control Mode Scheme**

A torque-step set point is applied. The changing of set-points depends on the actual position. The set point can be ramp with **E12 - pSPTRQ_ACC_RAMPS** and **E14 – pSPTRQ_DEC_RAMPS.** Feedback come from load cell like torque closed loop.

User can act on this second PI ( **E58 – pVPI_KP, E59 – pVPI_TI, E60 – pVPI_TF**). The output of PI is limited with **E54 – pVPI_LMN_MAX** and **E56- pVPI_LMN_MIN**.

Eventually a Speed Feed-Forward depending on the Feed-back can be enabled (filter with **E63 – pTD_OUT_FLT_FFW_PI**, derivtes with **E62 – pTD_PI_SPD_FFW_PI**, enabling with **E61- pEN_SPD_FFW_PI**).

PI-Output modulates a Profile generator with speed reference equal to the maximum speed (**MAX_SPEED_IE**) acceleration and deceleration equal to **E04 – 05 – pPROFACC** and **E06 – 07 – pPROFDEC**.

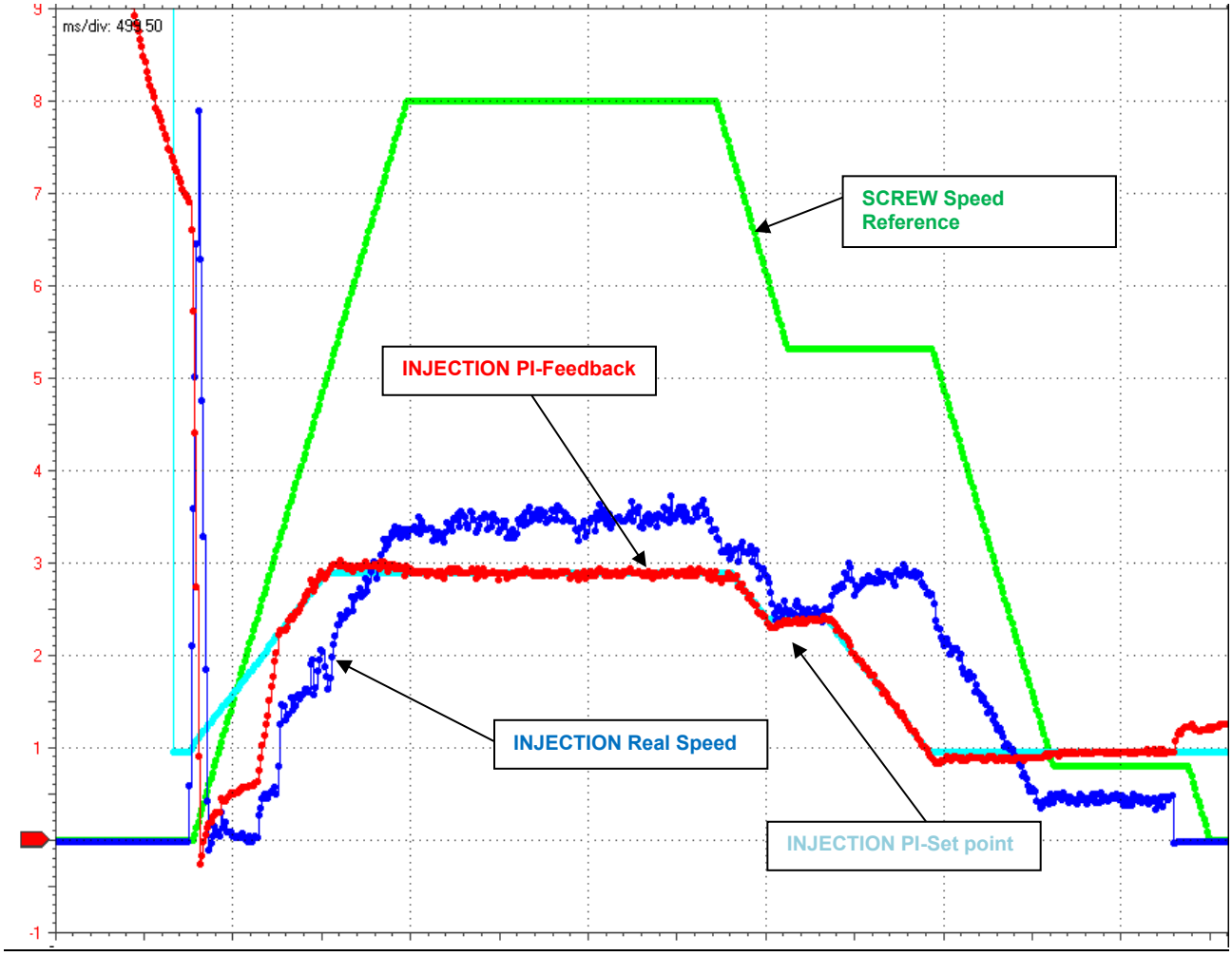
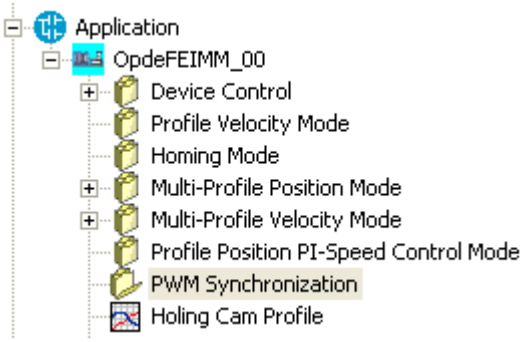



**Fig. 26- Back-pressure example**

**Fig. 26** shows the dosing-phase for Injection and Screw axes where a Back-pressure is present. Injection Axes works in **Profile PI-Control Mode**, the PI works modulating the Profile Generator references (**Fig. 25**). Injection Axes send the position to Screw Axes by second line CAN2.
Screw drive works in **Multi Profile Velocity**: the change of speeds depends on the position received from CAN 2.

The graphs shows also the ramps on Pressure Set Point.

## 2.9 PWM SYNCHRONIZATION




| Name | Description | Min | Max | Default | UM | Scale | index | Type | Access |
|---|---|---|---|---|---|---|---|---|---|
| EN_PWM_SYNCH | E85 – Enable PWM - Synchronization | Range | | 0 | | 1 | **CAN**: 0x3102 sub 0x2A (16 msb) | INTEGER32 | R/W |
| | | 0 | 0 - No | | | | **MODBUS**: 0x0181 | | |
| | | 1 | 1 - Master | | | | | | |
| | | 2 | 2 - Slave | | | | | | |
| PWM_SYNCH_PHASE | E86 – PWM Synchronization plhase | -175 | 175 | 0 | ° | 1 | 0x3102 sub 0x2B (16 lsb) | INTEGER32 | R/W |
| | | | | | | | 0x0182 | | |
| PWM_SYNCH_DELAY | D77 – PWM SYNCH Delay | -400.0 | 400.0 | 0.0 | us | 1 | 0x2003 sub 0x4d | INTEGER32 | R/W |
| | | | | | | | 0x03cd | | |

**Tab. 28- PWM Synchronization**

With this function it's possible to synchronize two or more OPDE at PWM level.
Parameter **E85 – EN_PWM_SYNCH** is used to select the drive function:

1 Master= Every PWM period the third digital output (O3) is configured like PWM syncrhronization output.
2 Slave= Eigth physical input (I08) is used to synchronize the drive.

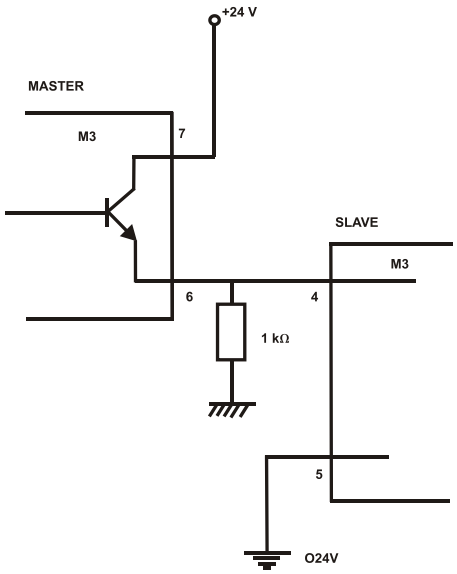



**Fig. 27- PWM Synchronization**

In the slave there is a tracking loop with gain Kp (P11) e Ta (P12). It's possible to set also the phase between master and slave with parameter **E86 – PWM Synchronization plhase**.

Note1: Master and slave have to be set with the same PWM frequency (P101)

Note2: If the PWM frequency is great than 5kHz is necessary to use a pull-down 1kΩ resistance 1W.

## 2.10 ALARMS

| Alarms | | | Description | Correction |
|---|---|---|---|---|
| HEX | DEC | | | |
| A.4.0.H | A4.0 | Life guarding Error | Master's timeout | Check the correct setting of the master or check the CAN cable or check the CAN setting of the drive. |
| A.4.1.H | A4.1 | CAN 2 / SPI communication lost | CAN 2 /SPI communication lost (not data received for value in **E46 - THR_ALARM_COM**) | Check the CAN2 /SPI connection cable or check the parameter **E46** |
| A.4.2.H | A4.2 | Tracking error too big | Tracking error too big (greater than threshold pFOLLERR E16-E17 | Check the speed and position control. Verify if the drive is in torque limit and if the feed-back position is read correctly. Eventually increase the threshold (**E16 – E17**). |

**Tab. 29- Alarms table**

## 2.11 DIGITAL INPUT AND OUTPUT

| Digitals Inputs | |
|---|---|
| **Name** | **Descriptions** |
| I00 | Run command |
| I02 | External enable |
| I04 | Profile Start Holding Cam |
| I05 | Operative Mode Bit0 |
| I06 | Operative Mode Bit1 |
| I07 | Operative Mode Bit2 |
| I08 | Reset alarms |
| I10 | New SetPoint |
| I11 | Profile Positive Start Enable |
| I12 | Profile Negative Start Enable |
| I20 | Enable Operation |
| I21 | Halt |
| I22 | Quick Stop |
| I23 | Motor thermo-switch |
| I28 | Positive Limit Switch |
| I29 | Negative Limit Switch |
| I31 | PWM Synchronization Input |

**Tab. 30- Digital Input**

| Digitals Inputs | |
|---|---|
| **Name** | **Descriptions** |
| O32 | Target Reached |
| O33 | Set Point Acknowledge |
| O34 | Following Error |
| O35 | Homing Attained |
| O36 | Op Mode Reply Bit0 |
| O37 | Op Mode Reply Bit1 |
| O38 | Op Mode Reply Bit2 |
| O39 | Operation Enabled |

**Tab. 31- Application Digital Output**

| OSC Variables | |
|---|---|
| **Name** | **Descriptions** |
| o69 – Position reference received (LSW) | Position reference less significant word |
| o70 – Position reference received (MSW) | Position reference more significant word |
| o71 – Actual Position (LSW) | Actual position less significant word |
| o72 – Actual Position (MSW) | Actual position more significant word |
| o73 – Actual position error | Actual position error |
| o74 – Actual Set point PI | PI closed loop (Multi Profile Position Mode) or PI velocity (Profile Position PI-Control Mode) Set point |
| o75 –Feedback PI | PI closed loop (Multi Profile Position Mode) or PI velocity (Profile Position PI-Control Mode) Feedback |
| o76 – Start holding cam profile flag | Holding Cam Profile – trigger flag |
| o77 – Actual PI Error | PI closed loop (Multi Profile Position Mode) or PI velocity (Profile Position PI-Control Mode) error |
| o78 – Actual PI Output | PI closed loop (Multi Profile Position Mode) or PI velocity (Profile Position PI-Control Mode) output |
| o79 – Actual Derivate Speed FFW | PI closed loop (Multi Profile Position Mode) or PI velocity (Profile Position PI-Control Mode) speed FFW |

**Tab. 32- Osc variables**

OSC Application variables are refreshed every **E96 – pCYCLICPERIOD** Time (default time = 1ms).

# 3. APPLICATION REVISION HISTORY

**Rev. 71.00.74** (24/08/2015), Minimum core target: Opendrive Brushless 22.10/ Async 12.10

**Issues fixed**

| | |
|---|---|
| | |

**New Functionality**

| | |
|---|---|
| 71.00.74 | Realized the Step Linear pressure set point reference. Adjust internal variables. |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