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MACS Grip and Joystick CAN Profile

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1 Document revision history

Rev: R1A Issue date: 20141127 Issued by: Anders Häll

2 CANopen

2.1 References

For further information of the CANopen protocol see CiA 301 – CANOpen Application Layer and Communication Profile.

2.2 COB ID

Used COB-ID:

Name	COB-ID
NMT Service	0
Transmit PDO #1	180
Transmit PDO #2	280
Transmit PDO #3	380
Transmit PDO #4	480
Transmit SDO	580
Receive SDO	600
NMT Error Control	700

2.3 Bit rate

The bit rate can be set to 125/250/500 kbit/s.

2.4 Supervision

Units are heartbeat producers.

2.5 SYNC Message

Not used.

2.6 Time Stamp Message

Not used.

2.7 NMT

2.7.1 NMT Control

Received from master:

COB-ID	Byte 0	NMT Service
0x000	0x01	Start Remote Node
0x000	0x02	Stop Remote Node
0x000	0x80	Enter Pre-operational State

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0x000	0x81	Reset Node
0x000	0x82	Reset Communication

Byte 1 is the node ID of the affected node. Use zero (0) to command all nodes.

2.7.2 NMT Response

Sent from slave:

COB-ID	Byte 0	State
0x700+NI	0x00	Initialising
0x700+NI	0x04	Stopped
0x700+NI	0x05	Operational
0x700+NI	0x7F	Pre-operational

Note: bit 7 (0x80) is a toggle bit; first time 0.

2.7.3 NMT Boot-up

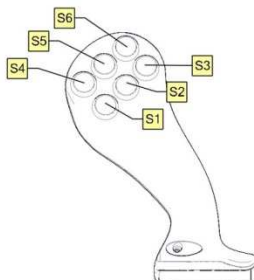
Sent from slave (spontaneous):

COB-ID	Byte 0	Comment
0x700+NI	0x00	Pre-operational (from Initialising)

2.8 Transmit PDO Grip

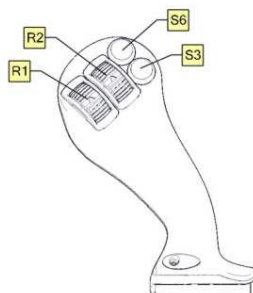
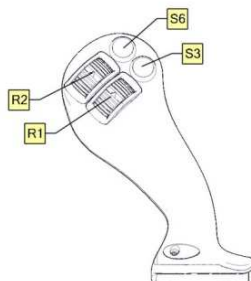
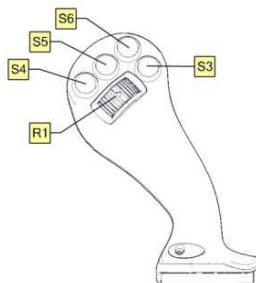
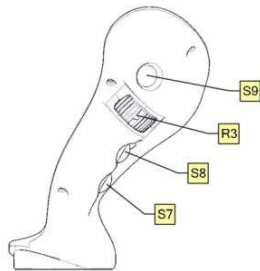
Node Id (NI) = 7 for right grip and 8 for left grip.

2.8.1 Switch Positions



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2.8.2 Transmit PDO #1 (0x180+NI)

Send a remote frame with id 0x180+NI to the node for start sending PDO.

Sample time is every 50 ms and on change of state but no faster than every 10 ms.

Data byte number	Description
1-2	Switch 1 (S1) 0x0000 – Open 0x83FF – Closed
3-4	Switch 2 (S2) 0x0000 – Open 0x83FF – Closed
5-6	Switch 3 (S3) 0x0000 – Open 0x83FF – Closed
7-8	Switch 4 (S4) 0x0000 – Open 0x83FF – Closed

2.8.3 Transmit PDO #2 (0x280+NI)

Send a remote frame with id 0x280+NI to the node for start sending PDO.

Sample time is every 50 ms and on change of state but no faster than every 10 ms.

Data byte number	Description
1-2	Switch 5 (S5) 0x0000 – Open 0x83FF – Closed
3-4	Switch 6 (S6) 0x0000 – Open 0x83FF – Closed
5-6	Switch 7 (S7) 0x0000 – Open 0x83FF – Closed
7-8	Switch 8 (S8) 0x0000 – Open 0x83FF – Closed

2.8.4 Transmit PDO #3 (0x380+NI)

Send a remote frame with id 0x380+NI to the node for start sending PDO.

Sample time is every 50 ms and on change of state but no faster than every 10 ms.

Data byte number	Description
1-2	Switch 9 (S9) 0x0000 – Open 0x83FF – Closed

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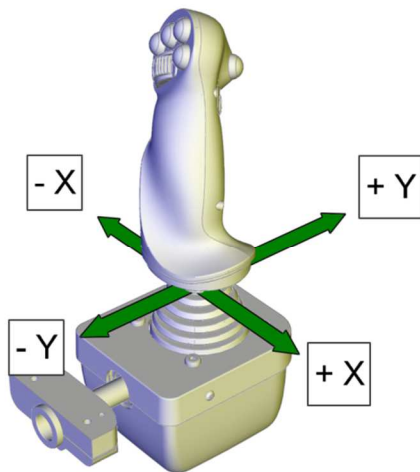
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3-4	Roller 1 (R1) 11 bits signed integer 0x8401 – Min (-1023) 0x83FF – Max (+1023)
5-6	Roller 2 (R2) 11 bits signed integer 0x8401 – Min (-1023) 0x83FF – Max (+1023)
7-8	Roller 3 (R3) 11 bits signed integer 0x8401 – Min (-1023) 0x83FF – Max (+1023)

2.9 Transmit PDO Joystick

Node Id (NI) = 5 for right joystick and 6 for left joystick.

2.9.1 Joystick Directions



2.9.2 Transmit PDO #1 (0x180+NI)

Send a remote frame with id 0x180+NI to the node for start sending PDO.

Sample time is every 50 ms and on change of state but no faster than every 10 ms.

Data byte number	Description
1-2	Lever X-axis, Right/Left 11 bits signed integer 0x8401 – Min (-1023) 0x83FF – Max (+1023)
3-4	Lever X-axis central position switch 0x0000 – Not in central position 0x83FF – In central position
5-6	Lever Y-axis, Forward/Backward

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	11 bits signed integer 0x8401 – Min (-1023) 0x83FF – Max (+1023)
7-8	Lever Y-axis, central position switch 0x0000 – Not in central position 0x83FF – In central position

2.10 Object Dictionary

2.10.1 Object 1002h: Manufacturer Status Register

Subindex	Name	Type	RW	Description	Default
0x00	Number of Entries	U8	RO		0x07
0x01	Unlock code	U32	WO	Code to set subindex 0x02-0x07 in write enabled mode	
0x02	Product number	S12	RO		
0x03	Serial number	S19	RO		
0x04	Hardware version, MSB	U8	RO		
0x05	Customer id	U16	RO		
0x06	Hardware version, LSB	U8	RO		
0x07	Product version	U16	RO		

2.10.2 Object 1017h: Producer Heartbeat Time

Subindex	Name	Type	RW	Description	Default
0x00	Producer Heartbeat time	U16	RW		0x0032

2.10.3 Object 1018h: Identity

Subindex	Name	Type	RW	Description	Default
0x00	Number of Entries	U8	RO		0x03
0x01	SVAB id	U32	RO	"SVAB"	0x42415653
0x02	Product id	U32	RO		Joystick = 0x00010003 Grip = 0x00010004
0x03	Software Version	U32	RO		

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2.10.4 Object 5500h: Configuration object

Subindex	Name	Type	RW	Description	Default
0x01	CANopen node id	U8	RW		Joystick: Right = 5 Left = 6 Grip: Right = 7 Left = 8
0x02	CAN bit rate	U8	RW	0x02 – 500 kbit/s 0x03 – 250 kbit/s 0x04 – 125 kbit/s	0x03

3 Grip and joystick calibration

If rollers or joysticks hardware is replaced with spare parts or if a calibration error signal is received on CAN, the rollers and joysticks must be calibrated. The sequence for calibration is following.

3.1 Start calibration

- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x32 0x09 0x01 0x00
- Wait 10 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x0C 0x01 0x03 0x00
- Wait 10 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x0C 0x01 0x04 0x00

3.2 Calibration mode

- Push and pull the rollers to the end positions.
- Move the joysticks to the end positions.
- Every time a new end value is accepted following CAN message will be sent:
Id=0x609, Dlc=8, Data=0x23 0x01 0x20 0x00 0x09 0x00 0x00 0x00

3.3 Stop calibration

- Release rollers and joysticks to neutral position
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x03 0x02 0x00 0x00
- Wait 300 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x03 0x00 0x00 0x00
- Wait 50 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x0C 0x00 0x04 0x00
- Wait 100 ms

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- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x0C 0x01 0x04 0x00
- Wait 50 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x03 0x02 0x00 0x00
- Wait 300 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x03 0x00 0x00 0x00
- Wait 50 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x0C 0x00 0x03 0x00
- Wait 100 ms
- Send CAN message for all nodes that should be calibrated:
Id=0x600+NodeId, Dlc=8, Data=0x23 0x01 0x20 0x00 0x0C 0x01 0x04 0x00