



# **Application Note**

Starting up a Nanotec Controller/Drive with IDEC SmartAXIS FT1A-H40RSA

Version 1.0.0

www.nanotec.com





# Contents

1	Pre	requisites	1
2	Har	dware	1
3	Soft	tware	1
4	Cre	ating a new project and configuring the communication	2
5	Exa	mple file for Profile Position Mode	5
	5.1	Set up and description of the positioning example project	5
	5.2	How to start positioning movements	7
6	Exa	mple for operation with Plug & Drive Interface (PDI)	8
	6.1	Set up and Description of the PDI example project	8
	6.2	How to use the PDI	
7	Liat	oility	11
8	Сор	oyrights and contact	11



# **1** Prerequisites

The slave drive (Nanotec Controller) must be configured beforehand. Proper operation of the motor and slave drive must be ensured before the example can be used. Make sure that the controller/drive operation is not hindered, e.g. by a stand-alone program running on the slave.

# 2 Hardware

IDEC SmartAXIS FT1A-H40RSA, System Software Version 2.30 N5-2-4, Firmware version FIR-v1825-B577172

# 3 Software

WindLDR, Version 8.12.0



# 4 Creating a new project and configuring the communication

- 1 Create a new project in WindLDR and select your PLC. The given examples are for Ladder programming.
- 2 Go to tab **Configuration** -> **Network Settings**.
- 3 Set the appropriate IP address for your PLC. It must match the drive IP address, e.g. 192.168.99.5 for the PLC and 192.168.99.149 for the drive.

	- (n) en 🔁 🚛 💭 =	Profile Positio	n_Testprojekt.pjw - WindLl
ш,	iome Configuration Inline View	$\sim$	
PLC Type PLCs	Run/Stop Memory Input Control Backup Configuration Ports	A Cartridges LCD Device Program Self Calendar Network Connection Settings Settings Protection Diagnostic & Clork Settings Settings Settings Remote I/O	
Project Win	Function Area Settings		? ×
	Run/Stop Control Memory Backup Input Configuration Communication Ports Cartridges LCD Settings Device Settings Program Protection Self Diagnostic Calendar & Clock Network Settings Connection Settings	Configure Network settings. IP Settings Obtain an IP Address automatically (DHCP) Use the following IP address: IP Address: IP Address: Subnet Mask: 255.255.255.0 Default gateway: 0.0.0.0.0	

4 Go to tab **Configuration** -> **Connection Settings** and choose **Modbus TCP Client** in the dropdown menu for **Communication Mode**.

	🗐 🤊 🖓 📲 💭 Ŧ	Profile Position_Testproj	ekt.pjw - Win
•••	Home Configuration Inline Vie	w	
PLC Type PLCs	Run/Stop Memory Input Control Backup Configuration P	Imm. Cartridges LCD Device Program Self Calendar Network Connection Settings Settings Protection Diagnostic &Clock Settings Settings Protection Diagnostic &Clock Settings Settings Protection Diagnostic & Clock Settings Settings Protection Diagnostic & Clock Settings Protection Diagnostic & Clock Settings Protection Protectica Protection Protection Prot	
Project W	Function Area Settings		
	Run/Stop Control Memory Backup	Configure parameters for connections.	
<b>.</b>	Communication Ports	Connections	
	Cartridges	1 Modbus TCP Client TCP Configure	
	Device Settings	2 Maintenance Communication Server TCP Configure	
	Program Protection Self Diagnostic	3 User Communication Client Modbus TCP Server TCP Configure	
	Calendar & Clock	Remote I/O Master	
	Network Settings		
	Connection Settings		



5 Click on **Configure** and set up the communication mapping.

For both examples below there are configurations available for import. These are suitable for the standard mapping of the drive.

When importing you still need to set up the **Remote Host No.** with the right IP address of your drive.

ques	t Execution Device	Error Status	 	@#	Use a sinole DR for a	l communication re-	quests		
Use	(Onuse	Ouse	 	Onuse	Update error status o	only when communic	ation fails		
leq. No.	Function Code	Master Device Address	Data Size	Word/Bit	Remote Host No.	Slave Number (1 to 247)	Modbus Slave Address	Req. Execution Device	Error Status
1	03 Read Holding Registers	D0001	 1	Word	1: 192.168.99.149 (502)	1	405001		
2	03 Read Holding Registers	D0002	 1	Word	1: 192.168.99.149 (502)	1	405002		
3	03 Read Holding Registers	D0003	 2	Word	1: 192.168.99.149 (502)	1	405003		
4	03 Read Holding Registers	D0005	 1	Word	1: 192.168.99.149 (502)	1	405005		
5	03 Read Holding Registers	D0006	 2	Word	1: 192.168.99.149 (502)	1	405006		
6	06 Preset Single Register	D0010	 1	Word	1: 192.168.99.149 (502)	1	406001		
7	06 Preset Single Register	D0011	 1	Word	1: 192.168.99.149 (502)	1	406002		
8	16 Preset Multiple Registers	D0012	 2	Word	1: 192.168.99.149 (502)	1	406003		
9	16 Preset Multiple Registers	D0014	 2	Word	1: 192.168.99.149 (502)	1	406005		
10	16 Preset Multiple Registers	D0016	 2	Word	1: 192.168.99.149 (502)	1	406007		

For a clearer view of the registers you can set tag names and comments for the used registers.
 Go to the **Tag Editor** and name the used registers accordingly.
 For both examples below there are configurations available that can be imported. Please note that the used Device Type is D (Data Register).



Application Note – IDEC SmartAXIS FT1A-H40RSA Version 1.0.0



## Standard default mapping Tx PDO (defined in Nanotec CANopen object 0x3602:xx):

Nanotec	CANopen	Object
---------	---------	--------

0x6041	Statusword
0x6061	Modes of Operation Display
0x6064	Position Actual Value
0x6042	VI Velocity Actual Value
0x60FD	Digital Inputs
0x2292:01	PDI Status
0x603F	Error Code
0x2292:02	PDI Return Value

# **IDEC Modbus Slave Address**

405001 405002 405003 and 405004 405005 405006 and 405007

404997 404998 404999 and 405000

# Standard default mapping Rx PDO (defined in Nanotec CANopen object 0x3502:xx):

# Nanotec CANopen Object

0x6040	Controlword
0x6060	Modes of Operation
0x3202	Motor Drive Submode Select
0x607A	Target Position
0x6081	Profile Velocity
0x6042	VI Target Velocity
0x60FE:01	Digital Outputs
0x2291:01	PDI Set Value 1
0x2291:02	PDI Set Value 2
0x2291:03	PDI Set Value 3
0x2291:04	PDI Command

**IDEC Modbus Slave Address** 406001 406002 406003 and 406004 406005 and 406006 406007 and 406008 406009 406010 and 406011

405997 and 405998 405999 406000 Byte 0 406000 Byte 1



# 5 Example file for Profile Position Mode

This example shows how the Profile Position Mode could be used in a WindLDR ladder program.

# 5.1 Set up and description of the positioning example project

#### Set up the example:

You simply need to import the example project and adjust your communication settings.

- 1 Click on the round button in the top left corner and choose Open -> WindLDR Project. Then choose the file Application Note – Nanotec – IDEC SmartAxis FT1A-H40RSA – Example Project – Profile Position.
- 2 Go to tab **Configuration** -> **Network Settings**.
- 3 Set the appropriate IP address for your PLC. It must match the drive IP address, in the example it is set to 192.168.99.5, the drive address was set beforehand to 192.168.99.149.
- 4 Go to tab Configuration -> Connection Settings
- 5 Click on **Configure** and adjust the **Remote Host No.** according to your drive settings. When using the standard PDO mapping now the communication should be set up correctly.
- 6 To run the example, right-click anywhere in the ladder structure, go to **Online** -> **Convert**, **Download**, **and Monitor**. Afterwards the program should be running on the PLC.

#### **Description of used Device Addresses:**

Address	Tag Name	Description
D0001	StatusWord	gives the current state of the Statemachine
D0002	ModeOfOperationDis	Low Byte shows active Operation Mode, High Byte is a Dummy
D0003	ActualPosition_1	Shows Actual Position value, high part of DWORD
D0004	ActualPosition_2	low part of DWORD
D0005	vl_ActualVelocity	Actual Velocity value
D0006	Inputs_1	Input mask value, high part of DWORD
D0007	Inputs_2	low part of DWORD
D0010	ControlWord	controls the Statemachine
D0011	ModeOfOperation	Low Byte controls Operation Mode, High Byte Dummy
D0012	SubModeSelect_1	Selection of control loop options, high part of DWORD
D0013	SubModeSelect_2	low part of DWORD
D0014	TargetPosition_1	Sets Target Position, high part of DWORD
D0015	TargetPosition_2	low part of DWORD
D0016	ProfileVelocity_1	Sets Profile Velocity, high part of DWORD
D0017	ProfileVelocity_2	low part of DWORD
D0018	vl_TargetVelocity	Target Velocity for velocity mode
D0019	Outputs_1	sets Output mask value, high part of DWORD
D0020	Outputs_2	low part of DWORD



# **Description of Ladder Program:**

## Rung 1:

This Rung simply shows how a Device Address could be set in a ladder rung. But when online and monitoring the Device Addresses can also be written to directly, for example in the **Batch Monitor**. In the example the *ModeOfOperation* is set to "1", which is Profile Position Mode.

			Application Note - Nanotec - IDEC SmartAXIS FT1A-H40RSA - Example Project - Profile Position.pjw - WindL	DR
Home Configuration Online View				
Download Upload Device Data List Transfer	onitor Monitor	tom • th sed I/O	PowerLine Port Monitor Set Up Simulation Communication	
Property P ×	Main Prog	gram		
	Rung 1		MoO; High	Т
🔛 21 🐵		SetMoO	MOV(W) S1 - D1 - REP 1 ModeOfOpera	]
	Batch N	lonitor	? ×	li
	Device:	D (DataReg	ister) 🔹 0 🗘 Monitor Type: HEX (W) 💌	Н
	Comment	:		
		Current Value	Comment	н
	D0000	0000		11
	D0001	0233	SW	Ш
	D0002	0001	MoOD, High Byte Dummy, Low Byte MoOD	Π
	D0003	2260	ActPos1	Ш
	D0004	0000	vi Artvel	H
	D0006	0000	Inputs 1	
	D0007	0000	Inputs_2	1
	D0008	0001		H.
	D0009	0621		
	D0010	0007	ContW	
•	D0011	0001	MoO; High Byte Dummy, Low Byte MoO	
	D0012	0000	SubMode_1	
	D0013	0000	SubMode_2	
	D0014	0000	TargetPos_1	
	D0015	0000	TargetPos_2	
	00016	0000		H



# Rung 2:

This Rung represents the Statemachine of the Nanotec drive. The *ControlWord* is set depending on the *StatusWord* and user inputs (*Enable, New\_Setpoint, Change\_Setpoint\_imm, Relative\_Positioning*). If a fault is recognized by the drive the drive will be disabled and the *Error* Output is set. An error can be reset with the *Error\_Reset* input.



# 5.2 How to start positioning movements

- 1 Set the *Enable* input to power up the motor.
- 2 Set the desired Target Position in Online -> Monitor -> Batch. Please note: The Target Position is composed of two Device Addresses. This is due to the fact that the device addresses are set up to be 16 bit values, as is common for Modbus Registers. The target position however is a 32 bit value in our object dictionary. So, we need two 16 bit values to combine them to a 32 bit value.
  Termst Desition -> D0011 (TermstDesition -2)

Target Position = D0014 (TargetPosition\_1), D0015 (TargetPosition\_2) E.g. "-2000" (dec) = "FFFF F830" (hex) = [ D0014 == "FFFF" (hex), D0015 == "F830" (hex) ]

- 3 Set the optional inputs (*Relative\_Positioning, Change\_Setpoint\_imm*) according to your needs. The user inputs are set as bits in Data Register *D0000*.
- 4 Set the input New\_Setpoint to start a movement.
- 5 By toggling the input *New\_Setpoint* you can start new positioning movements.



# 6 Example for operation with Plug & Drive Interface (PDI)

This example shows the principle of using the PDI in a WindLDR ladder program. For further information on the application of PDI please refer to the Functional Description Plug&Drive-Interface.

# 6.1 Set up and Description of the PDI example project

# Set up the example:

You simply need to import the example project and adjust your communication settings.

- 1 Click on the round button in the top left corner and choose Open -> WindLDR Project. Then choose the file Application Note – Nanotec – IDEC SmartAxis FT1A-H40RSA – Example Project – Profile Position.
- 2 Go to tab **Configuration** -> **Network Settings**.
- 3 Set the appropriate IP address for your PLC. It must match the drive IP address, in the example it is set to 192.168.99.5, the drive address was set beforehand to 192.168.99.149.
- 4 Go to tab Configuration -> Connection Settings
- 5 Click on **Configure** and adjust the **Remote Host No.** according to your drive settings. When using the standard PDO mapping now the communication should be set up correctly.
- 6 To run the example, right-click anywhere in the ladder structure, go to **Online** -> **Convert**, **Download**, **and Monitor**. Afterwards the program should be running on the PLC.

## **Description of used Device Addresses:**

Address	Tag Name	Description
D0001	PDI_Status	gives the current state of the drive and PDI interface
D0002	Error_Code	shows the error code for the latest error
D0003	PDI_Return_Value_1	shows the return value, depending on the used mode,
		high part of DWORD
D0004	PDI_Return_Value _2	low part of DWORD
D0005	PDI_set_Value1_1	used differently depending on Mode, mostly for target
		Values, high part of DWORD
D0006	PDI_set_Value1_2	low part of DWORD
D0007	PDI_set_Value2	use depends on mode
D0008	Set_Value3_PDI_Cmd	High Byte: PDI Set Value 3 is used for reading/writing of
		objects and settings of Homing Method
		Low Byte: PDI-Cmd is used as control command



# **Description of Ladder Program:**

## Rung 1:

This Rung is used to set the PDI Command for the Operation Mode you want to start. In the example there are three different Commands, which are values "1" (Switch Off), "23" (Profile Velocity), and "20" (Profile Position absolute).

Switch Off will disable the drive, the motor will no longer be powered.

Profile Velocity will start the Profile Velocity mode with whatever the profile settings are. The settings must be checked and adjusted before starting the mode. This is possible with **Rung 2**.

Profile Position absolute will start the Profile Position mode with an absolute position movement. The settings for the movement must be checked and adjusted before starting the mode. This is possible with **Rung 3**.

All commands are automatically reset after they are sent.

📄 Main Pro	gram (	
Rung 1 1	Set PDI Command Switch Off Switch_Off	High Byte: PDISet-Valu MOV(W) S1 - D1 - REP 1 Set Value3 P
2		Switch Off
3	Start Profile Velocity	High Byte: PDISet-Valu MOV/W) S1 - D1 - REP
4	Start_ProfVel	Start Profile Velocity
5	Start Profile Position abso Start_ProfPos	Start_ProfVel High Byte: PDISet-Valu MOV(W) S1 - D1 - REP 20 Set Value3 P
6		Start Profile Position abso R Start_ProfPos

## Rung 2:

This Rung sets the parameter settings for the Profile Velocity Mode. Here the PDI Set Value 1 is set. Note that the PDI Value 1 is a 32-bit value. Therefore, two registers need to be set, in this case *PDI\_set\_Value1\_1* to "0" and *PDI\_set\_Value1\_2* to "60". PDI Set Value 1 is then "60" rpm (default unit).

Rung 7 2	Set Parameters for Profile Velocity Set Parameters f			PDI_Set_Val ue1_1
s	etParameters_PV	MOV(W)	S1 - 0	D1 - REP PDI Set Valu
8				0 PDI_Set_Val ue1_2
	·	MOV(W)	S1 - 60	D1 - REP PDI Set Valu 60

## Rung 3:

This Rung sets the parameter settings for the Profile Position absolute Mode. Here the PDI Set Value 1 and PDI Set Value 2 are set.

Instead of writing the two registers for *PDI\_Set\_Value1* with WORD data type (as shown in **Rung 2**) it is also possible to write two registers at once by choosing data type LONG. This way it is also easily



possible to write negative values. In the example the value is set to "-2000". The position unit by default is 3600 steps/revolution.

Rung 3	9	Set Parameters for Profile Position Set Parameters f			PDI_Set_Val ue1_1	
	S	etParameters PP	- MOV(L)	S1 -	D1 - PDI Set Valu	REP
	10		L	-2000	-2000 PDI_Set_Val ue2	
			MOV(W)	S1 - 120	D1 - PDI_Set_Valu 120	REP

The *PDI\_Set\_Value2* is set to "120". This is the speed for the position movement.

# 6.2 How to use the PDI

In general, the PDI can be used to start simple movements and can be used as an alternative to the Device Profile given in CiA 402 standard.

PDI commands can be used to start movements directly without using the Statemachine. By setting the PDI command to a certain value the corresponding drive profile will be started directly. It is important to check and adjust the boundary conditions for the profile before starting it.

# **Using Profile Velocity Mode:**

- 1 Set the input *SetParameters\_PV* in **Rung 2** to write the set values to PDI Set Value 1. In the example the speed will be set to 60 rpm (default unit).
- 2 Reset the input *SetParameters\_PV* in **Rung 2** after the value is set.
- 3 Set the input *Start\_ProfVel* in **Rung 1** to write the value "23" to *Set\_Value3\_PDI\_Cmd*. By setting the PDI Command to "23" the Profile Velocity Mode is started, the motor will move with the set speed.
- 4 To stop the movement set the input *Switch\_Off* in **Rung 1**.

## Using Profile Position absolute Mode:

- 1 Set the input SetParameters\_PP in Rung 3 to write the set values to PDI Set Value 1 and PDI Set Value 2. In the example the position will be set to "-2000" (1/10<sup>th</sup> of a degree) and the speed will be set to 120 rpm (default unit).
- 2 Reset the input SetParameters\_PP in Rung 3 after the values are set.
- 3 Set the input *Start\_ProfPos* in **Rung 1** to write the value "20" to *Set\_Value3\_PDI\_Cmd*. By setting the PDI Command to "20" the Profile Position absolute Mode is started, the motor will move with the set speed to the set target position.
- 4 To stop the movement or simply shut down the motor set the input *Switch\_Off* in **Rung 1**.



# 7 Liability

This Application Note is based on our experience with typical user requirements in a wide range of industrial applications. The information in this Application Note is provided without guarantee regarding correctness and completeness and is subject to change by Nanotec without notice.

It serves as general guidance and should not be construed as a commitment of Nanotec to guarantee its applicability to all customer applications without additional tests under the specific conditions and - if and when necessary - modifications by the customer.

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The responsibility for the applicability and use of the Application Note in a particular customer application lies solely within the authority of the customer. It is the customer's responsibility to evaluate, investigate and decide, whether the Application Note is valid and suitable for the respective customer application, or not.

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