

# New Eagle<sup>™</sup> CANopen MotoHawk<sup>™</sup> Library

NE-MH-CANOPEN-LIB-001

# User Guide

Revision 001

7/1/2015







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## **PRODUCT DESCRIPTION**

### OVERVIEW

The New Eagle<sup>™</sup> CANopen Library is the perfect toolbox to add the CANopen protocol to any Motohawk project. This library interface allows for complete customization of the CANopen initialization sequence and control of up to 64 slave nodes. The library enables you to quickly establish the communication protocol for a multi-node CANopen network in a familiar Motohawk environment, reducing development and complexity.

### **PRIMARY SOFTWARE FUNCTIONS**

Configuration of the library is narrowed to a PDO data definition file. From that file the library internalizes and manages the following protocols:

- CANopen Protocol Initialization
  - Network Management (NMT) protocol (master)
    - Module control protocol
    - Heartbeat protocol
  - Service Data Object (SDO) Protocol
    - Custom object dictionary definitions
- Process Data Object (PDO) Protocol
  - TPDOs 1-4 (Transmit PDOs) Customization
  - RPDOs 1-4 (Receive PDOs) Customization
- Synchronization Object (SYNC) Protocol
  - Configurable Sync-Producer



### INSTALLATION

To install the CANopen Library, copy the CANopenLib directory into your Libraries directory under the directory in which your project resides. In order for MATLAB to find the CANopen libraries, make sure your working path is set to your model's directory. You can use the Initialization block and the CANopen protocol blocks the library provides by browsing to 'CANopen Library' in the Simulink Library Browser.





# USAGE

CANOPEN PROTOCOL INITIALIZATION FLOWCHART

Understanding the entire initialization process isn't necessary to use this library, but understanding the general flow may be beneficial if issues arise.



Above, a simplified, but accurate, flowchart depicts the states of the initialization block sequence. It begins in the START state, and after the initialization process is complete, it enters the SYSTEM\_RUNNING state. This is indicated by the output state Enable\_DriveMessages == 1, and at this point the user process should take control to send and react to PDO messages.



### PDO CONFIGURATION

- a. The PDOs need to be changed from the default PDO configuration, you will need to update the corresponding PDO file. See 'pdoconfig\_example.m' for details on customizing the PDO configuration.
- b. Note: If there are multiple CANopen nodes with different PDO configurations, you will need a PDO m-file for each unique configuration.

#### INITIALIZATION BLOCK

b.

a. This block is critical to the CANopen Protocol. It handles the startup sequence to initialize the CANopen node, as well as logic to re-initialize should the node disconnect or restart.

leyRun			Enable_DriveMessag
	CANopen Prot	ocol Initializatio	n
	PDO Con	figuration 1	
	Node ID:	0x01	
	CAN:	CAN_1	
nitalize SDOs			Timed

- c. Block Inputs/Outputs:
  - i. Input Key Run
    - 1. The first time this is enabled, it will attempt to connect and initialize the drive. After the first initialization, enabling/disabling this will "pause" the system.
  - ii. Input Initialize SDOs:
    - 1. While the system is running it may be necessary to re-initialize a node. A rising edge on this input will trigger a re-initialization.
  - iii. Output Enable\_DriveMessages:
    - 1. When this output is high, the node is capable of receiving and transmitting messages.
  - iv. Output Timeout
    - 1. Indicates the initialization sequence has timed out.



d. Block Configuration/Parameters:

CAN Name  InvCAN' Node ID  1 PDO Config pdoconfig Object Dictionary Init File (Can be empty)  ExtraObjectDictionarySetup1  III	Paramet	ers				
'InvCAN' Node ID 1 PDO Config pdoconfig Object Dictionary Init File (Can be empty) 'ExtraObjectDictionarySetup1	CAN Na	ne				
Node ID 1 PDO Config pdoconfig Object Dictionary Init File (Can be empty) 'ExtraObjectDictionarySetup'	'InvCAN	ľ				
1 PDO Config pdoconfig Object Dictionary Init File (Can be empty) 'ExtraObjectDictionarySetup'	Node ID					
PDO Config pdoconfig Object Dictionary Init File (Can be empty) 'ExtraObjectDictionarySetup1 <	1					
pdoconfig Object Dictionary Init File (Can be empty) 'ExtraObjectDictionarySetup!	PDO Cor	nfig				
Object Dictionary Init File (Can be empty)  'ExtraObjectDictionarySetup'	pdocon	fig				
'ExtraObjectDictionarySetup¶ ∢ III ▶	Object [	ictionary	Init File (	Can be e	mpty)	
< III >	'Extra0	bjectDicti	onarySetu	p'		
4 III >>>						
	∢ [		111			Þ

- v. CAN Name: Specify the Motohawk CAN name, default is likely to be 'CAN\_1'
- vi. Node ID: The ID of the node you would like to communicate with (1-64).
- vii. **PDO Config**: The m-file that will be used during the PDO initialization sequence.
- viii. Object Dictionary Init File:
  - 1. This is an <u>optional</u> parameter.
  - Use this if you need custom Object Dictionary entries (do not specify PDO configurations here). <u>Note</u>: The parameter value is expecting the name of an m-file without the extension (.m) surrounded by single quotes, e.g. 'ObjectDictionarySetup'.

#### **TRANSMIT PDO**

b.

e.

a. Based off of the MotoHawk CAN Send block, this block transmits PDO messages.

on Enable									
	Name: CAN_1 Destantly ClNC								
	Protocol: CANU	pen DCM-1							
	Totowrol: 5 mg	(200 H	-)						
	TD: 0v000002	(200 H	ב) מסבחות	,					
	Maek: 0x000007	FF (DIA	NDARD	·					
peed % CMD	RTR: 0								
	Message: 'PDO (	Configu	ratio	n 1':	TX PDO 1				
	Description: P	DO1 Tx							
	Payload Size:	8							
coeleration	Payload Conten	ts:							
	Name	Units	LSB	Len	Typel	Byte Order	Gain	Offset	Min
	Run Enable	 I	561	16	UNSIGNED	LITTLE ENDIAN	1.00	0.001	0.00
	Speed % CMD	1	401	16	SIGNED	LITTLE_ENDIAN	1/100.00	0.001	-327.68
	Acceleration	1	241	16	SIGNED	LITTLE_ENDIAN	1/100.00	0.001	-327.68
oreleration	Acceleration	1	81	16	SIGNED	LITTLE_ENDIAN	1/100.00	0.001	-327.68



c.

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- d. Block Parameter Configuration:
  - ix. CAN Name: The MotoHawk CAN bus on which to transmit the PDO message.
  - x. Node ID: The node ID of which the PDO message will be addressed (1-64).
  - xi. **PDO Config**: The m-file that holds all of the PDO definitions.
  - xii. **PDO Tx Index** (1-4): The index of the TX PDO that will be transmitted, as it corresponds to the PDO Config file.
  - xiii. Pacing: Rate at which to send the PDO message in ms.

#### **RECEIVE PDO**

b.

a. This receives PDO messages from another CANopen node (references config.rx in pdo config file)

Name ( Chil 1							Trip
Slot: g 1 2 gapl	DeadDDO S	lot					
Protocol: CANOn	an	100					
Source Module:	DCM-1						
Interval: Asvncl	ironous ()	no peri	odic dead	line)			
Queue Size: 1		2000					
ID: 0x0000038	L (STANDA	RD)					
Mask: 0x000007f:	E						Trip
							p
RTR: 0							
RTR: 0							
RTR: 0 Message: 'PDO Co	onfigurat:	ion 1':	RX_PDO_3				
RTR: 0 Message: 'PDO Co Description: PDO	onfigurat: 03 rx	ion 1':	RX_PDO_3				
RTR: 0 Message: 'PDO Co Description: PDO Payload Size: 8	onfigurat: D3 rx	ion 1':	RX_PDO_3				
RTR: 0 Message: 'PDO Ca Description: PDO Payload Size: 8	onfigurat: D3 rx	ion 1':	RX_PDO_3				
RTR: 0 Message: 'PDO Co Description: PD Payload Size: 8 Payload Contents	onfigurat: D3 rx a:	ion 1':	RX_PDO_3				
RTR: 0 Message: 'PDO C Description: PDO Payload Size: 8 Payload Content:	onfigurat: D3 rx s:	ion 1':	RX_PDO_3				Trip
RTR: 0 Message: 'PDO C Description: PD Payload Size: 8 Payload Content: Name  U	onfigurat: D3 rx s: hits  LSB	ion 1':   Len	RX_PDO_3 Type1	Byte Order	Gain	Offset	Trip
RTR: 0 Message: 'PDO C Description: PD Payload Size: 8 Payload Content: Name  U Trip Word 1	onfigurat: D3 rx a: nits  LSB 	ion 1':   Len    16	Type  UNSIGNED	Byte Orderi LITTLE ENDIANI	Gain  1.000	Offset	 Trip
RTR: 0 Message: 'PDO C Description: PD Payload Size: 8 Payload Content: Name  U Trip Word 1  Trip Word 2	onfigurat: 03 rx a: nits  LSB   56   40	ion 1':   Len    16    16	RX_PDO_3 Type1 UNSIGNED  SIGNED	Byte Order  LITTLE_ENDIAN  LITTLE_ENDIAN	Gain   1.000  1/100.000	Offset 0.000 0.000	 Trip
RTR: 0 Message: 'PDO C Description: PD Payload Size: 8 Payload Content: Name  U Trip Word 1  Trip Word 2  Trip Word 3	onfigurat: 03 rx a: hits  LSB 	ion 1':   Len     16    16    16	Type   UNSIGNED  SIGNED  SIGNED	Byte Order  	Gain  1.000  1/100.000  1/100.000	Offset 0.000 0.000 0.000	 Trip
RTR: 0 Message: 'PDO C Description: PD Payload Size: 8 Payload Content: Name  U Trip Word 1  Trip Word 2  Trip Word 3  Trip Word 3  Trip Word 4	onfigurat: 03 rx =: hits  LSB    56   40   24   8	ion 1':   Len    16    16    16	Type I UNSIGNED I SIGNED I SIGNED I SIGNED I SIGNED I	Byte Order! LITTLE_ENDIAN! LITTLE_ENDIAN! LITTLE_ENDIAN! LITTLE_ENDIAN!	Gain  1.000  1/100.000  1/100.000  1/100.000	Offset 0.000 0.000 0.000 0.000	 Trip
RTR: 0 Message: 'PDO C Description: PD Payload Size: 8 Payload Content: Name  U Trip Word 1  Trip Word 2  Trip Word 3  Trip Word 4	nfigurat: 03 rx s: hits  LSB   56   40   24   8	ion 1':   Len    16    16    16	Type   Type   UNSIGNED   SIGNED   SIGNED   SIGNED	Byte Orderi LITTLE_ENDIANI LITTLE_ENDIANI LITTLE_ENDIANI LITTLE_ENDIANI	Gain  1.000  1/100.000  1/100.000  1/100.000	Offset 0.000 0.000 0.000 0.000	 Trip



### **EXAMPLE**

An example model is included with the CANopen Library, 'CANopen\_example.mdl'. This model should be sufficient to get you started. The included pdo configuration m-file contains additional help text and usage recommendations.





## SUPPORT

### INCLUDED SUPPORT

Eight (8) hours of general support is included with the purchase of the CANopen Library. Submit your inquiries to <u>support@neweagle.net</u>.

### POTENTIAL FUNCTIONALITY OPTIONS

With an additional contract, New Eagle can create custom software to meet your CANopen application's specific needs. This includes (but is not limited to):

- Customization of the CANopen library within your Motohawk project to meet a specific CANopen implementation
- Functioning as a slave node within the Network Management (NMT) protocol
- Compatibility with non-traditional CANopen implementations



## **APPENDIX A:** ADDITIONAL DOCUMENTATION AND REFERENCES

CANopen protocol specification via CAN-in-Automation: http://www.can-cia.org/?canopen

New Eagle's Wiki article on this CANopen library: link

pdo\_config\_example.m: Included in the library release, it contains additional information on how to customize the PDO configuration for your application.



### **PRODUCT DISCLAIMER**

This product is intended to be used by controls engineers familiar with the MotoHawk<sup>®</sup> and Simulink<sup>®</sup> model-based development environment. Please contact New Eagle for any necessary application assistance or product training.

# **PRODUCT COMPATIBILITY**

The library is compatible with recent versions of Motohawk and MATLAB 32/64bit. This library has been tested with the following versions: MATLAB 2009b 32-bit, MATLAB 2010a 64-bit, and MATLAB 2012a 64-bit.

If your version is not listed please contact New Eagle support (<u>support@neweagle.net</u>) to check for compatibility.