6. CAN bus CANopen information

6.1 Introduction to CANopen

6.1.1 CANopen standard

This document assumes the reader is familiar with the CiA 301 specification released by CAN in Automation. Terminology from the standard is used, but not described in detail. The Electrak® HD actuator is compliant with the standard. The default baudrate is 500kbit/s and it will only support the standard CAN frame with 11-bit identifier field.

6.1.2 EDS file

Thomson provides an electronic data sheet file (EDS) to integrate the Electrak HD into a specific CANopen network. The EDS file can be downloaded at www.thomsonlinear.com/en/support/docs-linear-actuators-literature under the Configuration Files section.

6.1.3 Node ID

The Electrak HD uses a default node ID of 19 (0x13). In applications where the default address is not available, it is possible to select an address through hardware switches. Activate the desired address select input by connecting it to positive and address select common to negative. This allows the user to change the default address using the address select inputs as defined in section (CANopen connection diagram). Activating individual select pins will create a binary adder to the default address. This method can allow up to 8 individual actuator addresses on a single bus. The below chart shows some examples on how this can be implemented.

Address Select					
Address select common	Address select 3	Address select 2	Address select 1	Binary adder	Default address
Gnd	0	0	0	0	19 (0x13)
Gnd	0	0	1	1	20 (0x14)
Gnd	0	1	0	2	21 (0x15)
...					
Gnd	1	1	1	7	26 (0x1A)

6.1.4 NMT State

The Electrak HD support the CANopen network management (NMT) slave state machine. It needs to be put in the operational state before operating properly.

Example
Sending a CAN message with id 0x0, containing the data 0x01 0x00 will put all connected actuators in the operational state. Sending a CAN message with id 0x0, containing the data 0x01 0x13 will put an actuator with the default Node ID in the operational state.
Ensure that the proper node ID is used when referencing multiple actuators on a single bus network.

6.1.5 Sleep operation

The Electrak HD utilizes a sleep mode operation when positioning is no longer required. This feature allows for a constant battery connection with minimal drain while the engine or vehicle is not running. After 120 seconds of bus inactivity, the actuator will put itself in a state of sleep. During this state the quiescent current is <1 mA for 12 Vdc models, <2 mA for 24 Vdc models and <2.5 mA for 48 Vdc models. The actuator will leave the sleep mode when bus activity is restored.

6.2 Actuator control

6.2.1 Control PDO properties

Operational control of the actuator is achieved by sending the statically mapped RPDO with COB-ID 0x200 + Node ID. It will have the following layout:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Target Position		Current Limit		Target Speed		Movement Profile	Control Bits

The preferred transmission repetition rate is 100ms (can also be sent as required by the application).

6.2.2 Control PDO entries

The Object Dictionary entries mapped to the RPDO are:

Index	0x2100
Name	Target Position
Object Type	VAR
Data Type	UNSIGNED16
Description	The target position for the next actuator motion. The 0.0 mm and full extend stroke values represent 0 to 100% stroke and are only relative to the actual available stroke of the individual unit. Resolution: 0.1mm/bit, 0 offset.

Index	0x2101
Name	Current Limit
Object Type	VAR
Data Type	UNSIGNED16
Description	The current at which the actuator will cease all motion. In the event a force is applied to the actuator that causes the motor current to exceed this settable value for more than 8 ms, the actuator will stop any current motion and activate a dynamic braking effect on the motor. This current limit does not apply during the motor starting phase where in rush current can be significantly higher than normal running. Range: 0.0 A to 25.0 A (12 Vdc models), 0.0 A to 12.5 A (24 Vdc models), 0.0 A to 6.5 A (48 Vdc models). Resolution: 0.1 A/bit, 0 offset

Index	0x2102
Name	Target Speed
Object Type	VAR
Data Type	UNSIGNED16
Description	Controls the PWM driver within the actuator and the voltage applied to the motor. The resultant actuator speed will be a ratio of the actuators max speed, and also dependent on the load applied to the actuator. Range: 20% to 100% duty cycle. Resolution: 0.1%/bit, 0 offset.

Index	0x2103
Name	Movement Profile
Object Type	VAR
Data Type	UNSIGNED8
Description	Controls the behavior of the actuator when trying to reach the target position. Value set to 0: Normal operation, the actuator will run towards the target position at the target speed. It will stop when the target position is reached. This should be the preferred value for most application. Value set to 1: Precise operation, the actuator will perform an extra move after the target position is reached, this will increase accuracy in some applications. Value set to 2: Small step operation, the actuator will run with reduced speed towards the target position. This will allow proper movement during very small positional increments.

Index	0x2104
Name	Control bits
Object Type	VAR
Data Type	UNSIGNED8
Description	Bit 0 (LSB) – Enable bit: This bit is used to enable motion from the actuator. If it is low (0), no motion will be allowed. This bit can be used to define the next actuator movement message without starting the motor. When movement is required this bit can be changed to high (1) and motion will begin using the values of the other objects contained in the RPDO.

6.2.3 Control PDO example

Sending a CAN message with ID 0x213 containing the data 0xE8 0x03 0x7D 0x00 0x20 0x03 0x00 0x01 will make an actuator to move to position 100mm, at 80% duty cycle, with the current limit set to 12.5A. The example will work on an actuator with the default Node ID, if it is in the operational NMT state.

6.3 Actuator feedback

6.3.1 Feedback PDO properties

Operational feedback of the actuator is achieved by receiving the statically mapped TPDO with COB-ID 0x180 + Node ID. It will have the following layout:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Measured Position		Measured Limit		Measured Speed		Motion Flags	Error Flags

6.3.2 Feedback PDO entries

The Object Dictionary entries mapped to the TPDO are:

Index	0x2200
Name	Measured Position
Object Type	VAR
Data Type	UNSIGNED16
Description	The measured position of the actuator. The 0.0 mm and ordered full extend stroke values represent 0 to 100% stroke but the signaled value does not take in to account any mechanical tolerances or play in the actuator. Resolution: 0.1mm/bit, 0 offset.

Index	0x2201
Name	Measured Current
Object Type	VAR
Data Type	UNSIGNED16
Description	The actual current being used by the actuator. Resolution: 0.1 A/bit, 0 offset

Index	0x2202
Name	Measured Speed
Object Type	VAR
Data Type	UNSIGNED16
Description	The actual duty cycle being applied to the motor through the internal actuator controller. Resolution: 0.1%/bit, 0 offset.

Index	0x2203
Name	Motion Flags
Object Type	VAR
Data Type	UNSIGNED8
Description	Contains information about the current actuator motion. Bit 0 (LSB) – Extending: 1 if currently extending, 0 otherwise. Bit 1 – Retracting: 1 if currently retracting, 0 otherwise.

Index	0x2204
Name	Error Flags
Object Type	VAR
Data Type	UNSIGNED8
Description	Contains information about actuator errors. Bit 0 (LSB) - Parameter Error: This flag is used to inform the user that one of the object values in the RPDO is outside the allowed ranges the specific model will allow. To prevent damage to the actuator motion is not allowed after this flag is set. Bit 1 – Current Overlaod: This flag is used to inform the user that the last motion the actuator attempted caused an overload condition. This occurs when the actuator determines the current set in the Current Limit object from the RPDO is exceeded for a consecutive 8 ms. When this flag is set by the actuator the user must reset the Motion Enable bit in the RPDO before attempting additional motion from the actuator. Bit 2 – Voltage Error: This flag is used to inform the user that the operational voltage is outside of allowable running parameters. Any motion already in progress will continue for 10 seconds, but additional movement request will not be allowed until the operational voltage returns within the normal operating range. Bit 3- Temperature Error: This flag is used to inform the user that the operational temperature is outside of allowable running parameters. Any motion already in progress will continue for 10 seconds, but additional movement request will not be allowed until the operational temperature returns within the normal operating range. Bit 4 – Backdrive Detected: This flag is used to inform the user that the actuator has determined positional movement in the extension tube that was not commanded from the user. This can be caused from excessive static load or vibration being applied to the actuator. Bit 5 – Message Timeout: This flag is used to inform the user that no RPDO has been received within the time specified in the PDO timeout time object(0x2005). When this flag is set by the actuator the user must reset the Motion Enable bit is the RPDO before attempting additional motion from the actuator. The default value is 5000ms. Bit 6 – Fatal Error: This flag is used to inform the user that the actuator was unable to detect any motion while trying to run the motor, or that the position was updating in the wrong direction. When this flag is set by the actuator the user must reset the Motion Enable bit in the RPDO before attempting additional motion from the actuator. Repeated activation of this flag indicates problems with the actuator, and it is recommended to contact the factory for additional support. Bit 7(MSB)- Memory Error: This flag is used to inform the user that the internal memory of the actuator is corrupted.