MAIN RFID Architecture (CEB-A)

Revision : 1.3

March 10, 2025

Via Robinie, 33 - 28883 - Gravellona Toce (VB) - MAIL information@sirius-es.it - PEC sirius.srl@pec.it - C.F. e P.Iva 01389770031
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Version	Date	Author	Description	Hw Version
1.0	11/06/2024	Palermo Antonio	First Release	2.0
1.1	18/06/2024	Palermo Antonio	Corrected "2.2.4 RFID Base-Band" parameters. Added "Figure 5: CEB-A Connectors location"	2.0
1.2	04/02/2025	Palermo Antonio	Modified page-header from "RFID Base Station" to "MAIN RFID Architecture (CEB-A) "	2.0
1.3	10/03/2025	Palermo Antonio	Added "Magnetic field strength" parameter in chapter "2.2.4 RFID Base-Band". Modified chapter "3.1 FCC Statement".	2.0

Table 1 : Revision History

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1 General information

1.1 Introduction

RFID data management solution:

- Hardware CEB-A
- Specialized firmware
- Application updater : Sirius Device Loader
- Setup and diagnostic software : Device Manager

1.2 Operational description

Sirius CEB-A is a compact transponder base station, capable of program and read RFID tags "on the fly". It supports 125 kHz RFID tag reading via CANOpen protocol, and has a serial port for debugging and update purposes. CEB-A features 7 digital outputs and 5 digital inputs.

1.3 Product images

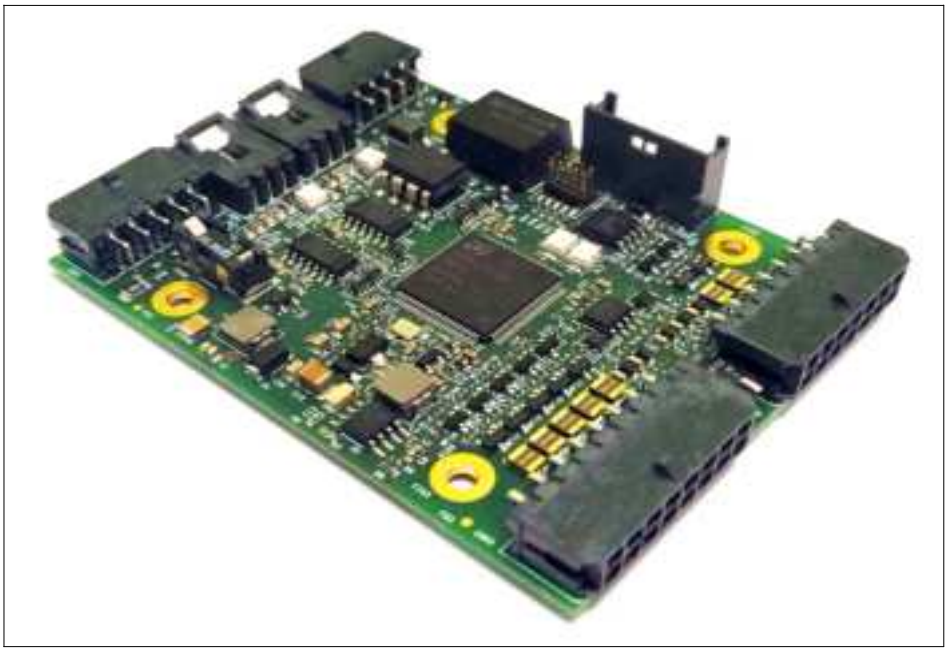

Figure 1: CEB-A (printed circuit board)

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Figure 2: CSIO1-1 (final product)

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2 Hardware

2.1 Absolute maximum ratings

Function	Value	Unit	Note
Power supply (logic)	30	Vdc	
Digital inputs (24Vdc)	28,8	Vdc	

2.2 Electrical Characteristics

2.2.1 Power Supply

Function	Parameter name	Min	Typical	Max	unit	Note
Control logic	Supply voltage	19,2	24	28,8	vdc	
	Supply current	50	65	80	mA	With all digital-out turned off

2.2.2 Digital Inputs

Parameter name	Min	Typical	Max	Unit	Note
Turn-on Voltage	14,85	16,2	18	V	
Turn-off Voltage	11,8	13,5	14,9	V	
Switching frequency	--	--	500	Khz	
Current	--	4,2	--	mA	

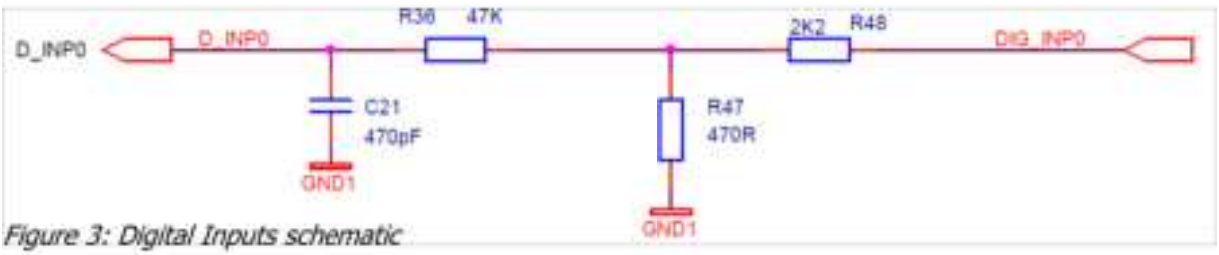

Figure 3: Digital Inputs schematic

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2.2.3 Digital Outputs

Parameter Name	Min	Typical	Max	Unit	Note
Output Current	--	100	150	mA	Can deliver 150 mA, only when a single output is active at a given time.
Leakage Current	1	--	10	µA	When any output is OFF

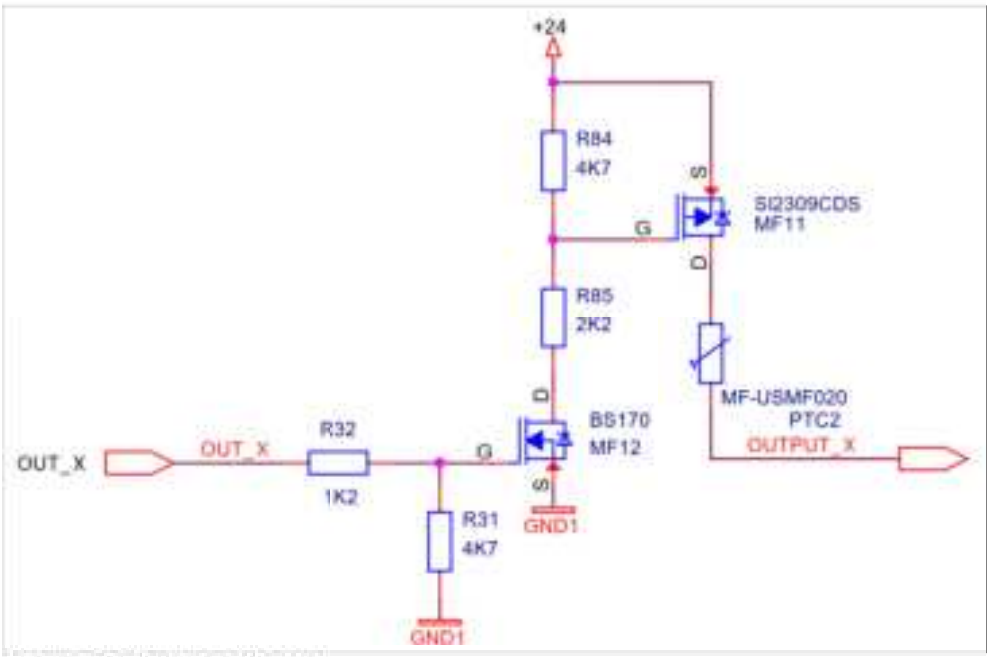

Figure 4: Outputs schematic

2.2.4 RFID Base-Band

Parameter Name	Min	Typical	Max	Unit	Note
RFID frequency	--	125	--	kHz	
Voltage at antenna terminals	--	27	--	Vpp	
Output current	--	170	200	mApp	
Output power	--	4.6	--	Wpp	
Magnetic field strength	--	-10.28	--	dBµA/m	Distance of measurement = 10m

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2.2.5 Mechanical and environmental condition

Parameter Name	Values
Dimensions (L x W x H)	86 x 61 x 16.5 mm
Weight	34 g
Temperature	Operating from 0 to +45 °C; Storage from -40 to +85°C
Humidity	0 to 95%, non-condensing

2.3 Functional Characteristics

2.3.1 UART

Parameter Name	Values / Description
Mode	Full-Duplex
Baud-rate	115.2 KBaud – 1.25 MBaud
Usage	Setup, Debug, Control and Firmware-Update
Protocol	Binary

2.3.2 CAN

Parameter Name	Values / Description
Isolation	Optical
Format	CAN V2.0b physical layer for high-speed connection compliant
Data	In according to CANopen CIA DS301 directives
Address Selection (ID)	settable via serial port
Line Termination	120 Ohm enabled by dip-switch

2.3.3 RFID

Parameter Name	Values / Description
RFID antennas	2
Modulation Type	Amplitude

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2.4 Connections

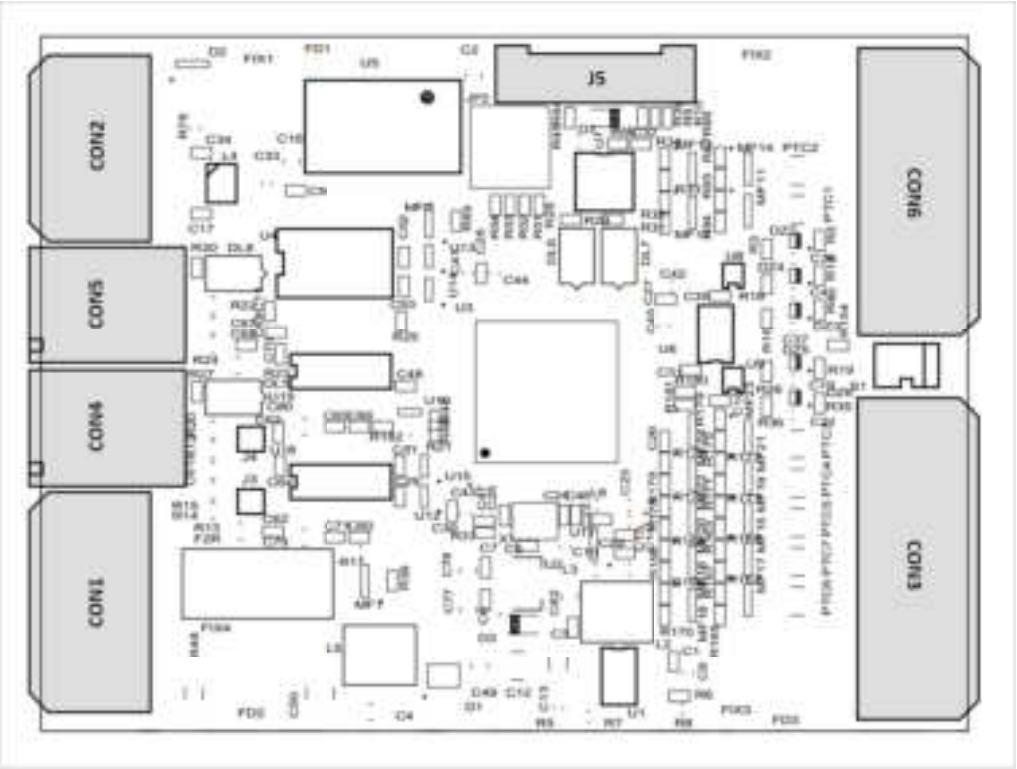
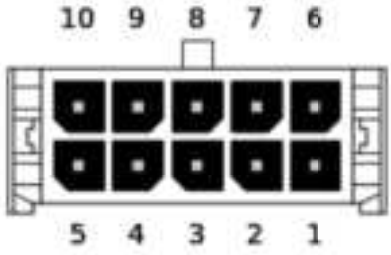


Figure 5: CEB-A Connectors location

2.4.1 CON1 – Power supply

CON1	Pin Nr	Name	Type	Description
	1	0V	In	Power supply for Logic (0V)
	2	24V Logic	In	Power supply for Logic (+24V)
	3	Ground	-	Power Earth
	4	N.C.	-	No connection
	5	N.C.	-	No connection
	6	0V	-	Power supply for Logic (0V)
	7	24V Logic	In (Out)	Power supply for Logic (+24V)
	8	Ground	-	Power Earth
	9	N.C.	-	No connection
	10	N.C.	-	No connection

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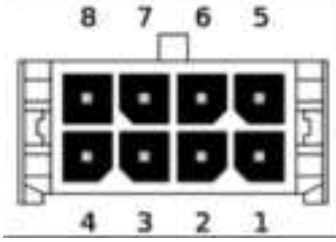
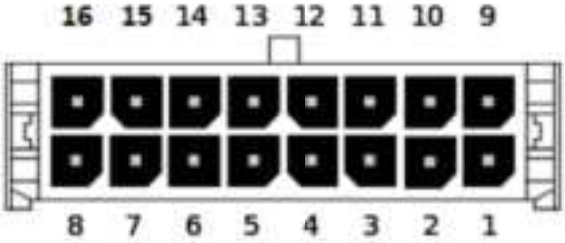
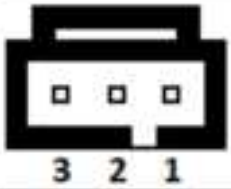
2.4.2 CON2 – CANopen

CON2	Pin Nr	Name	Type	Description
	1 - 5	CH+	In / Out	CAN High
	2 - 6	CH-	In / Out	CAN Low
	3 - 7	CAN Ground	-	0V CAN Reference
	4- -8	CAN Ground	-	0V CAN Reference

2.4.3 CON3 – I/O "A"

CON3	Pin Nr	Name	Type	Description
	1	24V	OUT	24V Power For Digital Input 3
	2	DI_3	IN	Digital Input 3
	3	0V	-	0V Power For Digital Input 3
	4	24V	OUT	24V Power For Digital Input 4
	5	DI_4	IN	Digital Input 4
	6	0V	-	0V Power For Digital Input 4
	7	0V	-	0V Return For Digital Output 6
	8	DO_6	OUT	Digital Output 6
	9	0V	-	0V Return For Digital Output 2
	10	DO_2	OUT	Digital Output 2
	11	0V	-	0V Return For Digital Output 3
	12	DO_3	OUT	Digital Output 3
	13	0V	-	0V Return For Digital Output 4
	14	DO_4	OUT	Digital Output 4
	15	0V	-	0V Return For Digital Output 5
	16	DO_5	OUT	Digital Output 5

2.4.4 CON4 – RFID Antenna "1"

CON4	Pin Nr	Name	Type	Description
	1	ANT_1_A	In / Out	RFID Antenna "1" TX1
	2	ANT_1_B	In / Out	RFID Antenna "1" TX2-RX
	3	0V	-	RFID Antenna "1" Ground

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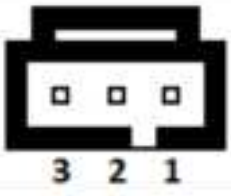
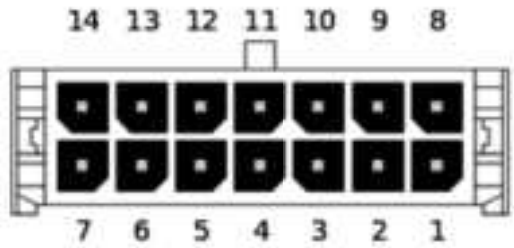
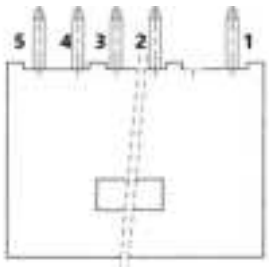
2.4.5 CON5 – RFID Antenna "2"

CON5	Pin Nr	Name	Type	Description
	1	ANT_2_A	In / Out	RFID Antenna "2" TX1
	2	ANT_2_B	In / Out	RFID Antenna "2" TX2-RX
	3	0V	-	RFID Antenna "2" Ground

2.4.6 CON6 – I/O "B"

CON6	Pin Nr	Name	Type	Description
	1	N.C.	-	No Connection
	2	24V	OUT	24V Power For Digital Input 2
	3	DI_2	IN	Digital Input 2
	4	0V	-	0V Power For Digital Input 2
	5	24V	OUT	24V Power For Digital Input 1
	6	DI_1	IN	Digital Input 1
	7	0V	-	0V Power For Digital Input 1
	8	0V	-	0V Return For Digital Output 1
	9	DO_1	OUT	Digital Output 1
	10	DO_0	OUT	Digital Output 0
	11	0V	-	0V Return For Digital Output 0
	12	24V	OUT	24V Power For Digital Input 0
	13	DI_1	IN	Digital Input 0
	14	0V	-	0V Power For Digital Input 0

2.4.7 J5 – UART

J5	Pin Nr	Name	Type	Description
	1	0V	-	0V
	2	5V	In	5V Supply Voltage
	3	RXD	In	UART Receive Data (Warning TTL logic level)
	4	TXD	Out	UART Transmit Data (Warning TTL logic level)

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3 EMI Certifications

3.1 FCC Statement

Note:
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This product complies with FCC and ISED radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

This radio transmitter has been approved to operate with the antenna types listed in filing FCC ID: 2BALJ-CEBA0001 with the maximum permissible gain indicated. Antenna types not included in that list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

3.2 Industry Canada statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause interference,
2. and this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio ex- empts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouil- lage est susceptible d'en compromettre le fonctionnement.

CAN ICES-3 (A)/NMB-3(A)

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4 Firmware Description

4.1 State machine operation

4.1.1 Enqueue pallet

As soon as a pallet is recognized from the antenna, its ID is inserted into the queue (4 elements deep), only if it is not already present, and the rfidCnt timer is preset.

4.1.2 Pallet photocell events

The photocell generates events on the rising / falling edges,
respectively when a pallet arrive to / depart from the photocell.

4.1.2.1 On the rising edges (a pallet arrives at the photocell)

1. The first ID is picked and removed from the queue.
2. This ID is processed.
   The value of rfidCnt is compared to determine if the antenna is too close / far.
3. If the pallet takes too much time between the antenna identification and the photocell detection, the next valid ID is processed.

4.1.2.2 On the falling edges (a pallet leave the photocell)

1. If the gate is opened, the time between the rising and falling edges of the photocell determines the pallet speed.
   If the speed is in bounds, the delay used to generate the deviation signal is calculated using the following formula:

$$\frac{palletDimension}{palletTime} = \frac{gatePhotocellDistance}{delay}$$

   else one of the following errors is generated : "PALLET_FAST", "PALLET_SLOW", "PALLET_TOO_FAST" or "PALLET_TOO_SLOW".

2. If the pallet is in the action-list, received from the master, the associated action take place:

   (a) If the command is "ADD_EMPTY_PALLET"

      i. "PASSEMPTY" flag is active (that means you didn't enable the tube present photocell while the pallet passed) :
      if the skipCnt counter is expired, the "DIVERTED" message is sent,
      else the "PALLET_TOO_SLOW" error is sent.

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ii. "PASSFULL" flag is active (that means you have activated the tube present photocell while the pallet passed) :
the "TUBE_PRESENT_WHEN_NOT_EXPECTED" error is sent.

(b) If the command is ADD_FULL_PALLET

i. "PASSFULL" flag is active (that means you have activated the tube present photocell while the pallet passed) :
if the skipCnt counter is expired, the "DIVERTED" message is sent,
else the "PALLET_TOO_SLOW" error is sent.

ii. "PASSEMPTY" flag is active (that means you didn't enable the tube present photocell while the pallet passed) :
the "TUBE_ABSENT_WHEN_NOT_EXPECTED" error is sent.

3. If the pallet is in the action-list but there is no room for the pallet on the destination lane, the "NO_ROOM_TO_DIVERT" error is sent.

4. If the pallet is in the action-list but the node is offline, the "NODE_STATUS_OFFLINE" error is sent.

5. If the pallet is not on the action-list, and there aren't pending errors, then it is diverted and the "PASSFULL" / "PASSEMPTY" message is sent respectively on presence or absence of the tube on the pallet.

4.1.3 Start motor logic

The startMot signal activation occurs when the counter PulseDelayCnt expires, and remains active for a fixed time of 20 ms.
PulseDelayCnt is preset by the deviation delay calculated above.

4.1.4 Photocell tube

The photocell is used to set the flags "PASSFULL" or "PASSEMPTY" according to the presence of the tube.
If the tube photocell signal is active but pallet's one is not, the "UNEXPECTED_TUBE" error is sent only for the first occurrence.
From the second onwards the "TOO_MUCH_UNXP_TUBE" error is sent (indicating the eventual photocell light interference).

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4.1.5 Gate Management

The gate's electrovalve is activated when :

1. HomeMot signal = 0 (the motor is performing homing).
2. Receiving "EMERGENCY_GATE_OUT" command.
3. Receiving "HOME_GATE" command.

Deactivated when :
1. HomeMot signal = 1 (the motor isn't performing homing).
2. Receiving "EMERGENCY_GATE_IN" command.

4.1.6 Engine Management

4.1.6.1 The motor board MSV

When the motor board turns on, it automatically starts the homing procedure (homeMot is set to zero).
When this procedure is correctly completed, with the pad aligned to the track the homeMot goes to 1.

4.1.6.2 The RFID board CEB-A

1. When the RFID turns on it sets the state variable homeMotStt to "HM_BOOTUP".

2. When in "HM_BOOTUP" state, it waits for the homing completion by the motor board through NRZ communication.
   If within 5 second the homing isn't performed, then the procedure is requested 4 more times.
   If the homing isn't correctly done, the "HOMING_TMO_ALIGNED" or "HOMING_TMO_NOT_ALIGNED" error is sent, according to the pad position, else the state is set to "HM_READY".

3. In the state "HM_READY" when the signal homeMot goes to zero (meaning a position lost of the pad) the "HOMING_GATE_IN" or "HOMING_GATE_OUT" error is sent according to the gate state. Then it goes into the "HM_WF_TMO" state waiting for homing (homeMot = 1).

4. When in the "HM_WF_TMO" state, if the homing procedure isn't completed within the time homeMotTmo (5 seconds) the "HOMING_TMO_ALIGNED" or "HOMING_TMO_NOT_ALIGNED" error is sent, according to the pad position. If the homing finish properly it send a null message (all zeroes).

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