

ABSOLUTE ROTARY ENCODER OPTOCODE (OCD) CANOPEN



CANOPER

---APPLICATION NOTE---

OCD CANOPEN WITH SCHNEIDER TWIDO PLC

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OCD CANopen with Schneider Twido PLC

Main Features

- Compact and heavy-duty industrial designs
- Interface: CANopen / CAN
- Housing: 58 mm Ø
- Solid / hollow shaft: 6 or 10 mm Ø / 15 mm Ø
- Through hollow shaft: 12 mm Ø
- Max. 65536 steps per revolution (16 Bit)
- Max. 16384 revolutions (14 Bit)
- Velocity- and Acceleration- output
- LSS Services

Mechanical Structure

- Aluminium flange and housing
- Stainless steel shaft
- Optional: Stainless steel flange/ housing
- Precision ball bearings with sealing or cover rings
- Code disc made of unbreakable and durable plastic

Programmable Parameters

- Direction of rotation (complement)
- Resolution per revolution
- Total resolution
- Preset value
- Two limit switches and eight CAMs
- Baud rate and CAN-identifier
- Transmission modes: Polled mode, cyclic mode, sync mode

Electrical Features

- Temperature insensitive IR-opto-receiver-ASIC with integrated signal conditioning
- Connection cap: Status indication with two LEDs
- Highly integrated circuit in SMD-technology
- Polarity inversion protection
- Over-voltage-peak protection

OCD CANopen manual can be downloaded at:

http://www.posital.com/us/products/POSITAL/AbsoluteEncoders/AbsoluteEncoders OCD CANopen base.html

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1. INTRODUCTION

An OCD-CANopen 24-bit absolute, multiturn rotary encoder was connected to a Schneider-TWIDO programmable logic controller (PLC) through a CANopen communication interface. The step-by-step connection procedure and the working of encoder in a CAN bus are illustrated in the following sections.

2. CONTROLLER NETWORK - SETUP AND INITIALISATION

HARDWARE



SOFTWARE PROJECT INFORMATION

Project inform	nation	
File information		
Project	OCDinPLC	
Directory	C:\Program Files (x86)\Schneider Electric\TwidoSuite\My projects	
Project information		
Author	ANA	
Department	Engineering	
Index	Singapore	
ndustrial Property	FRABA	
Comment Descript	tion Image	

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CONTROLLER DESCRIPTION



CANOPEN MASTER DESCRIPTION



Description of the module Reference number TWDNC01M Address 1 Description CANopen bus master module. I <t< th=""><th>e P</th></t<>	e P
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• OCD ENCODER – ELECTRONIC DATA SHEET (EDS)

The OCD EDS file, once uploaded will load all the objects including the PDOs to the controller. The Schneider system automatically identifies the PDOs and maps them on to the slave device.



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• CONNECTION NETWORK SETUP

The above illustration shows the connection of elements in the CAN bus. At first, the CANOpen communication interface is connected to the main controller. Then the encoder is connected to the CANOpen communication interface.

The next step after the setup of the network is the configuration of all the parameters and settings, to facilitate the communication between the master, slave and the controller.

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3. CONFIGURATION

• OCD PROCESS DATA OBJECTS (PDO) MAPPING

The list of all available objects is pre-programmed in the EDS file. Upon loading the EDS file, the PDOs can be accessed for configuration. Then, according to the need, the objects are mapped on to the Transmit-PDO's of the OCD.

In this case we will be loading the position values (Available in object 2000h) to the 1st transmit PDO, to read out the position values of the encoder through the PLC.



OCD CANOPEN NODE CONFIGURATION

The baud rate is adjusted to 125 Kbaud and node number to 1 using the switches in the connection cap. Then the PLC's connection to the node (OCD) is configured.

Configuration	×
Element	
Na	ame OCD
Protocol	
Туре	CANopen 🔽
Address	1
Supervision	None
Init	Default 🔽
	OK Cancel

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• CANOPEN BUS NETWORK CONFIGURATION

The CANopen bus network configuration is for the setting of a new CANopen network. If an already existing network is available, we need to configure only the encoder in order to make it compatible with the existing network.

Configur	ation				×
CANor	oen network_				
Na	me	canopen			
Pa	rameters				
		Baudrate	125	- Kbps	
		Supervision	300	ms	
		l	OK	Can	cel
Ľ					

• LINKING OF CANOPEN MASTER AND OCD TRANSMIT-PDOS

The PDOs of the slave are mapped on to the CANopen master so that the information contained in the objects at the slave end are transmitted and saved on to the controller's memory. The position values thus obtained can be used for control purposes as directed by the PLC.

Li	nking								x
	Not-Linked Slaves PDOc			Link	ed Master	r PDOs			
	Type Transmit 🔽		4		Û ()		Type Re	ceive	-
	Slave	Name	COB-ID	#	PDO		Name	COB-ID	^
				1	<u>e'</u>	00	D PDO TX 1	181	
				2	E.	00	D PDO TX 2	281	
				3					
				4					
				5					
				6	<u></u>			-	Ξ
				/					
				8					
				10					
				11					
				12				-	
				13					
				14					
				4.5					Ŧ
	SDO								
	Memory space							9%	
						ОК		Cancel	

OCD CANopen with Schneider Twido PLC

OCD & CONTROLLER MEMORY CONFIGURATION

The current and updated position values from the OCD encoder are mapped on to an EEPROM memory location in the controller. In this case it is stored in %IWCD1.0.0 as indicated.

Module co	onfiguration.								
#	Slave	Туре	Supervision	Init	Use	Address	Symbol	Object	Size
1 OCD		OCD Encoder Series (V1	None	Default		%IWCD1.0.0	POSITION	Position value	32
						Address	in EEPROM		

4. DEBUGGING

The debugging stage is done on completing the configuration of the PDO's.

It involves the following steps:

Connection for debugging							
This connection mode allows you	Select a	Connection					
to directly connect to a controller or	Туре	Name	Connection mode	IP address/Number			
controller	Pc	COM9	Serial	COM9,Punit			
The communication has been established							
	Test the	connection					
	PLC app PLC ==>	toSuite and the PLC (iate connection import e configurations are of PLC Transfer is pose blication is not protect > PC transfer is author	applications are differe ssible compatible: sible ed: orized	int:			
	Comparis	on of applications					
			Project	Controller			
	Applicat	tion Name My	Twido N	/ly Twido			
	Type of	base TWI	DLMDA20DTK T	WDLMDA20D-K			
	Choose a	a type of exchange					
					Ţ	Transfer PC ==> controller	Transfer controller ==> PC
	Confirm y	our type of exchange.					
	ОК	Cancel					

The USB serial communication port is selected and PC-> controller transfer is initiated. Once the transfer is initiated the configured parameters and the programming done on the PC is debugged and transferred to the controller for real time application. The following illustrations are the intermediate tasks during debugging.

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•	1	Y		1			/			
	Project	Describe	Program	Report						Offline
		- C. (3)-		_			c	Configure	Program Debug	
Con	nec	osuite	and the second							Connect
This c	onnect									
to dire	ectly od					dress/Number				Memory
contro	iller).Punit				Managment
			Т	ransferring binary.dat						
Thor	omm									
riie c										
	-			The TwidoSuite and t	he PLC applications are o	lifferent				
				immediate connecti	on impossible	indicit.				
				Hardware configuration	ons are compatible:					
				PLC application is not	r is possible i protected:					
				PLC> PC transfer	is authorized					
				Comparison of applica	tions					
					Project	Controller				
				Application Name	My Twido	My Twido				
				Type of base	TWDLMDA20DTK	TWDLMDA20D-K				
				Choose a type of exch	ange					
							internet.		100.00	
							2		BUE	
							Trans	for	Transfer	
							PC ==	> controller	controller ==> PC	
				Confirm your type of e	change					
				OK Cano	el					
										*
				Comm	EXECUTION WAR	NING> : NO START IN RUN WAS		3		
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Converting all the programmed parameters to binary format.....

	C DinPLC - Microsoft Word	OCDinPLC	
Project Describe Program Report		II 🐼	Offline
TwidoSuite	Configure	Program Debug	
This connect			Connect
to directly co	dress/Number		Memory
controller Creating a bac	kup of the controller application		managinen
The comm			
The T	vidoSuite and the PLC applications are different.		
imm Hardy	date connection impossible are configurations are compatible:		
PLC	PLC I renster is possible pplication is not protected:		
Compa	ison of applications		
	Project Controller		
Appli Type	ation Name My Twido My Twido of base TWDLMDA20DTK TWDLMDA20D-K		
Choos	a type of exchange		
	50	30	
	Transfer	Transfer	
Confir	i your type of exchange		
	K Cancel		
			~
	KEXECUTION WARNINGS : NO START IN RUN WAS		
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Creating a back up of the controller parameters before going into online mode......

Once the controller goes into the online mode, the PDOs cannot be changed. But, we can program the SDOs as and when need arises.

OCD CANopen with Schneider Twido PLC

5. RUN

Once debugged, the controller goes into online mode. We then, can program the SDOs if needed and then run the controller.

-	
Application name:	My Twido
Twido State:	Running
Reference:	TWDLMDA20D-K
Firmware version:	5.20
Current Time:	
I/O Failure:	TRUE
I/O Forced:	
Current PLc scanning period:	3
Address used:	Punit
Port used:	
COM9	
1.4	
LAC: NA	
L St.	
·	
VDLMDA20D-K	
RUN	
Error	
Stat	500

Upon start up, we can create an animation table to monitor the necessary controller parameters and the system variables which contain the position value. In this case %IWCD1.0.0 which contains the OCD position value (EEPROM memory mentioned in Section 3). Once the animation table is setup, we can run the controller.

	Δ	Us	Address	Symbol	Current	Retained	Format
1	Ι		%SW81		000000000101000	00000000000000000	Binary
2			%SW20		0	0	Decimal
3			%IWCD1.0.0	POSITION	0	0	Decimal
4							

%SW81 : System variable indicating the processing of CANOpen commands.

%SW20 : System variable indicating the current mode of the CAN network

=0: CAN bus off and error free nodes.

=2: Node operational and error free.

%IWCD1.0.0 : Memory location carrying the position value.

OCD CANopen with Schneider Twido PLC

• TRANSMITTED PDO BY OCD

Once we run the controller all the system variables and position values gets updated regularly. We can see that the position value is updated to current position of the OCD. We know that the OCD is 12 bit single turn and 12 bit multi turn.

Therefore, SINGLETURN (ST) RESOLUTION is $(360^{\circ}/4096) \sim 0.088^{\circ}$

If the output is: 0000EB6C Hex

(Hex) EB6C -> (Bin) 1110101101101100 -> (Dec) 14 2924 -> [Resolution: ST = 0.088]

POSITION: MT 14 Turns & ST (2924 x 0.088) = 257.312°

🔥 Us 🛛 Address	Symbol	Current	Retained	Format
1 🛛 %SW81		0000000000001011	000000000000000000000000000000000000000	Binary
2 📘 🗆 %SW20		2	0	Decimal
3 🛛 🗆 %IWCD1.0.0	POSITION	0000EB6C	0000000	Hexadecimal
4				
	Analization come		×	
	Twido State:	Running		
	Reference:	TWDLMDA20D-K		
	Firmware version:	5.20		
	Current Time:	TRUE		
	I/O Forced:	INCL		
	Current PLc scann	ing period: 3		
	Address used:	Punit		
	COM9			
	L Ac: NA			
	L SI.			
	TWDLMDA20D-K			
	RUN			
	Error		9	
	Jai			
	6	TwidoSuite		

The mathematical computation of the position values vary according to the user. There are various methods of computing from the obtained value. The values are calculated such that, references can be set by the controller for particular programmed tasks according to the position or turn value or both as required by the application.

OCD CANopen with Schneider Twido PLC

• SDO REQUEST AND EXECUTION*

In order to continuously monitor the position values of the OCD, the **cyclic timer needs to be set** to a value. This can be done by using the object 6200h. Here we set the timer to 64h ms (100ms).

<mark>1</mark>	L		
0	*		LD 1
1	4/*		[%MWO := 16#0004]
2	1/*		[%MW1 := 16#0001]
3	25088/*		[%MW2 :≓ 16#6200]
4	2/*	Cyclic Timer set	[%MW3 := 1 6#0002]
5	100/*	Cyclic Tiller Set	[%MW4 := 16#0064]
6	0/*	$t_{0.64H} = 100 ms$	[%MW5 := 16#0000]
7	* /*	200110	[CAN_CMD1 %MW0:6]

The equivalent program in ladder logic:

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1			OCD_test	8
Project Describe	Program Report	Continue		Stop 👥
8 123 Lad	ider 🔽 🖶 🗛 🐄 🤇	४ 100% ॼ ৡ ि ि ि २ н≈ ॎ ऺ ि ि डि	Trogram acasy	Disconnect
Program HO I Ladder) (/) 🖬 🙀 🗄 🗔 % % 🚿 🔹 🕨 I F I/I IPF INF		Antonio
Top [0] Ru	ng 0	914840 4040004		the program
Bottom [0]	SHORT	%50004 %50004 %60004	4	Manage animation tables
		96MVV1 := 16#0001		Check PLC
			· · · · · · · · · · · · · · · · · · ·	Monitor hardware
/×		9(10/0/2 16#6200		configuration
		%MW2 = 16#6200		software
		225		Monitor
TwidoSuite		%MW3 := 16#0002		described configuration
Tindocuno		%MW3 := 16#0002	2	Monitor the behavior
		%MW4 := 16#0064 %MW4 := 16#0064		
		1	00	
		%MW/5 := 16#0000		
		%MW5 := 16#0000	<u>.</u>	
		CAN_CMD1 %MW0:6 CAN_CMD1 %MW0:6		
	L		······	*
		EXECUTION WARNINGS NO START IN RUN WAS		
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* All the programming are unique to Twido Suite and can vary from controller to controller. But the basic logic used in the programming is always the same.

OCD CANopen with Schneider Twido PLC

6. Illustration of obtained Position Values

Initial (0°) Position:

	Δ	Us	Address	Symbol	Current	Retained	Format
1	I		%SW81		000000000001011	000000000000000000000000000000000000000	Binary
2	Ĩ		%SW20		2	0	Decimal
3	I		%IWCD1.0.0	POSITION	0000A27A	00000000	Hexadecimal
4							

Position: MT= 10 Turns ST= 55.792°

At approximately 180 degree rotation:

	Δ	Us	Address	Symbol	Current	Retained	Format
1	Ι		%SW81		000000000001011	000000000000000000000000000000000000000	Binary
2	I		%SW20		2	0	Decimal
3	I		%IWCD1.0.0	POSITION	0000AAA4	0000000	Hexadecimal
4							

Position: **MT=** 10 Turns **ST=** 239.712°[55.792° + 180° = 235.792° **]

At approximately 360 degree rotation i.e. 1 turn:

	Δ	Us	Address	Symbol	Current	Retained	Format
1	T		%SW81		000000000001011	000000000000000000000000000000000000000	Binary
2			%SW20		2	0	Decimal
3	I		%IWCD1.0.0	POSITION	0000B2BA	00000000	Hexadecimal
4							

Position: **MT=** 11 Turns **ST=** 61.424°[55.792°+360° = 59.792°**]

The above example shows the intermediate position values read out from the controller in one full rotation.

** The errors in the readings are due to the manual rotation by hand. It is just used to illustrate the variation of the readings obtained in rotating the shaft for one full turn.

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For detailed information or any queries please contact:

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