RFID Base Station

Revision: 1.3

July 24, 2014

version	date	author	description	fw version
1.0	25/05/2014	Marco Trentarossi	first delivery	RFID-03.00_b#
1.1	06/06/2014	Marco Trentarossi	added OBD and messages	RFID-03.00_b#
1.2	09/06/2014	Marco Trentarossi	added two error messages	RFID-03.00_b#
1.3	24/07/2014	Francesco Trentarossi	FCC / Industrial Canada statements+ RFID specs	RFID-03.00_b#

Table 1: revision history

Contents

Chapter 1

General information

1.1 Introduction

RFID data management solution:

- Hardware MOL
- Specialized firmware
- Winloader - Application updater
- Oscilloscope - Setup and diagnostic software

1.2 Operational description

Sirius MOL is a compact transponder base station, used to read and write RFID codes on moving objects on the fly. It supports 125k RFID tag reading via CANOpen protocol and has a serial port for readind and writing purpose. MOL features 7 digital output and 5 digital inputs and can be powered from 20 to 55 Vdc.

1.3 Product images

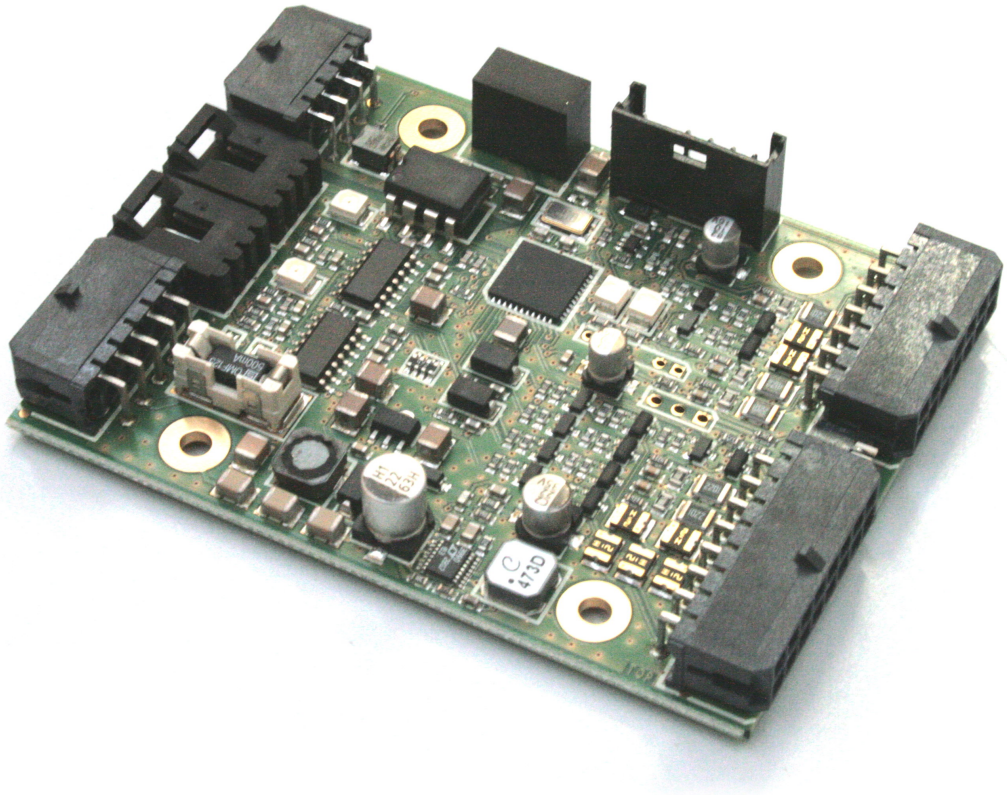

Figure 1.1: MOL-A

Chapter 2

Hardware

2.1 Configuration

	MOL-A	*U.M.*
CAN	√	-
BASE-STATION	2	-
VDC	20-55	V

2.2 Specifications

2.2.1 Power Supply

	MOL-A	*U.M.*
Input Voltage min-max	20-55	V
Current	0.1	A

2.2.2 RFID Feature

	MOL-A	*U.M.*
RFID frequency	125k	Hz
Modulation	amplitude	-
Modulation Voltage	10	Vpp
Output current	200	mA
Output power	2	Wpp

2.2.3 Command Inputs

	MOL-A
CANopen	tag reading
Serial TTL	tag reading, writing

2.2.4 Digital Inputs

	MOL-A
Number, type	5, non-insulated
All inputs	operating from 24V with RC filter
Logic levels	Vin-LO < 5.6V, Vin-HI > 13V
(IN0..4)	2 Medium Speed inputs with 22us RC
Current rating	10mA @ 24V

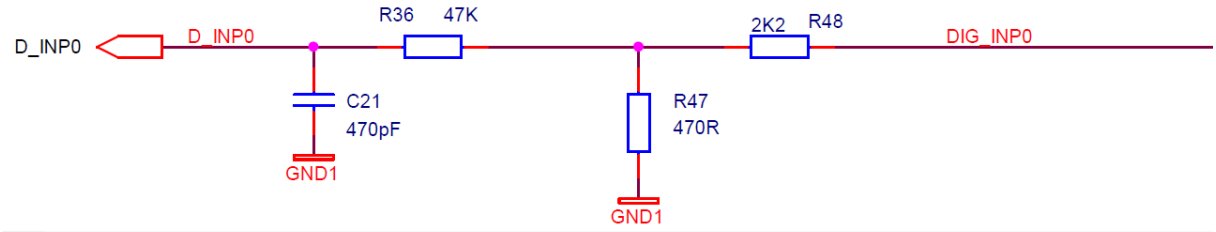

Figure 2.1: MS Inputs

2.2.5 Digital Outputs

	MOL-A
Number, type	7, non-insulated
(OUT0..6)	Current-sourcing MOSFET at 24V (PNP)
Current rating	200mA with PTC protection

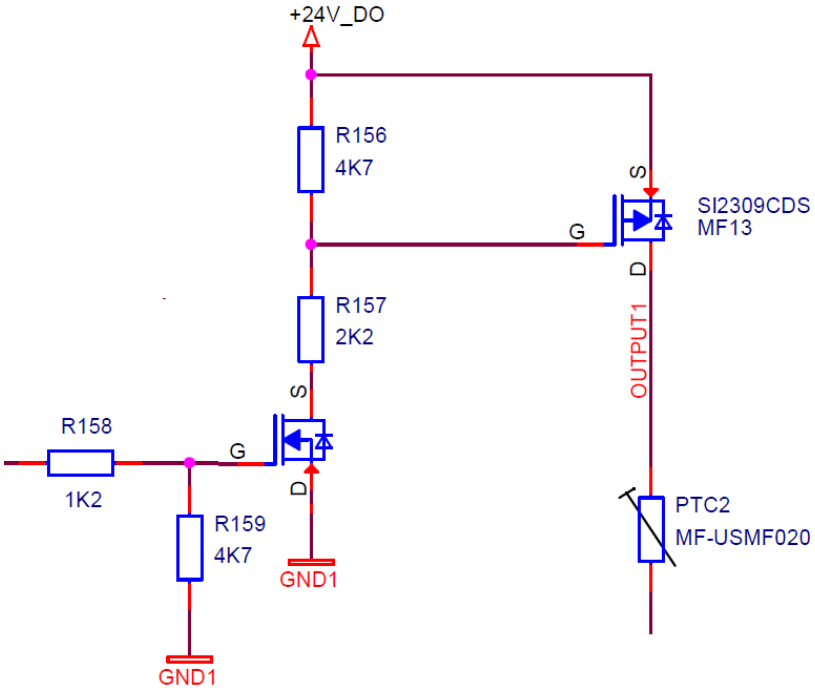

Figure 2.2: Output

2.2.6 UART Port

	MOL-A
Signals	RX, TX, GND
Mode	full-duplex, serial communication port for drive setup and control, 115200 - 1250000 baud rate
Protocol	Binary

2.2.7 CAN Port

	MOL-A
Signals	CANH, CANL, GND
Isolation	CAN interface circuit and +5 Vdc supply for CAN is optically insulated from drive circuits
Format	CAN V2.0b physical layer for high-speed connection compliant
Data	in according CANopen CIA DS301
Address selection	determined by dip-switch
Stub	121 ohm selectable

2.2.8 Status Indicators

	MOL-A
CAN status	green and red leds, in according with CAN indicator specification DR303-3
RFID status channel 0	blue
RFID status channel 1	blue

2.2.9 Mechanical & Environmental

	MOL-A
Size (L x W)	79 x 57 mm
Height	21 mm
Weight	45 g
Ambient temperature	0 to +45 °C operating, -40 to +85 °C storage
Humidity	0 to 95%, non condensing
Cooling	conduction through heatplate on driver chassis, or convection

2.2.10 Agency Conformance

	MOL-A
CE	CE compliant
61000_6_4	Generic standards - Emission Standard for industrial environments
61000_6_2	Generic standards - Immunity for industrial environments
ROHS	ROHS Compliant

2.3 Connections

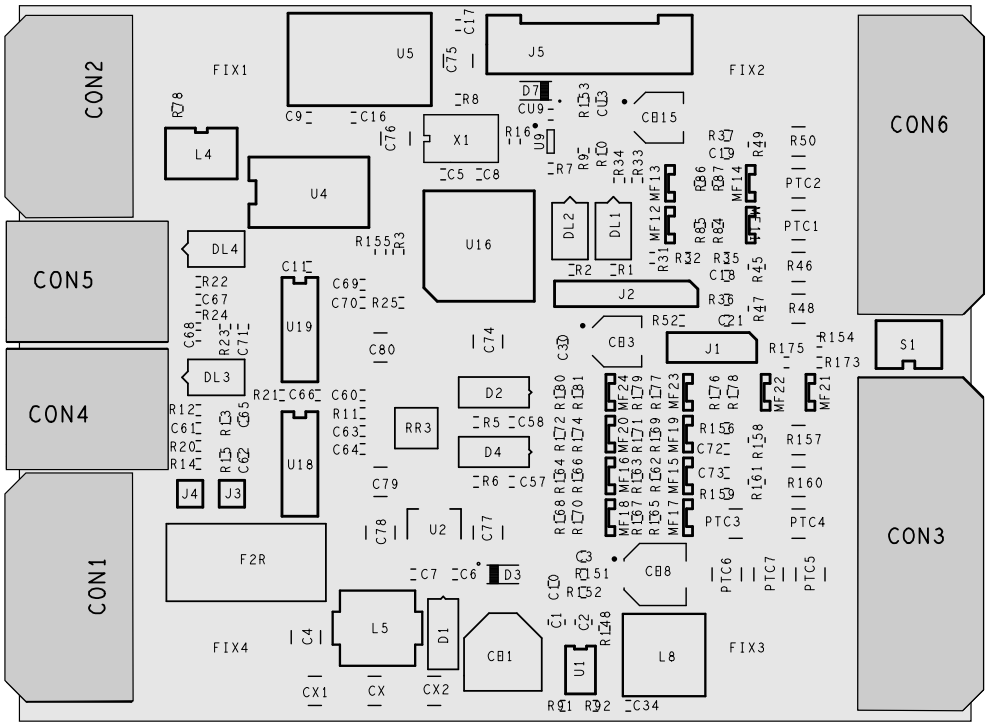

Figure 2.3: MOL-A Connectors

2.3.1 CON1 - Power supply

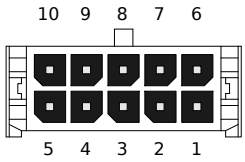

Figure 2.4: MICROFIT 3.0 430451000

pin	*name*	*type*	*description*
1-6	comune	IN	0V power supply reference
2-7	24V	IN	24V power supply
3-8	Ground	IN	ground
4-9	NC	-	-
5-10	NC	-	-

2.3.2 CON2 - CANopen

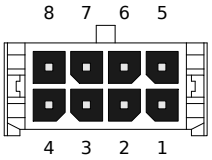

Figure 2.5: MICROFIT 3.0 430450800

pin	*name*	*type*	*description*
1-5	CH+	IN	CAN high
2-6	CH-	IN	CAN low
3-7	CAN reference	IN	0V CAN reference
4-8	CAN reference	IN	0V CAN reference

2.3.3 CON4 - RFID 0

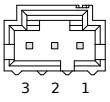

Figure 2.6: TE CONNECTIVITY 0103634-02

pin	name	type	description
1	TX1	IN-OUT	transmitter 1
2	TX2	IN-OUT	transmitter 2
3	reference	-	0V RFID reference

2.3.4 CON5 - RFID 1

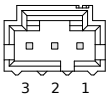

Figure 2.7: TE CONNECTIVITY 0103634-02

pin	name	type	description
1	TX1	IN-OUT	transmitter 1
2	TX2	IN-OUT	transmitter 2
3	reference	-	0V RFID reference

2.3.5 CON6 - I/O 1

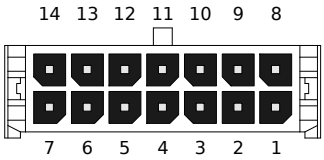

Figure 2.8: MICROFIT 3.0 430451400

pin	name	type	description
1	NC	-	Not connected
2	+24V	OUT	Inputs power supply
3	DI_2	IN	digital input 2
4	GND	-	I/Os reference
5	+24V	OUT	Inputs power supply
6	DI_1	IN	digital input 1
7	GND	-	I/Os reference
8	GND	-	I/Os reference
9	DO_1	OUT	digital output 1
10	DO_0	OUT	digital output 0
11	GND	-	I/Os reference
12	+24V	OUT	Inputs power supply
13	DI_0	IN	digital input 0
14	GND	-	I/Os reference

2.3.6 CON3 - I/O 2

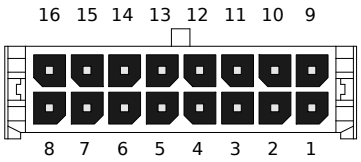

Figure 2.9: MICROFIT 3.0 430451600

pin	*name*	*type*	*description*
1	+24V	OUT	Inputs power supply
2	DI_3	IN	digital input 3
3	GND	-	I/Os reference
4	+24V	OUT	Inputs power supply
5	DI_4	IN	digital input 4
6	GND	-	I/Os reference
7	GND	-	I/Os reference
8	DO_6	OUT	digital output 6
9	GND	-	I/Os reference
10	DO_2	OUT	digital output 2
11	GND	-	I/Os reference
12	DO_3	OUT	digital output 3
13	GND	-	I/Os reference
14	DO_4	OUT	digital output 4
15	GND	-	I/Os reference
16	DO_5	OUT	digital output 5

FCC Statement

Note: 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.

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, and*
2. *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 exempts 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 brouillage est susceptible d'en compromettre le fonctionnement.*

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

Chapter 3

Logic

3.1 Enque version state machine

3.1.1 Queuing pallet

Setting the variable enqueue = 1 activates the insertion of the read pallet in a queue, before being disposed of by the deviation.

The tail is 4 pallets deep.

Just read a pallet on the antenna inserts into the queue, if it is not already present. Otherwise it could be the same pallet, moving in front of the antenna, recurs periodically.

When an ID is read, the related rfidCnt timer is preset.

3.1.2 Pallet photocell reading

The photocell of the pallet is read constantly, generating events of rising/falling edge.

Rising edge

On the rising edge following actions take place:

1. the first ID is picked up in this queue
2. Whether the rfidCnt timer is still countdown means that you have just read, then the ID is deleted from the list to be processed. In this phase the value of rfidCnt is compared to determine if the antenna is too close / far.
3. Whether the rfidCnt timer has finished the countdown means that it was a long time between the antenna and the photocell. Since we are in mode enque delete the ID from the list and however process the pallet.
4. we reset the variable Temp_coll that will serve to determine the speed of the pallet

Falling edge

The falling edge always occurs when the gateEv is off, that is, a pallet is passing. Whenever gateEv is activated the pallets are locked, then the passing time can not be calculated. To achieve this, the variable blankTempoColl is set to true.

On the falling edge of the following actions take:

1. if the variable BlankTempoColl is not true, then the on time of the photocell pallet is count to calculate the speed of passage to determine if the pallet is fast / slow (PALLET_FAST, PALLET_SLOW) or too fast / slow (PALLET_TOO_FAST, PALLET_TOO_SLOW). It will still reset the variable blankTempoColl to allow the calculation to the next falling edge.
2. based on the speed, is calculated the delay for the generation of the deviation signal
3. whether the pallet was in the list runs the action associated with it:
   (a) the command was ADD_EMPTY_PALLET
      i. the state is PASSEMPTY (you did not enable the photocell of the tube while the pallet passed) then is sent the message DIVERTED
      ii. the state is PASSFULL (you have activated the photocell of the tube while the pallet passed) then is sent the error TUBE_PRESENT_WHEN_NOT_EXPECTED
      iii. the skipCnt counter is not exhausted, then is sent the error PALLET_TOO_SLOW
   (b) the command was ADD_FULL_PALLET
      i. the state is PASSEMPTY (you did not enable the photocell of the tube while the pallet passed) then is sent the error TUBE_ABSENT_WHEN_NOT_EXPECTED
      ii. the state is PASSFULL (you have activated the photocell of the tube while the pallet passed) then is sent the message DIVERTED
      iii. skipCnt the counter is not exhausted, then is sent the error PALLET_TOO_SLOW
4. whether the pallet was on the list but there is no room for divert, then is sent the error NO_ROOM_TO_DIVERT
5. whether the pallet was on the list but the node is offline, then is sent the error NODE_STATUS_OFFLINE
6. whether the pallet was not on the list, and has not been detected an error in the previous stages, then it is diverted and the message of presence or absence of the tube (PASSEMPTY / PASSFULL) without error is sent

The calculation of the delay to divert is calculated with the following proportion:

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

3.1.3 Logic of start motor

The activation of startMot signal occurs after the counter PulseDelayCnt has exhausted its value, and holds for a fixed time of 10 ms.

PulseDelayCnt is preset by the deviation delay calculated above, or by the fixed value of 2s when the divert command it is received via CANopen.

3.1.4 Reading photocell tube

The photocell tube is read constantly and prepares the flag to confirm the presence of the tube on the pallet (PASSFULL).

If the signal of the photocell tube is active but photocell of the pallet is off, then it sends a first message of unexpected tube (UNEXPECTED_TUBE). If by the time fotTubeFIt you have repeated signals, then the message of light interference on the photocell (TOO_MUCH_UNXP_TUBE) is sent.

3.1.5 Gate Management

The gate's electrovalve is activated in case of:

1. homeMot signal = 0 (the engine is performing the homing)
2. receiving a command of EMERGENCY_GATE_OUT
3. receiving a command of HOME_GATE (2s ahead of the start homing)

The solenoid valve is turned off:

1. homeMot signal = 1 (is not performing a homing)
2. receiving a command of EMERGENCY_GATE_IN

Throughout the time of gate EV activation the timer skipCnt is preset with the skipTmr value. The timer begins to countdown when the solenoid is off. This timer prevents any deviation that would produce the error PALLET_TOO_SLOW .

3.1.6 Engine Management

The motor board MOH

When the board motor turn on, it runs automatically the homing research and resulting in a position aligned to the track. In this phase the signal homeMot is held at 0. Just finished zeroing, the homeMot goes to 1.

The RFID board MOL

When the RFID is turn on it sets the state variable homeMotStt to HM_BOOTUP, starts the verification process of homing and then goes into HM_WF_BOOTUP. In this state, it waits for the reset of the card by toggling the motor signal startMot, every homeMotTmo. After 10 inversions (5 attempts homing) without receiving answers from the card engine, says that the communication between the two boards is not working by sending the error message COMM_MOT_FAULT.

In the state HM_READY the system observes the signal homeMot = 0 to send the error HOMING. Then it goes into the HM_WF_TMO state waiting for homing (homeMot = 1). If this does not happen within the time homeMotTmo the error HOMING_TIMEOUT is sent. If the homing finish properly it send a null message (all 0).