 561 Hillgrove Ave. LaGrange, Illinois 60525	<u>Engineering Specification</u>	Date: 12/14/2016 Revision Level: C
	3JUM1330-1	
	User Manual, VDC, CANopen	Written By: BMM

Applicable Products:		Grayhill Vehicle Display controllers (VDC) with CANopen	
REVISION	DESCRIPTION	CHECKED	APPROVED
A	Original ECN 384722	RMO 5-3-2011	RAL 5-3-2011
B	Corrected TPDO param. RTR not supported. ECN 386036	RMO 10-26-2011	RAL 10-26-2011
C	Removed support for 10kbps. Added appendix with "How To" examples. ECN 408888	RMO 12-14-2016	RAL 12-14-2016

This form is used to describe the software components or a new product or feature. This form is provided as a base to describe construction of a software module(s). Sections may be added at the discretion of the design engineer to detail more functionality of the software components.



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1. Scope

This document describes the implementation of CANopen on the Grayhill VDC.

2. Relevant Documents

- CiA Draft Standard 301, Application Layer and Communication Profile
- CiA Draft Standard 305, Layer Setting Services (LSS) and Protocols

3. Product Validation –

- Compliance shall be per CiA conformance test tool version 2.0.
- Grayhill CANopen vendor ID – 0x0307

4. Hardware Description

The Grayhill standard VDC have inputs that include: five buttons, a rotary encoder with an optional push select that behaves as a sixth button, and an optional eight directional joystick. The only output the VDC has is the backlight intensity of the entire module. The object dictionary entries shall be the same for all options. The bits associated with the unused options shall read as zero.

4.1. Input

Inputs will correspond to a bit within the corresponding Object Dictionary (OD) entry. A pressed/released button shall have a value of 1/0 respectively.

These inputs shall be transmitted using the default TPDO 1 as defined in CiA 301. The user is free to change the COB-ID.

4.2. Outputs

The backlight brightness is an analog value mapped to an eight-bit OD entry that can be controlled by the RPDO1 or using the Service Data Object (SDO).


5. Object Dictionary (OD)

All of the mandatory entries of the Object Dictionary (OD) as defined in CIA 301 and 305 shall be implemented. The following is the list of the Object Dictionary entries that are implemented.

5.1. 1000h – Device Type

Value = 0x00:

This value indicates that this device is Manufacturer Specific and is not base on a CIA standard.

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5.2. 1001h – Error Register

The use of the this register is not yet defined but is mandatory to be compliant

5.3. 1008h – Manufacturer Device Name

This is a visible string constant and gives the name of the device.

5.4. 1009h – Manufacturer Hardware Version

This is a visible string constant and describes the version of the hardware

5.5. 100Ah – Manufacturer Software Version

This is a visible string constant and describes the version of the software

5.6. 1010h – Store Parameters

This entry will be used to store parameters pertaining to the communication device specific parameters as defined by CIA v301. Not all Manufacturer Specific parameters are stored. Refer to the Manufacturer Specific OD entries for the parameters that are stored.

5.7. 1011h – Load Parameters

This entry is used to load the parameters that were stored according to Sec. 5.6.

5.8. 1017h* – Producer Heartbeat Time

5.9. 1018h – Identity Object

Sub Entry:

- 00h – Number of Subentries. (4)
- 01h – Vendor ID 307h
- 02h – Product Code 334Ah (ASCII 3J)
- 03h – Revision Number
- 04h – Serial Number

5.10. 1400h* – 1st Receive PDO Communication Parameter


Sub Entry:

- 00h – Number of Subentries. Value = 3
- 01h* - COBID (Default: 20Ah)
- 02h – Transmission Type

5.11. 1600h – 1st Receive PDO Mapping

Sub Entry:

- 00h – Number of subentries. Value = 1
- 01h – Backlight brightness mapping parameter. Value = 20100108h

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5.12. 1800h* – 1st Transmit PDO Communication Parameter

Sub Entry:

- 00h – Number of Subentries. Value = 5
- 01h* - COBID (Default: 18Ah + 2³⁰) RTR not supported
- 02h – Transmission Type
- 03h* – Inhibit Time (Default: 0)
- 04h – Reserved, not used
- 05h* – Event Timer. (Default: 0)

5.13. 1A00h – 1st Transmit PDO Mapping

Sub Entry:

- 00h – Number of Subentries. Value = 3
- 01h - Encoder Mapping. Value = 20000110h
- 02h – Button Mapping. Value = 20010108h
- 03h – Joystick Mapping. Value = 20020108h

5.14. 2000h* – Encoder Information.

Sub Entry:

- 00h – Number of Subentries
- 01h – Current Value: 16 bit signed number indicating the current value of the encoder
- 02h – Direction: 8 bit unsigned indicating the direction of the turn
 1. Clockwise
 2. Counter Clockwise
- 03h – Not Used. Reserved:
- 04h* – Rollover: 8 bit unsigned value used to enable or disable the Current Value from rolling over.
 - 0 – Disabled
 - 1 - Enabled
- 05h – Revolutions: 16 bit signed integer holding the revolutions of the encoder.
- 06h* – Top Value: 16 bit unsigned value that holds the top most value the Current Value counts up to.

Turing the encoder clockwise will increase the value.

5.15. 2001h – Button Information.


Sub Entry:

- 00h – Number of Subentries
- 01h – 8 bits unsigned. The first five bits correspond to buttons 1 through 5. The sixth bit corresponds to the encoder select pushbutton if capable.

5.16. 2002h – Joystick Information

Sub Entry:

- 00h – Number of Subentries
- 01h – 8 bits unsigned. Bits 0 through 3 correspond to joystick up, down, left, right respectively. Direction Up/Down are mutually exclusive. Direction Left/Right are mutually exclusive. Moving the joystick up and to the left will set both bit 0 and bit 3.

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5.17. 2010h* – Backlight Brightness

Sub Entry:

- 00h – Number of entries
- 01h* – 8 bit unsigned value controlling the brightness of the backlights
 - Valid Range from 0 (off) to 255 (full illumination)
- 02h* – 8 bit unsigned value used as a scalar value for the full brightness. This value ranges from 64 (40h) to 255 (FFh) and can be thought of as the ratio of this number over 255. Ex. if 100% on is too bright (255/255) a value of 191 can be entered in this OD entry to scale the full range down to 75% (191/255).

6. Process Data Objects (PDO's)

6.1. RPDO

One RPDO exist controlling the brightness of the backlights.

6.1.1. RPDO1

OD 2010sub01 is mapped to this RPDO and will be used to receive the analog input used for controlling the backlight brightness.

6.2. TPDO

One TPDO will be used to transmit the VDC information. Remote Transmit Request (RTR) will not be supported on the TPDO

6.2.1. TPDO1

This PDO will transmit OD 2000sub01, 2001sub01 and 2002sub01 in a four byte CAN Object (COB) using the default COBID for TPDO1.

6.3. Dynamic PDO Mapping


No Dynamic Mapping shall be used.

7. Layer Setting Services

The Grayhill keypads shall support the following baud rates.

- 20kbps
- 50kbps
- 100kbps
- 125kbps
- 250kbps (Default)
- 500kbps
- 1000kbps

Note: 10kbps not supported.

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Using the LSS, the device shall have the ability to change the node ID and the baud according to CIA v305


* Value is stored in non-volatile memory when the Store Parameters are performed for the Manufacturer Specific entries.

8. Grayhill CAN Open Configuration Variables

Custom versions of our 3J product feature a customer-specific part number and allow factory configuration of numerous parameters. A description of parameters Grayhill can configure for custom part numbers appears below in table 1.

Table 1 – Configurable parameters

Field Name	Parameter Type	Size (bytes)	Range	Default Value	Comments
Add customer part number on label	YES/NO			NO	
Default Node ID	INTEGER	1		0x0A	
Heartbeat period	INTEGER	1		0	
Receive PDO Comm Params					
COBID	INTEGER	2		0x020A	
Transmit PDO Comm Param					
COBID	INTEGER	2		0x4000018A	PDO mapping not supported, RTR not supported
Inhibit Time	INTEGER	2		0	
Event Timer	INTEGER	2		0	
Encoder Variables					
Rollover	BOOLEAN	1	0.. 1	0	When enabled will roll over from TOP to zero
TOP	INTEGER	2	0.65535		
Backlight Brightness					Equal to high byte of the value multiplied by the scalar.
Value	INTEGER	1	0.255	0	
Scalar	INTEGER	1	64.255	255	

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Appendix

A1: Change Node ID.


Changing the NodeID requires the use of the CANopen Layer Setting Services (LSS DS-305)

Follow the steps outlined below.

1. Put the device in STOP mode by sending the following
ID = 000h, LEN=2, Data = {02h, 00h}
2. Send the Switch State Config.
ID = 7E5h, LEN=8, Data = {04h 01h 00h 00h00h00h00h 00h}
3. Send the Change Node ID command
ID = 7E5h, LEN=8, Data = {11h 0Bh 00h 00h00h00h00h 00h}
The 2nd byte holds the value of the new node ID
This example sets it to 11 decimal (0x0B hex)
4. Send the command to store the new setting in eeprom
ID= 7E5h LEN= 8 Data = {17h 00h 00h00h00h00h00h00h}

A2: Change COBID

1. Invalidate the current COBID by setting the most significant bit in OD entry 1800sub01. Replace xx with the current node ID. by default it is 0Ah
ID = 6xxh, LEN = 8, Data = {23h 00h 18h 01h 00h 00h00h 80h}
2. Writes the new COBID making sure the 31st bit is set signifying Remote Transmit Request is not supported. In this example, the COBID is changed from the default of 18Ah to 123h. Replace xx with the current node ID.
ID = 6xxh, LEN = 8, Data = {23h 00h 18h 01h 23h 01h 00h 40h}
3. Store the new setting in non-volatile memory (eeprom). Writes 'save' to OD entry 1010sub01
ID = 6xxh, LEN = 8, Data = {23h 10h10h 01h 73h 61h 76h 65h}

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A3: Change Baud Rate

1. Put the device in STOP mode by sending the following:
ID = 000h, LEN=2, Data = {02h, 00h}
2. Send the Switch State Config message
ID = 7E5h, LEN=8, Data = {04h 01h 00h 00h00h00h00h 00h}
3. Send the Change Baud command
ID = 7E5h, LEN=8, Data = {13h 00h <id> 00h 00h00h00h 00h}
The <id> field holds the baud ID as defined in CiA-305
 - 125k = 4
 - 250k = 3
 - 500k = 2
 - 800k = 1
 - 1000k = 0
4. Send the command to store the new setting in eeprom
ID= 7E5h LEN= 8 Data = {17h 00h 00h00h00h00h00h00h}

At this point you can simply cycle power to the device since the new Settings are stored. The legitimate way is to then send the Activate Bit Timing command. There is a field in this command that specifies the amount of time to allow all devices to change to the new baud, usually a second.

Then, the Switch State Wait command is sent and finally all devices are put in RUN mode.