EPOS

Positioning Controller

Application Note
"Device Programming"

Edition May 2008

EPOS 24/1, EPOS 24/5, EPOS 70/10, MCD EPOS 60W, EPOS2 50/5
Firmware version 2000h or higher

Introduction

The EPOS positioning controller is a digital positioning system suitable for DC and EC (brushless) motors with incremental encoders in a modular package. The performance range of these compact positioning controllers ranges from a few watts up to 700 watts.

A variety of operating modes allows all kinds of drive and automation systems to be flexibly assembled using positioning, speed and current regulation. The built-in CANopen interface allows networking to multiple axis drives and online commanding by CAN bus master units.

Objectives

This application note shows some typical commanding sequences for different operation modes. The explanations are based on writing and reading commands to access to the object dictionary. For further information about the objects see document 'EPOS Firmware Specification'. Detailed information of the command structure will be also found in the EPOS Graphical User Interface tool (command analyzer).

References and Required Tool

The latest editions of maxon motor documents and tools are freely available at http://www.maxonmotor.com category «Service & Downloads».

Document	**Suitable order number for EPOS Positioning Controller**
EPOS Firmware Specification	280937, 302267, 302287, 317270, 275512, 300583
EPOS2 Firmware Specification	347717

Tool	
EPOS Studio Version 1.30 or higher	280937, 302267, 302287, 317270, 275512, 347717, 300583

Table of contents

1 First Step

Before the motor will be activated the motor parameters, the position sensor parameters and the regulation gains are to be set. All objects are described detailed in the document 'EPOS Firmware Specification'.

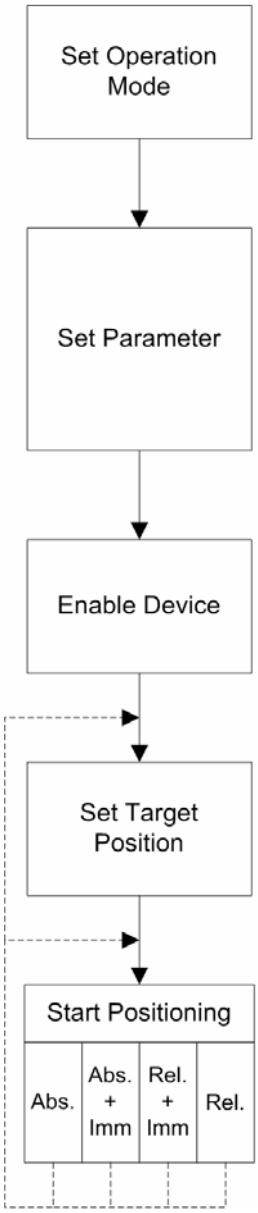
Remark: Detailed information of the command structure will be found in the EPOS Studio tool (command analyzer revision 2.0 or higher).

Diagram	Object name	Object	User value [default value]
Set Communication Settings	RS232 Baudrate CAN Bitrate	0x2001-00 0x2002-00	User specific [3] User specific [0]
Set Motor Parameters	Motor Type Continuous Current Limit Pole Pair Number Thermal Time Constant Winding	0x6402-00 0x6410-01 0x6410-03 0x6410-05	Motor specific [10] Motor specific [5000] Motor specific [1] Motor specific [40]
Set Position Sensor Parameters	Encoder Pulse Number Position Sensor Type	0x2210-01 0x2210-02	Sensor specific [500] Sensor specific [1]
Set Current Regulator Gains	Current Regulator P-Gain Current Regulator I-Gain	0x60F6-01 0x60F6-02	Motor specific. Determine the optimal parameter by using the 'Regulation Tuning' of EPOS Studio.
Set Velocity Regulator Gains	Speed Regulator P-Gain Speed Regulator I-Gain	0x60F9-01 0x60F9-02	Motor specific. Determine the optimal parameter by using the 'Regulation Tuning' of EPOS Studio.
Set Position Regulator Gains	Position Regulator P-Gain Position Regulator I-Gain Position Regulator D-Gain	0x60FB-01 0x60FB-02 0x60FB-03	Motor specific. Determine the optimal parameter by using the 'Regulation Tuning' of EPOS Studio.

2 Profile Position Mode

2.1 Set Position

The axis moves to an absolute or relative position with a motion profile.

Diagram	Object name	Object	User value [default value]
	Modes of Operation	0x6060-00	0x01 (Profile Position Mode)
	Max. Following Error	0x6065-00	User specific [2000 qc]
	Min. Position Limit	0x607D-01	User specific [-2147483648 qc]
	Max. Position Limit	0x607D-02	User specific [2147483647 qc]
	Max. Profile Velocity	0x607F-00	Motor specific [25000 rpm]
	Profile Velocity	0x6081-00	Desired Velocity [1000 rpm]
	Profile Acceleration	0x6083-00	User specific [10000 rpm/s]
	Profile Deceleration	0x6084-00	User specific [10000 rpm/s]
	Quick Stop Deceleration	0x6085-00	User specific [10000 rpm/s]
	Motion Profile Type	0x6086-00	User specific [0]
	Controlword (Shutdown)	0x6040-00	0x0006
	Controlword (SwitchOn)	0x6040-00	0x000F
	Target Position	0x607A-00	Desired Position [qc]
	Controlword (absolute positioning) or	0x6040-00	0x001F
	Controlword (abs. pos., start immed.) or	0x6040-00	0x003F
	Controlword (rel. pos., start immed.) or	0x6040-00	0x007F
	Controlword (relative positioning)	0x6040-00	0x005F

2.2 Read Status

Diagram	Object name	Object	User value [default value]
	Statusword (Target reached)	0x6041-00	The axis is at the target position if bit 10 is set.

2.3 Stop Positioning

Diagram	Object name	Object	User value [default value]
	Controlword (Stop positioning) or Controlword (QuickStop)	0x6040-00 0x6040-00	0x010F 0x000B

3 Homing Mode

3.1 Start Homing

The axis references to an absolute position with the selected homing method.

Diagram	Object name	Object	User value [default value]
Set Operation Mode	Modes of Operation	0x6060-00	0x06 (Homing Mode)
Set Parameter	Max. Following Error	0x6065-00	User specific [2000 qc]
	Home Offset	0x607C-00	User specific [0 qc]
	Max. Profile Velocity	0x607F-00	Motor specific [25000 rpm]
	Quick Stop Deceleration	0x6085-00	User specific [10000 rpm/s]
	Speed for Switch Search	0x6099-01	User specific [100 rpm]
	Speed for Zero Search	0x6099-02	User specific [10 rpm]
	Homing Acceleration	0x609A-00	User specific [1000 rpm/s]
	Current Threshold Homing Mode	0x2080-00	User specific [500 mA]
	Home Position	0x2081-00	User specific [0 qc]
Set Homing Method	Homing Method	0x6098-00	Select Homing Method (see document 'EPOS Firmware Specification')
Enable Device	Controlword (Shutdown)	0x6040-00	0x0006
	Controlword (SwitchOn)	0x6040-00	0x000F
Start Homing	Controlword (SwitchOn)	0x6040-00	0x000F
	Controlword (Start homing mode)	0x6040-00	0x001F

3.2 Read Status

Diagram	Object name	Object	User value [default value]
Read Statusword	Statusword (Target reached / Homing attained)	0x6041-00	The home position is reached if bit 10 / bit 12 is set to 1.

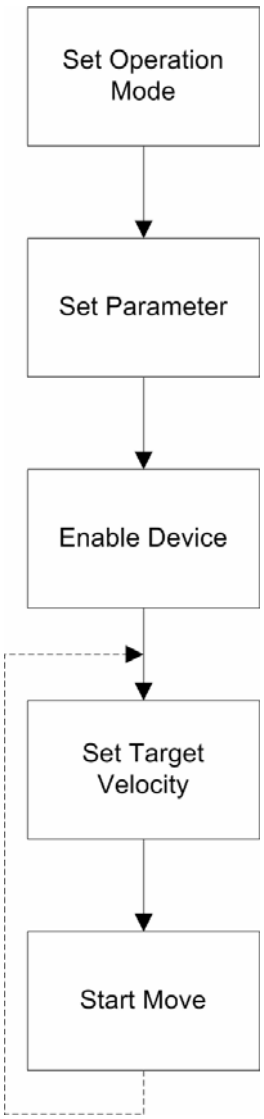
3.3 Stop Homing

Diagram	Object name	Object	User value [default value]
	Controlword (SwitchOn) or Controlword (HaltHoming) or Controlword (QuickStop)	0x6040-00 0x6040-00 0x6040-00	0x000F 0x011F 0x000B

4 Profile Velocity Mode

4.1 Start Velocity

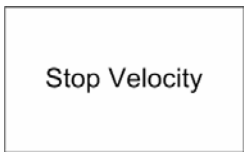
Motor shaft runs with a certain speed with velocity profile.

Diagram	Object name	Object	User value [default value]
	Modes of Operation	0x6060-00	0x03 (Profile Velocity Mode)
	Max. Profile Velocity Profile Acceleration Profile Deceleration Quick Stop Deceleration Motion Profile Type	0x607F-00 0x6083-00 0x6084-00 0x6085-00 0x6086-00	Motor specific [25000 rpm] User specific [10000 rpm/s] User specific [10000 rpm/s] User specific [10000 rpm/s] User specific [0]
	Controlword (Shutdown) Controlword (SwitchOn)	0x6040-00 0x6040-00	0x0006 0x000F
	Target Velocity	0x60FF-00	Velocity for movement [rpm]
	Controlword	0x6040-00	0x000F

4.2 Read Status

Diagram	Object name	Object	User value [default value]
	Statusword (Target velocity reached)	0x6041-00	The target velocity is reached if bit 10 is set.

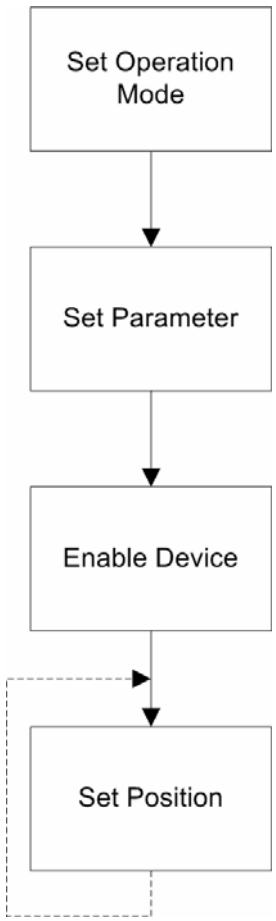
4.3 Stop Velocity

Diagram	Object name	Object	User value [default value]
	Controlword (Halt Profile Velocity Mode) or Controlword (QuickStop)	0x6040-00 0x6040-00	0x010F 0x000B

5 Position Mode

5.1 Set Position

The axis moves to new absolute position with maximum acceleration and maximum velocity. There is no trajectory for this movement. When the difference between the new and the actual position is greater then the 'Max Following Error' an Emergency will be launched.

Diagram	Object name	Object	User value [default value]
	Modes of Operation Max. Following Error Min. Position Limit Max. Position Limit Controlword (Shutdown) Controlword (SwitchOn) Position Mode Setting Value	0x6060-00 0x6065-00 0x607D-01 0x607D-02 0x6040-00 0x6040-00 0x2062-00	0xFF (Position Mode) User specific [2000 qc] User specific [-2147483648 qc] User specific [2147483647 qc] 0x0006 0x000F New Position [qc]

5.2 Stop Positioning

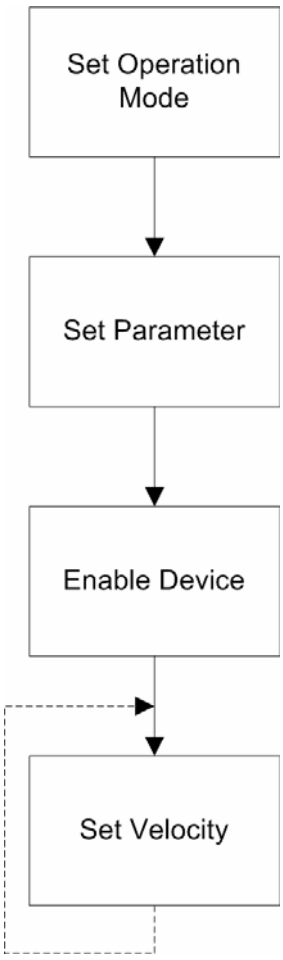
The axis stops with maximum deceleration.

Diagram	Object name	Object	User value [default value]
	Controlword (QuickStop)	0x6040-00	0x000B

6 Velocity Mode

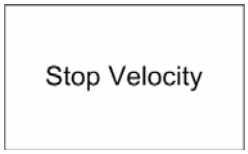
6.1 Set Velocity

Motor shaft runs with a certain speed with maximum acceleration.

Diagram	Object name	Object	User value [default value]
	Modes of Operation - Controlword (Shutdown) Controlword (SwitchOn) Velocity Mode Setting Value	0x6060-00 0x6040-00 0x6040-00 0x206B-00	0xFE (Velocity Mode) 0x0006 0x000F Velocity for movement [rpm]

6.2 Stop Velocity

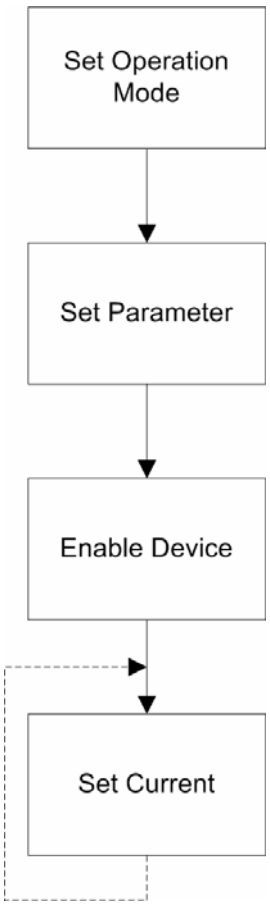
The axis stops with maximum deceleration.

Diagram	Object name	Object	User value [default value]
	Velocity Mode Setting Value or Controlword (QuickStop)	0x206B-00 0x6040-00	0x00000000 0x000B

7 Current Mode

7.1 Set Current

This command applies a certain current on the motor winding.

Diagram	Object name	Object	User value [default value]
	Modes of Operation	0x6060-00	0xFD (Current Mode)
	Continuous Current Limit Max. Speed in Current Mode Thermal Time Constant Winding	0x6410-01 0x6410-04 0x6410-05	Motor specific for all parameters (see catalogue motor data)
	Controlword (Shutdown) Controlword (SwitchOn)	0x6040-00 0x6040-00	0x0006 0x000F
	Current Mode Setting Value	0x2030-00	User specific current [mA]

7.2 Stop Current

Diagram	Object name	Object	Value
	Current Mode Setting Value or Controlword (QuickStop)	0x2030-00 0x6040-00	0x0000 0x0002

8 State Machine

8.1 Clear Fault

Resetting “Fault” condition sends the 'Controlword' with value 0x0080.

Diagram	Object name	Object	User value [default value]
Clear Fault	Controlword (FaultReset)	0x6040-00	0x0080

8.2 Send NMT Service

This command sends a NMT protocol from a master to a slave. It is a command without acknowledge.

Diagram	Parameters	Command specifier
NMT Service	Node-ID (Unique Node-ID or 0 for all nodes) Command specifier	0x01 Start Remote Node 0x02 Stop Remote Node 0x80 Enter Pre-Operational 0x81 Reset Node 0x82 Reset Communication

9 Motion Info

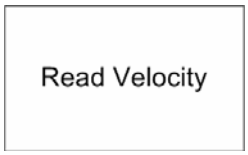
9.1 Get Movement State

Diagram	Object name	Object	Value
	Read Statusword	0x6041-00	Bit 10 tells you if the target is reached. For more detail see operation mode above or 'EPOS Firmware Specification' documentation

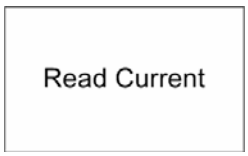
9.2 Read Position

Diagram	Object name	Object	Value
	Read Position	0x6064-00	Position [qc]

9.3 Read Velocity

Diagram	Object name	Object	Value
	Read Velocity	0x2028-00	Velocity [rpm]

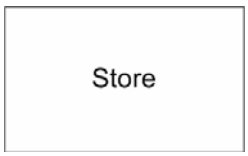
9.4 Read Current

Diagram	Object name	Object	Value
	Read Current	0x6078-00	Current [mA]

10 Utilities

10.1 Store all parameters

Saves all parameters.

Diagram	Object name	Object	Value
	Save All Parameters	0x1010-01	0x65766173 “save”

10.2 Restore all default parameters

Restores all parameters to factory default.

Diagram	Object name	Object	Value
	Restore All Default Parameters	0x1011-01	0x64616F6C “load”

10.3 Restore default PDO COB-ID’s

Set all COB-IDs of the PDOs to the default (Node-ID based) value.

Diagram	Object name	Object	Value
	Restore Default COB-IDs	0x1011-05	0x64616F6C “load”