MICROPHASE
Technology & Performance

CANopen

Additional Information

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CONTENTS

Chapter

MANUAL REV 1.0
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1 CANopen MAIN FEATURES

Table 1.1 CANopen Features.

NMT:	Slave
Error Control:	Node Guarding
Node Id:	Parameter in drive EEPROM
Bit rate:	Parameter in drive EEPROM
Number of PDOs:	2 Rx, 2 Tx
PDO Modes:	Syncronous (cyclic, acyclic) Asyncronous Remotely requested (sync or async)
PDO Linking:	Yes
PDO Mapping:	Variable, max 4 entries per PDO
Numbers of SDOs:	1 Server, 0 Client
Emergency message:	Yes
CANopen version:	DS-301 V4.01
Device profile:	DSP-402 V1.1
Certification:	In progress
Operational modes:	Profile position mode Homing mode Interpolated position mode (linear interpolation) Profile velocity mode

For further information refer to CIA (CAN in Automation) documentation:

⇨ CANopen Communication Profile for Industrial Systems: Standard DS-301 V4.01.

⇨ Device Profile Drives and Motion Control DSP 402 V1.1.

2 DIGITAL I/O BUS

In the 16 poles connector, you have a 16 lines digital I/O bus working at 24 Vdc. Input and output voltages are intended with respect of the negative 24 Vdc supply.

Table 2.1 Digital I/O bus.

Connector pin number	Pin mode	CANopen I/O bit number	CANopen function
1	In	17	Digital in
2	In	18	Digital in
3	In	19	Digital in
4	In	20	Digital in
5	In	21	Digital in
6	In	22	Digital in
7	In	23	Reserved
8	In	24	Negative limit switch / Digital in
9	In	25	Positive limit switch / Digital in
10	In	27	Digital in
11	In	16	Position latch / Digital in
12	Out	16	Digital out
13	Out	17	Digital out
14	In	26	Home switch / Digital in
15	Out	19	Reserved
16	Out	18	Brake / Digital out

CANopen I/O bit number, is used in objects:

0x60FD - digital_inputs

0x60FE - digital_outputs

sub-index 01: physical_outputs

sub-index 02: bitmask

Position latch input is used to freeze the user position of axle at the instant of the signal rising edge. The frozen position is then available at object 0x2001. Because of filtering, the input signal must remain high at least 2 ms.

CANopen function not used (e.g. Limit Switches), can be utilized as general digital I/O.
If the corresponding bit in "digital_outputs - bitmask" bit is set, the pin is configured as output.

3 DESCRIPTION of MAIN PARAMETERS USED by CANopen

Parameters Description:

F3	**Emergency stop ramp**	Value in %

Defines the emergency deceleration ramp:

(00 - 99): 00 = Fastest stop ramp;
50 = About 1.5 seconds (from nominal velocity to zero);
99 = About 3 seconds (from nominal velocity to zero).

c7	**CANopen Node-Id**	Number

Defines the CANopen Node_Id.
This parameter is read only at power-up. So, every change during normal operation is not performed.

c9	**Drive mode select**	Number

Select drive mode: 5 CANopen mode.

i1	**Position loop proportional gain**	Value in %

Defines the proportional gain used by the position controller.

i2	**Position loop integral gain**	Value in %

Defines the integral gain used by the position controller.

i3	Position loop derivative gain	Value in %

Defines the derivative gain used by the position controller.

i4	**Position loop feed-forward gain**	Value in %

Defines the feed-forward gain used by the position controller.
Feed-forward is a correction of the output of position controller, based on acceleration requirements.

n1	**CANopen bit rate**	Value in %

Bit-rate parameter is coded as follows:

Parameter value:	1	2	3	4	5	6	7	8
bit rate (kBaud):	10	20	50	125	250	500	800	1000

This parameters is read only at power-up. So, every change during normal operation is not performed.

Table 3.1 Ranges and default values of main parameters used by CANopen.

Parameter	**Range**	**Default**	**Meaning**
f3	00 - 99	00	Emergency ramp
c7	01 - 99	01	CANopen Node-Id
c9	00 - 05	05	Drive mode select
i1	01 - 99	20	Position loop proportional gain
i2	00 - 99	10	Position loop integral gain
i3	00 - 99	00	Position loop derivative gain
i4	00 - 99	00	Position loop feed-forward gain
n1	01 - 08	08	CANopen bit rate

Parameters can be changed by means of the little keyboard placed in the front of drive or using a PC with appropriate software and serial communication interface.

4 ALARM CODES

Drive alarm-codes are described in the drive manual. Additional alarm-codes concerning positioning system and the relative actions taken, are defined as follows.

Table 4.1 *Alarm details.*

Code	Description	Meaning	Action
AL13	Network error	CANopen network error (e.g. node guarding) or CAN-bus error.	Stop with emergency ramp (defined by parameter "f3").
AL14	Homing error	Error during homing operations.	Axis releases immediately.
AL15	Overflow error	Overflow in positioning system.	Stop with emergency ramp (defined by parameter "f3").
AL16	Position following error	Max following error is exceeded for a time greater then the specified time-out.	Axis releases immediately.

5 CHANGING of PARAMETERS from CANopen

You have the option to change drive-parameters values by means of CANopen object at index 0x2000 (write-only operations are allowed).
The change is not permanent (is made only in RAM), so at power-off you lose your modifications. Every change is active after a period of time that can reach about 20 ms.
To modify a parameter value, you must specify new value (sub-entry 002) and parameter address (sub-entry 001).
The meaning of every parameter is specified into the user's manual of the drive.
For correct operations, first change value, then write the address.
Parameter addresses can be changed by manufacturer without notification.

Actually they are defined as follows, in table 5.1.

Table 5.1 Parameters from CANopen.

Parameter	Address	Meaning
d1	1	Description in drive manual.
d2	2	Description in drive manual.
d5	5	Description in drive manual.
d6	6	Description in drive manual.
d7	7	Description in drive manual.
d8	8	Description in drive manual.
e3	58	Description in drive manual.
f1	11	Description in drive manual.
f2	12	Description in drive manual.
f3	13	Description in drive manual.
c2	15	Description in drive manual.
c3	16	Description in drive manual.
c4	17	Description in drive manual.
c5	18	Description in drive manual.
c7	20	CANopen Node-Id.
c9	22	Drive mode select.
i1	35	Position loop proportional gain.
i2	36	Position loop integral gain.
i3	37	Position loop derivative gain.
i4	38	Position loop feed-forward gain.
n1	40	CANopen bit rate.

6 MANUFACTURER SPECIFIC OPTIONS and SPECIAL FEATURES

Manufacturer specific options and special features.

- 0x2000 Drive parameters setting - utility

See chapter "Changing of parameters from CANopen".

- 0x2001 Hardware latched user position

This object contains the position (in user units) frozen at the transition of the input signal in the corresponding input line.
Every update is indicated through the statusword.

- 0x2002 IP position set-point 16 bit

In interpolated position mode, you can write position set-point with 16 or 32 bit word. To use the standard 32 bit word you have to access the object at index 0x60C1, sub-index 1.
Operations with 16 bit words are allowed using object at index 0x2002.

- 0x2003 Position Actual Value in User Unit - 16 bit

In addition to the standard object 0x6064 (position actual value in user unit - 32 bit word), at index 0x2003 is defined a 16 bit word position.
Contents of this object is obtained from the 16 least significant bits of the actual position in user units.

- 0x2004 Hardware latched user position 16 bit

This object contains the 16 LSB (least significant bits) of position (in user units) frozen at the transition of the input signal in the corresponding input line.
Every update is indicated through the statusword.

- 0x3000 Master encoder increments per shaft revolution

This object contains the number of increments per shaft revolution of the master encoder.
The parameter is used in electrical **axle** mode.

- 0x3001 Numerator of electrical axle gear ratio

This object contains the numerator of the gear ratio for electrical **axle** operations.

- **0x3002 Divisor of electrical axle gear ratio**

This object contains the divisor of the gear ratio for electrical axle operations.

- **0x3100 Acceleration Jerk**

This object contains the jerk used for positioning operations during the acceleration phase. Note that not all the profile types make use of this parameter.

- **0x3101 Deceleration Jerk**

This object contains the jerk used for positioning operations during the deceleration phase. Note that not all the profile types make use of this parameter.

- **0x3201 Auxiliary input nr. 1 (32 bit)**

This is a general purpose object used for input.

- **0x3202 Auxiliary input nr. 2 (32 bit)**

This is a general purpose object used for input.

- **0x3301 Auxiliary output nr. 1 (32 bit)**

This is a general purpose object used for output.

- **0x3302 Auxiliary output nr. 2 (32 bit)**

This is a general purpose object used for output.

- **0x3401 Auxiliary input nr. 3 (16 bit)**

This is a general purpose object used for input.

- **0x3402 Auxiliary input nr. 4 (16 bit)**

This is a general purpose object used for input.

- **0x3501 Auxiliary output nr. 3 (16 bit)**

This is a general purpose object used for output.

- **0x3502 Auxiliary output nr. 4 (16 bit)**

This is a general purpose object used for output.

- **0x3601 Auxiliary input nr. 5 (32 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- **0x3602 Auxiliary input nr. 6 (32 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- **0x3603 Auxiliary input nr. 7 (32 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- **0x3604 Auxiliary input nr. 8 (32 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- **0x3701 Auxiliary input nr. 9 (16 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- **0x3702 Auxiliary input nr. 10 (16 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- **0x3703 Auxiliary input nr. 11 (16 bit)**

This is a general purpose object used for input with pdo mapping allowed.

- 0x3704 Auxiliary input nr. 12 (16 bit)

This is a general purpose object used for input with pdo mapping allowed.

- 0x6040 Controlword - manufacturer specific bits

bit 14: reset bit 14 (latch updated) of statusword.
A transition from 0 to 1 of this bit causes a reset of bit 14 of statusword.

bit 11: start electrical axle operations (lock) in electrical axle mode.

bit 12: when this bit is forced to 1, the object 0x6069 "velocity sensor actual value", returns the velocity of the master axle.
The velocity is expressed in counter increments per ms.

- 0x6041 Statusword - manufacturer specific bits

bit 15: target velocity forced to zero.
When this bit is 1, target velocity is forced to zero.

bit 14: latched position updated.
A 1 in this bit indicates that a new position latch has occurred.
This bit is resetted through a transition 0 to 1 of bit 14 of the controlword.
The new value of latched position is stored in objects:
0x2001 Hardware latched user position.
0x2004 Hardware latched user position 16 bit.

bit 8: latching input status.
This bit shows the status of the latching input line.
Therefore, every transition from zero to one of the bit causes a position latch.
The new value of the latched position is stored in objects:
0x2001 Hardware latched user position.
0x2004 Hardware latched user position 16 bit.

- 0x6060 Modes of operations - manufacturer specific modes

mode - 1: Pulse Positioner mode.
Documentation under development.

mode - 2: Electrical axle mode.
Documentation under development.

mode - 127: Analog velocity reference.
Documentation under development.

- 0x6065 Following Error Window

With the value 0xFFFFFFFF, the following error check is switched off.

- 0x6069 Velocity Sensor Actual Value

To make the use of this object simpler, the velocity value is always referred to a sensor with 8192 increments per turn.

- 0x606D Velocity Window

With the value 0xFFFF, no check is made for velocity window.

- 0x606F Velocity Threshold

With the value 0xFFFF, no check is made for velocity threshold.

- 0x6086 Motion Profile Type - manufacturer specific types

mode - 1: S ramps.

The positioner performs the so called S-ramp velocity profile.
The motion is jerk, acceleration and velocity limited.
Acceleration and jerk parameters can be specified for acceleration and deceleration phases.
Jerk parameters are defined at objects 0x3100 and 0x3101, the remaining parameters follows the DS 402 standard.
The 'change_set_immediately' option, is not available.
Parameters are sampled at the beginning of the positioning cycle, so every change of their value during the cycle itself, is performed only on next move.

mode - 2: Sin-like ramps.

The positioner performs a Sin-like velocity profile.
Like Sin-function, the velocity profile, starts with max acceleration. At the required instant, acceleration is then reduced according to the specified jerk. With the right parameter's choice, the velocity profile ramps sounds like those of Sin-function.
Jerk parameter is defined at objects 0x3100, the remaining parameters follows the DS 402 standard.
The 'change_set_immediately' option, is not available.
Parameters are sampled at the beginning of the positioning cycle, so every change of their value during the cycle itself, is performed only on next move.

- 0x6092 Feed Constant

In feed constant definition, shaft revolution parameter is fixed to 1.

- 0x6098 Homing Method

Standard modes:

standard modes available are: methods 1 to 6, 17 to 22, 33 to 35.

Manufacturer specific modes:

setting to 1 bit 7 of "Homing Method" object, causes the axle to move until the zero position of the application is reached.

In other words, if bit 7 is set to 1, once the standard homing operation is concluded, the axle continues to move for a space equal to the Home Offset. In that way, the axle is carried into the so called zero position of the application.

- 0x60C1 Interpolation Data Record

This object contains the data words which are necessary to perform the interpolation algorithm. Sub-index 1 contains the position set-point.

You must also set object 0x60C2, sub-index 1 to define the interpolation time period.

7 USER UNITS

User position units are defined by means of feed constant (object at index 0x6092, sub index 1).

It declares the user units increment per shaft revolution.
Once position user units are fixed, also velocity and acceleration user units are defined, in fact, velocities well be expressed in position increments per second while accelerations will be expressed in velocity increments per milli-second.

8 WARNING

Position feedback:

Position feedback (object 0x6064) is internally updated at a rate of 1 ms.

The instant in witch the position is sampled, has therefore an uncertainty of 1 ms.