PD42-x-1243-IOLINK Firmware Manual

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PD42-x-1243-IOLINK is a small easy-to-use mechatronic PANdrive™ IO-Link® actuator device. It combines a NEMA17 stepper motor with controller and driver electronics. The industry-standard IO-Link connection through the standard 4-pin M12 connector offers full control over the stepper motor as well as configuration, and status monitoring.

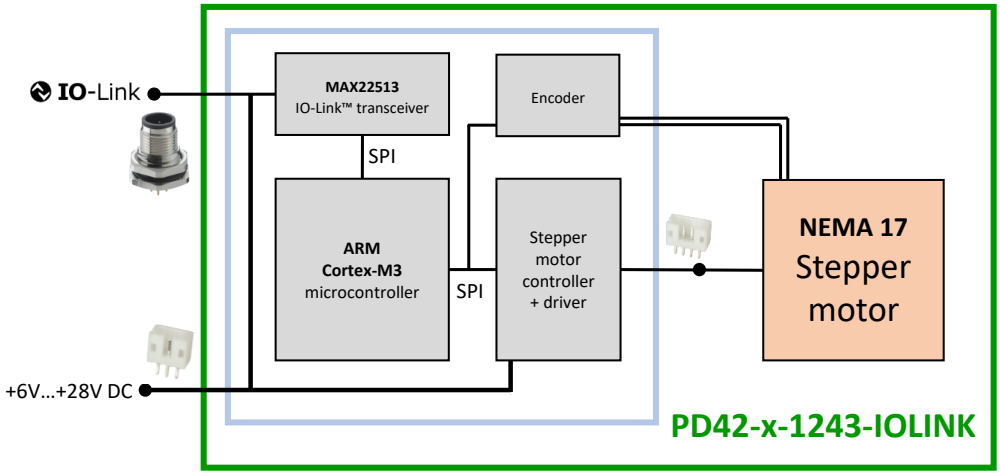
Features

- Stepper motor **NEMA17** / 42mm
- **+6…+28V** DC supply voltage
- Up to **1.2A RMS** motor current
- **IO-Link®** interface
- Integrated motion controller
- **PANdrive™** smart motor
- **StealthChop™** silent PWM mode
- **SpreadCycle™** current control
- **StallGuard2™** load detection
- **CoolStep™** autom. current scaling
- Integrated absolute position sensor

Applications

- Laboratory Automation
- Manufacturing
- Semiconductor Handling
- Robotics
- Factory Automation
- Test & Measurement

Simplified Block Diagram



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Contents

1 Introduction

IO-Link® is a 3-wire industrial communication standard designed for linking sensors and actuators into control networks. The PD42-x-1243-IOLINK brings the power and capabilities of Trinamic motion controlled stepper motors into the IO-level of these networks.

The PD42-x-1243-IOLINK operates at an IO-Link COM3 bitrate (230.4 kbit/s), and with a minimum cycle time of 1.4 ms. The drive applies the Common Profile and the BLOB Transfer & Firmware Update Profile. The IODD-file which is standardized by the IO-Link community, contains all required information to interface with the drive in a machine readable format. It can be downloaded from the Trinamic website [4]. For further information on IO-Link in general, have a look at Maxim's IO-Link Handbook [3].

The following pages give information on how to use the drive. Section 2 is about the Output Process Data witch is used to control the motor position or velocity and about the Input Process Data witch gives feedback of the drive. In section 3 details on the available drive settings and features, are given. When making first steps with the drive, the Quick Start Guide in section 6 can be very helpful.

2 Process Data

2.1 Output Process Data

The output process data is used to control the motor.

2.1.1 Frame Structure

Figure 1: PD42-x-1243-IOLINK Output Process Data Bit Sizes and Bit Positions

2.1.2 Field Description

Target Position (Signed Integer)	In position mode, the new target position to be moved to.
Target Velocity (Signed Integer)	In velocity mode, the new target velocity to be moved with.
Control Word (Enumeration)	Sets the mode of operation.

Value	Operation
0	Off
1	Position Control
2	Velocity Control

2.2 Input Process Data

The input process data can be used to get feedback from the drive.

2.2.1 Frame Structure

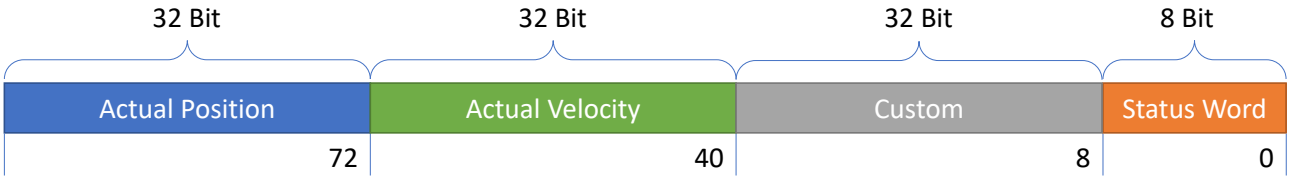

Figure 2: PD42-x-1243-IOLINK Input Process Data Bit Sizes and Bit Positions

2.2.2 Field Description

Actual Position (Signed Integer)	Reflects the position of the motor.
Actual Velocity (Signed Integer)	Reflects the velocity of the motor.
Custom (Signed Integer)	Value of one of the monitoring parameters selected by parameter Custom Process Data Select
Status Word (Bit-Field)	A bit field used to check for positioning status, moving state and errors.

Bit	Flag	Description
0	Moving	Active during an ongoing moving action.
1	Position Reached	Signals, that the target position is reached. This bit is cleared if a new target position is given.
2	Velocity Reached	Signals, that the target velocity is reached. This bit is cleared if a new target velocity is given.
3	StallGuard Error	If StallGuard is enabled, this flag is set when the motor was stopped due to a detected motor stall.
4	Following Error	If the following error detection is enabled (see section 5 for details), this flag is set when the motor was stopped due a detected following error.
5	Drive Error	This flag is the bit-wise logical OR-link of bit 1, 2, 3, and 4 of the Driver Chip Error Flags

3 ISDU Parameter

3.1 Parameter List

Index	Parameter Name
	General Configuration
0x40	Microstep Resolution
0x41	Motor Steps per Revolution
0x42	Custom Process Data Select
	Current Limits
0x50	Maximum Current
0x51	Standby Current
	Encoder Parameter
0x61	Initialize Position
0x62	Following Error Window
0x63	Set Encoder Position
	Profile Parameter
0x70	Profile Start Velocity
0x71	Profile V1
0x72	Profile Velocity
0x73	Profile Stop Velocity
0x74	Profile A1
0x75	Profile Acceleration
0x76	Profile Deceleration
0x77	Profile D1
0x78	Standby Delay
0x79	Ramp Wait Time
0x7A	Power Down Ramp
	Smart Energy
0x80	Smart Energy Current Minimum
0x81	Smart Energy Current Down Step
0x82	Smart Energy Hysteresis
0x83	Smart Energy Current Up Step
0x84	Smart Energy Hysteresis Start
0x85	Smart Energy Filter Enable
0x86	Smart Energy Threshold Speed

Index	Parameter Name
	Chopper Parameter
0x90	Fullstep Threshold Speed
0x91	High Speed Chopper Mode Enable
0x92	High Speed Fullstep Mode Enable
	Stall Guard
0xA0	StallGuard2 Threshold
0xA1	Stop on Stall
	Stealth Chop
0xB0	PWM Threshold Speed
0xB1	PWM Gradient
0xB2	PWM Amplitude
	Monitoring
0xC0	Actual Load Value
0xC1	PWM Scale Value
0xC2	Motor Supply Voltage
0xC3	Actual Current
0xC4	Encoder Position
	Homing
0xD0	Set Actual Position
	Diagnosis
0xE1	Driver Chip Error Flags
0xE2	Drive Temperature

Table 1: Parameter List

3.2 Parameter Details

Note: in the following tables, data types are given according to international standard IEC 61131. The column with the hading DS tells if the parameter is included in the IO-Link data storage.

3.2.1 Microstep Resolution

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x40	USINT	rw	0	8	8	-	yes

Microstep resolutions per full step:

Value	Explanation
0	fullstep
1	halfstep
2	4 microsteps
3	8 microsteps
4	16 microsteps
5	32 microsteps
6	64 microsteps
7	128 microsteps
8	256 microsteps

3.2.2 Motor Steps per Revolution

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x41	DINT	rw	0	65535	200	-	yes

Number of full steps of the motor within one complete revolution. Please do not change! Changing this parameter is only needed if the drive is equipped with another motor.

3.2.3 Custom Process Data Select

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x42	USINT	rw	0	4	0	-	yes

Maps one of the monitoring parameters to the custom process data field.

Value	Parameter that is mapped to the custom process data field
0	Actual Load Value
1	PWM Scale Value
2	Motor Supply Voltage
3	Actual Current
4	Encoder Position

3.2.4 Maximum Current

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x50	INT	rw	0	255	128	-	yes

Motor current used when the motor is running. The maximum value is 255 which means 100% of the current limit of the drive.

Value	Current Scaling factor (CS)	Resulting Percentage of the drives current limit
0..7	1/32	3.125%
8..15	2/32	6.25%
16..23	3/32	9.375%
…	…	…
248..255	32/32	100%

3.2.5 Standby Current

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x51	INT	rw	0	255	8	-	yes

Motor current used when the motor is not running. The maximum value is 255 which means 100% of the maximum current of the module. This value should be as low as possible so that the motor can cool down when it is not moving.

3.2.6 Initialize Position

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x61	BOOL	rw	0	1	1	-	yes

If enabled the actual position is initialized with the encoder position while the drive is booting.

3.2.7 Following Error Window

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x62	DINT	rw	0	2 147 483 647	0	steps	yes

Setting this parameter to a value different from 0 enables the encoder based position error detection. If the difference between the actual position and the encoder position is greater than the specified value, the motor is stopped and the "Following Error" flag is set in the Status Word, see section 2.2.

3.2.8 Set Encoder Position

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x63	DINT	wo	-2 147 483 648	2 147 483 647	steps	-	no

With this parameter the encoder position can be set to zero or any other value. This is helpful in the context of homing via StallGuard. Beware that the internally calculated offset value is not stored permanently in the drive. See section 5 for more details on the encoder.

3.2.9 Profile Start Velocity

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x70	DINT	rw	0	249 999	1	pps	yes

Motor start velocity (in position mode only). Make sure this parameter is greater than Profile Stop Velocity.

3.2.10 Profile V1

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x71	DINT	rw	0	1 000 000	0	pps	yes

First acceleration and decelaration phase target velocity (in position mode only). Setting this value greater than 0 enables the six point ramp (see section 6.3 for details)

3.2.11 Profile Velocity

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x72	DINT	rw	0	7 999 774	51 200	pps	yes

The maximum speed used for positioning ramps.

3.2.12 Profile Stop Velocity

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x73	DINT	rw	0	249 999	10	pps	yes

Motor stop velocity (in position mode only).

3.2.13 Profile A1

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x74	DINT	rw	0	7 629 278	25 600	pps^2	yes

First acceleration between Profile Start Velocity and Profile V1 (in position control only).

3.2.14 Profile Acceleration

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x75	DINT	rw	0	7 629 278	51 200	pps^2	yes

Second acceleration between Profile V1 and Profile Velocity, in six point ramp mode, otherwise the liner ramp acceleration.

3.2.15 Profile Deceleration

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x76	DINT	rw	0	7 629 278	51200	pps^2	yes

First deceleration between Profile Velocity and Profile V1, in six point ramp mode, otherwise the liner ramp deceleration (in position control only).

3.2.16 Profile D1

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x77	DINT	rw	0	7 629 278	25600	pps^2	yes

Second deceleration between Profile V1 and Profile Stop Velocity (in position control only).

3.2.17 Standby Delay

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x78	INT	rw	0	400	0	10 ms	yes

Standstill period before the current will be ramped down to standby current. The value is given in a multiple of 10 ms, so the value 200 results in a delay of 2000 ms.

3.2.18 Ramp Wait Time

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x79	DINT	rw	0	65 535	0	$\frac{1}{32\,768}$ s	yes

Defines the waiting time after ramping down to zero velocity before next movement can start. Time range is 0 to 2 seconds. See diagram in figure 4.

3.2.19 Power Down Ramp

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x7A	INT	rw	0	15	7	0.2 s	yes

Controls the number of clock cycles for motor power down after a motion as soon as the motor has stopped and the setting time has expired. The smooth transition avoids a motor jerk upon power down. A value of 0 means instant power down and a value of 15 makes the longest possible power down ramp.

3.2.20 Smart Energy Current Minimum

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x80	BOOL	rw	0	1	0	-	yes

Also referenced as SEIMIN. Sets the lower motor current limit for CoolStep operation by scaling the CS value.

Value	Resulting lower motor current limit
0	$\frac{1}{2}$ of CS
1	$\frac{1}{4}$ of CS

3.2.21 Smart Energy Current Down Step

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x81	USINT	rw	0	3	0	-	yes

Sets the number of StallGuard2 readings above the upper threshold necessary for each current decrement of the motor current. Number of StallGuard2 measurements per decrement:

Value	measurements per decrement	remark
0	32	slow decrement
1	8	
2	2	
3	1	fast decrement

3.2.22 Smart Energy Hysteresis

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x82	INT	rw	0	15	0	-	yes

Sets the distance between the lower and the upper threshold for StallGuard2 reading. Above the upper threshold the motor current becomes decreased.

3.2.23 Smart Energy Current Up Step

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x83	USINT	rw	0	3	0	-	yes

Sets the current increment step. The current becomes incremented for each measured StallGuard2 value below the lower threshold (see SmartEnergy hysteresis start).

Value	Current increment	remark
0	1	slow increment
1	2	
2	4	
3	8	fast increment / fast reaction to rising load

3.2.24 Smart Energy Hysteresis Start

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x84	INT	rw	0	15	0	-	yes

The lower threshold for the StallGuard2 value (see SmartEnergy current up step).

3.2.25 Smart Energy Filter Enable

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x85	BOOL	rw	0	1	0	-	yes

Enables the StallGuard2 filter for more precision of the measurement. It reduces the measurement frequency to one measurement per four fullsteps. In most cases it is expedient to set the filtered mode before using CoolStep. Keep it switched off for step loss detection.

3.2.26 Smart Energy Threshold Speed

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x86	DINT	rw	0	2 147 483 647	15	pps	yes

Above this speed CoolStep will be active.

3.2.27 Fullstep Threshold Speed

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x90	DINT	rw	0	16 777 215	16 777 215	pps	yes

Speed at which CoolStep is deactivated if High Speed Chopper Mode Enable is enabled. Also this is the speed at which microstepping is switched to full step mode if High Speed Fullstep Mode Enable is enabled.

3.2.28 High Speed Chopper Mode Enable

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x91	BOOL	rw	0	1	0	-	yes

Enables switching to other chopper mode when measured speed is exceeding the Fullstep Threshold Speed.

3.2.29 High Speed Fullstep Mode Enable

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0x92	BOOL	rw	0	1	0	-	yes

Enables switching to fullstep mode when measured speed is exceeding the Fullstep Threshold Speed.

3.2.30 StallGuard2 Threshold

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xA0	INT	rw	-63	63	0	-	yes

This signed value controls StallGuard2 threshold level for stall output and sets the optimum measurement range for readout. A lower value gives a higher sensitivity. Zero is the starting value. A higher value makes StallGuard2 less sensitive and requires more torque to indicate a stall.

3.2.31 Stop on Stall

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xA1	DINT	rw	0	2 147 483 647	0	pps	yes

Below this speed motor will not be stopped. Above this speed motor will stop in case StallGuard2 load value reaches zero.

3.2.32 PWM Threshold Speed

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xB0	DINT	rw	0	16 777 215	0	pps	yes

The StealthChop feature will be switched off when the actual velocity is higher than this value. It will be switched on when the actual velocity is below this value (and PWM Gradient is greater than zero).

3.2.33 PWM Gradient

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xB1	INT	rw	0	255	0	-	yes

Velocity dependent gradient for PWM amplitude(StealthChop). Setting this value to 0 turns off StealthChop.

3.2.34 PWM Amplitude

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xB2	INT	rw	0	255	0	-	yes

Maximum PWM amplitude when switching to StealthChop mode. Do not set too low. Values above 64 are recommended.

3.2.35 Actual Load Value

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xC0	INT	ro	0	1 023	-	-	no

Readout of the actual load value used for stall detection (StallGuard2).

3.2.36 PWM Scale Value

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xC1	INT	ro	0	255	-	-	no

Actual PWM amplitude scaler, a value of 255 corresponds to maximum voltage. In voltage mode PWM, this value allows to detect a motor stall.

3.2.37 Motor Supply Voltage

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xC2	DINT	ro	0	4 095	-	10 mV	no

Motor supply voltage given in a multiple of 10 mV. So a value of 2400 means 24 V.

3.2.38 Actual Current

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xC3	INT	ro	0	31	-	-	no

This status value provides the actual motor current setting as controlled by CoolStep. The value goes up to the CS value and down to the portion of CS as specified by SEIMIN (Smart Energy Current Minimum).

Value	Actual motor current scaling factor (CS)
0	1/32
1	2/32
…	…
31	32/32

Note that, if CoolStep is not enabled, this value only changes between standby- and maximum current depending on moving.

3.2.39 Encoder Position

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xC4	DINT	ro	-2 147 483 648	2 147 483 647	-	steps	no

The position determined by the internal encoder. See section 5 for further details on the Encoder.

3.2.40 Set Actual Position

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xD0	DINT	wo	-2 147 483 648	2 147 483 647	-	steps	no

With this parameter the actual position can be set to zero or any other value. This is helpful in the context of homing via StallGuard. Please make sure not to set a new position during an ongoing position move.

3.2.41 Driver Chip Error Flags

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xE1	BYTE	ro	0	255	-	-	no

Bit	Name	Description
0	StallGuard2 status	motor stall detected
1	Overtemperature	driver is shut down due to overtemperature
2	Overtemperature pre warning	overtemperature pre-warning threshold is exceeded
3	Short to ground at phase A	short condition detected, driver currently shut down
4	Short to ground at phase B	short condition detected, driver currently shut down
5	Open load at phase A	no chopper event has happened during the last period with constant coil polarity
6	Open load at phase B	no chopper event has happened during the last period with constant coil polarity
7	Stand still	motor halted

3.2.42 Drive Temperature

Index	Data Type	Access	Min	Max	Default Value	Unit	DS
0xE2	DINT	ro	-2 147 483 648	2 147 483 647	-	0.1°C	no

Measured temperature of the onboard temperature sensor.

4 Features

4.1 StallGuard™

StallGuard2 provides an accurate measurement of the load on the motor. It can be used for stall detection as well as other uses at loads below those which stall the motor, such as CoolStep load-adaptive current reduction. The StallGuard2 measurement value changes linearly over a wide range of load, velocity, and current settings. At maximum motor load, the value goes to zero or near to zero. This corresponds to a load angle of 90 ° between the magnetic field of the coils and magnets in the rotor. This also is the most energy-efficient point of operation for the motor.

For more details on StallGuard2 take a look at Application Note 002 [1].

4.2 SixPoint™ Ramp

The ramp generator allows motion based on target position or target velocity. It automatically calculates the optimum motion profile taking into account acceleration and velocity settings. The SixPoint ranp offers faster machine operation compared to the classical linear acceleration ramps. The SixPoint ramp generator allows adapting the acceleration ramps to the torque curves of a stepper motor and uses two different acceleration settings each for the acceleration phase and for the deceleration phase.

5 Encoder

Please note that the PD42-x-1243-IOLINK is an open-loop system, hence the encoder value, obtained by reading monitoring parameter Encoder Position, can only be used to check if the motor has really reached its target position or really follows the position counter. The Hall-Effect based encoder has a resolution of 4096 counts and is scaled that the encoder counts match the position counts per rotation. For the scaling calculation the Microstep Resolution is also taken into account. The Encoder Position value is counting through multiple turns, but the number of turns will not be saved. So on every power-on the Encoder Position is initialized with the absolute position of the encoder.

With parameter Following Error Window, the encoder based step loss detection can be enabled. When enabled, the motor is stopped as soon as the absolute difference between (scaled) encoder value and actual position is greater than the Following Error Window.

6 Quick Start Guide

6.1 Basic Move to Position

The factory default settings for the PD42-x-1243-IOLINK are chosen in a way that a positioning move only requires to set the process data. So setting

- the Control Word to "Position Control" and
- the Target Position to the desired target position, should move the motor.

Beware that per default the microstep resolution is set to 256, thus a full rotation requires 51 200 counts.

6.2 Basic Rotating

Rotating the motor with a given speed is done by setting

- the Control Word to "Velocity Control" and
- the Target Velocity to the desired target velocity.

6.3 SixPoint™ Ramp Move

By default the six point ramp is disabled as the Profile V1 parameter is set to zero. In this mode a linear ramp is active like shown in the velocity over time diagram in figure 3.

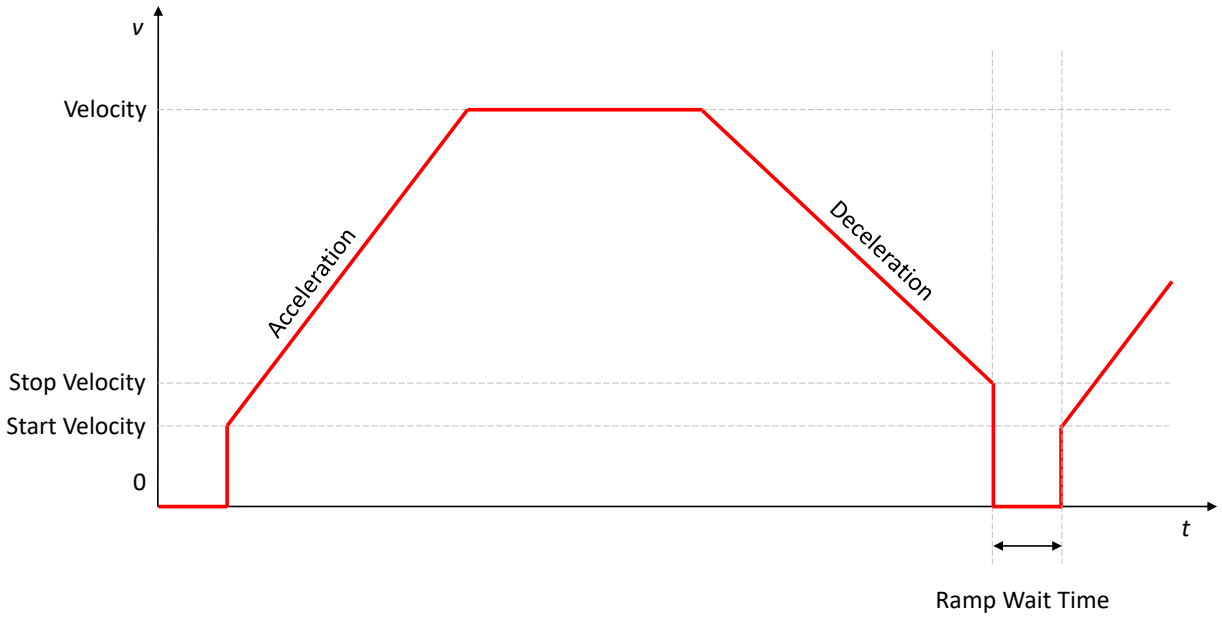

Figure 3: PD42-x-1243-IOLINK Linear ramp

To move to a position in six point ramp mode set

- Profile V1 to a value greater than 0 and
- set Profile A1 and Profile D1 to the desired value.

Optionally Profile Start Velocity and Profile Stop Velocity can be adapted. Now a position move can be done like described in section 6.1. With that the velocity over time characteristic will look like in diagram in figure 4.

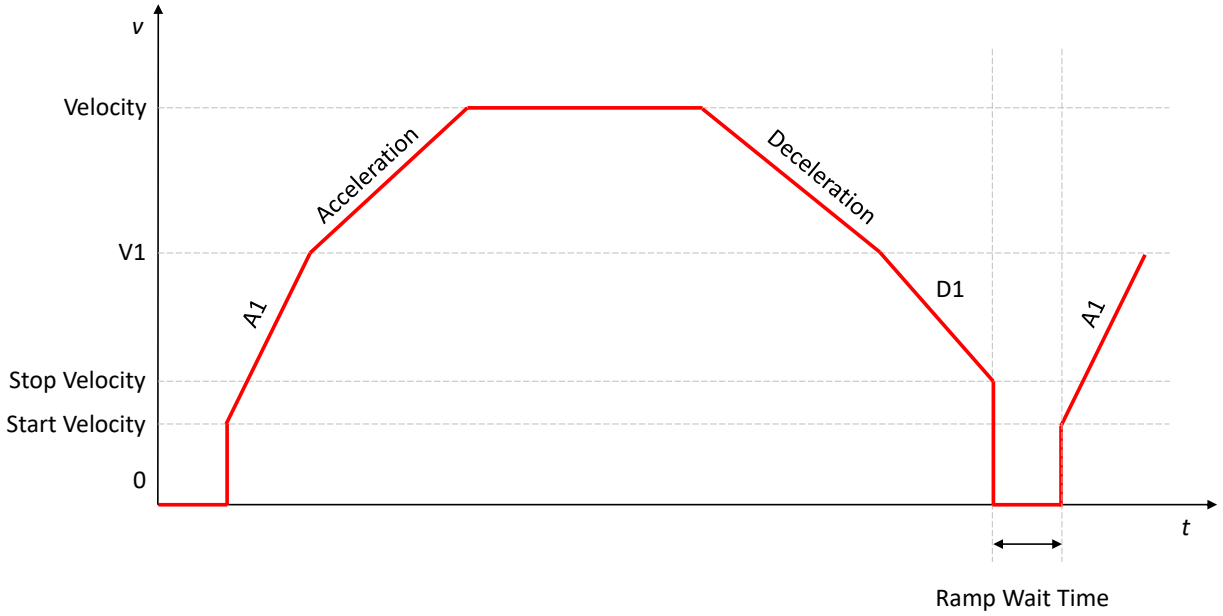

Figure 4: PD42-x-1243-IOLINK Six Point Ramp

6.4 StallGuard™ Stop on Stall Demo

Finding the right parameters for StallGuard2 is very much dependent on the load of the motor, so this example might only work without any load. Starting upon all parameters reset to their factory default state.

- Set the Maximum Current parameter to 32,
- set the StallGuard2 Threshold parameter to 3 and
- set the Stop on Stall parameter to 10 000.

To demonstrate the Stop on Stall feature, start rotating the motor with a velocity of around 51 200 pps. Note that StallGuard2 will work in both position and velocity mode. When applying load to the motor the motor should stop at a certain load level, and the StallGuard Error flag will be set in the status word (see section 2.2). To rerun the motor, toggle the control word or write a different target position or target velocity, depending on the mode. Beware that this is only an example to get a feeling for the StallGuard2. A good value for StallGuard2 Threshold must be found for any individual combination of load and Maximum Current.

6.5 CoolStep™ Demonstration

Note in order for CoolStep to work well in the final application the parameters must carefully be configured to fit the load changes of the application. This demo of the load adaptive current control feature assumes there is no load applied to the motor when the motor starts rotating. Starting upon all parameters reset to their factory default state.

- Set the Maximum Current parameter to 32,

- set the StallGuard2 Threshold parameter to 3,
- set the Smart Energy Current Minimum parameter to 1 and
- set the Smart Energy Hysteresis Start parameter to 2.

Now rotate the motor with around 102 400 pps, and then slightly apply load to the motor. The drive should increase the current as the load increases. To monitor the current adaption in software, continually read out the Actual Current parameter. For a higher update rate, the Actual Current can also be mapped to the input process data via the Custom Process Data Select.

6.6 StealthChop™ Demonstration

To minimize noise produced by the drive, StealthChop can be used. Starting upon all parameters reset to their factory default state.

- Set the Smart Energy Threshold Speed parameter to 2 000 000,
- set the PWM Threshold Speed parameter to 2 000 000 and
- set the PWM Gradient parameter to 15.

Now rotate the motor with around 200 000 pps. The noise of the drive should noticeably decrease compared to StealthChop switched off, which is done by setting PWM Gradient to 0. Make sure no additional noise is caused by motor vibration.

7 Acknowledgement

The firmware of the PD42-x-1243-IOLINK was developed in cooperation with TMG TE.

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8 References

[1] Trinamic. Application Note 002 - StallGuard™. https://www.trinamic.com/support/app-notes/.

[2] Trinamic. Application Note 009 - Tuning CoolStep™. https://www.trinamic.com/support/app-notes/.

[3] Maxim Integrated. IO-Link Handbook. https://www.maximintegrated.com/an6454

[4] Trinamic. Product website - PD42-1-1243-IOLINK. https://www.trinamic.com/products/drives/details/pd42-1-1243-iolink/

9 Figures Index

10 Tables Index

11 Supplemental Directives

11.1 Producer Information

11.2 Copyright

11.3 Trademark Designations and Symbols

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11.4 Target User

The documentation provided here, is for programmers and engineers only, who are equipped with the necessary skills and have been trained to work with this type of product.

The Target User knows how to responsibly make use of this product without causing harm to himself or others, and without causing damage to systems or devices, in which the user incorporates the product.

11.5 Disclaimer: Life Support Systems

TRINAMIC Motion Control GmbH & Co. KG does not authorize or warrant any of its products for use in life support systems, without the specific written consent of TRINAMIC Motion Control GmbH & Co. KG.

Life support systems are equipment intended to support or sustain life, and whose failure to perform, when properly used in accordance with instructions provided, can be reasonably expected to result in personal injury or death.

Information given in this document is believed to be accurate and reliable. However, no responsibility is assumed for the consequences of its use nor for any infringement of patents or other rights of third parties which may result from its use. Specifications are subject to change without notice.

11.6 Disclaimer: Intended Use

The data specified in this user manual is intended solely for the purpose of product description. No representations or warranties, either express or implied, of merchantability, fitness for a particular purpose

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11.7 Collateral Documents & Tools

This product documentation is related and/or associated with additional tool kits, firmware and other items, as provided on the product page at: www.trinamic.com.

12 Revision History

12.1 Firmware Revision

Version	Date	Author	Description
V1.00	2020-OCT-23	BP	Initial Version.
V1.01	2020-JAN-08	BP	Improved Version.

Table 2: Firmware Revision

12.2 Document Revision

Version	Date	Author	Description
V1.00	2020-OCT-23	BP	Initial version.
V1.01	2020-NOV-10	BP	Review.
V1.02	2020-JAN-08	BP	Review.

Table 3: Document Revision