

MOL81 485 1312

MOL81 485 1337

USER MANUAL

Document reference: **MOL81 485 1312-MOL81 485 1337-UM-1.4-EN**

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TABLE OF CONTENTS

1	FOREWORD	3
1.1	PURPOSE OF THIS MANUAL	3
1.2	DOCUMENT STATUS SHEET	3
1.3	NOTES.....	3
2	GENERAL INFORMATION	4
2.1	DEVICE DESCRIPTION	4
2.2	BASIC OPERATION.....	5
2.3	POWER.....	5
3	MECHANICAL ASPECTS	6
3.1	CASE DIMENSIONS	6
3.2	DEVICE ENVIRONMENT.....	6
4	CONFIGURATION	8
4.1	USER SETTINGS	8
5	CONNECTION TO HOST	9
5.1	INTRODUCTION.....	9
5.2	TRANSMISSION CHARACTERISTICS.....	9
6	MESSAGES RECEIVED BY READER	10
6.1	MODBUS PROTOCOL.....	10
6.2	MODBUS COMMANDS	11
6.3	COMMAND: READ LAST TAG CODE	11
6.4	COMMAND: 125 KHZ EMITTER CONTROL.....	12
6.5	COMMAND: READ FIRMWARE VERSION	12
6.6	COMMAND: READ DEVICE STATUS	13
6.7	COMMAND: WRITE PARAMETERS	14
6.8	COMMAND: RESET.....	14
6.9	COMMAND: WRITE DIGITAL OUTPUTS.....	14
7	DIGITAL OUTPUTS.....	15
7.1	125 kHz OK	15
7.2	TAG PRESENCE	15
8	CONNECTORS.....	16
8.1	CONNECTOR ON CASE	16
8.2	CONNECTOR FOR CABLE ASSEMBLY	17
8.3	TYPE OF CABLE TO USE	17
9	MAINTENANCE	18
9.1	REGULAR MAINTENANCE	18
9.2	DEVICE REPLACEMENT	18
9.3	RECYCLING	18
APPENDIX 1 : SPECIFICATION DRAWING		19
APPENDIX 2 : IMPORTANT NOTE ABOUT FCC RULES		20

1 **FOREWORD**

1.1 **Purpose of this manual**

This manual contains instructions for installing and operating the system.
Performance metrics and other characteristics can be found in the specification sheet.

1.2 **Document status sheet**

Version	Issue	Date	Description of changes
1	0	20/10/2010	First edition.
1	1	11/10/2011	Details added to §6.1 (code fct 3 or 4) and §7.2 Added §2.3. Translation in English, of the French version 1.1 (2011-10-11)
1	2	02/11//2011	§2.2 Basic operations: correction of behavior errors: no diagnostic and no asynchronous message. §7.1 125 KHz OK : no diagnostic function implemented.
1	3	02/14/2013	§2.1: Comment about differences between MOL81-485-1312 and MOL81-485-1337. §3.2: Installation requirements. §4.1: default behaviour of EEPROM status bit. MOL81 parametered in factory. §6.3: Comment about CV and CI counters behaviour. §6.6: Table for the description of status flags behaviour. §8.3: Cables max length.
1	4	5/17/2013	Added appendix 2

1.3 **Notes**

The contents of this manual are subject to changes without notice.

BALOGH can not be held responsible for the consequences of any error, omission, or incorrect interpretation of the information

2 GENERAL INFORMATION

2.1 Device description

The MOL81 is a short-range transponder designed especially for railway applications. This all-in-one device with internal antenna will typically be installed on board rolling stock, mounted externally under the vehicle chassis, in order to do on-the-fly reading of OMR radiofrequency tags placed on the track between the rails.

The data read from the tags is sent to a host computer/controller via a RS485 serial link. This data is used for real-time locating and depot storage.

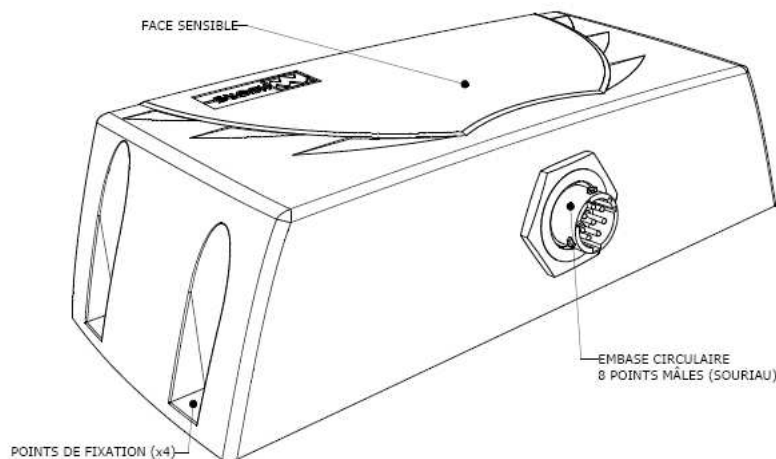
The device uses two operating frequencies, a 125 kHz transmitter of a non-modulated carrier for remote powering of tags and a 6.78 MHz narrow-band receiver for data reception. The unit is self-testing and this function can be activated via the serial link.

A watertight IP67 connector has pins for DC power, a serial link and digital outputs.

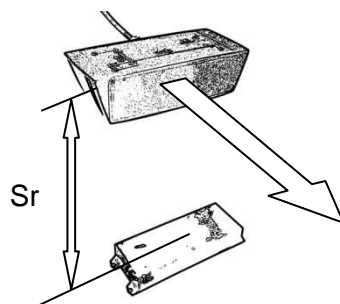
Two digital outputs inform of:

- 125 kHz ok
- Tag present

The device's self-test function checks for the correct operation of both the powering transmitter and the data receiver.



Direction of travel:



Sr : recommended reading height (see product specification).

The MOL81-485-1312 and the MOL81-485-1337 products are identical, except that the MOL81-485-1337 has particular adjustments so that it must be mounted on metal.

2.2 Basic operation

After a reset or a power-up, the MOL81 is ready for use, no other setting up is necessary. When a valid tag is detected, its identifier can be read with a MODBUS command.

Commands can be sent to the device at any time, for control and for special setups. These commands may be acknowledged (ACK or NAK) and may receive a response. No asynchronous commands are sent by the MOL81.

2.3 Power

The MOL81 is powered with 24Vdc, the voltage range acceptable for correct operation is 21Vdc to 29Vdc (including any ripples). Typical current drawn at 24Vdc is 600mA, with a maximum of 1A. The power module is protected against polarity inversions.

Any changes in settings are memorised, so that after a reset the same settings are used as before the previous power-down. In particular, if the 125 kHz emitter was deactivated before power-down, it will still be deactivated after power-up.

Conversely, if the 125 kHz emitter was activated after power-up, it will also be activated at the next power-up, if no configuration changes have been made. In this case, the activation time for the 125 kHz emitter is roughly 250 ms.

3 MECHANICAL ASPECTS

3.1 Case dimensions

Size (mm): 250 x 103.5 x 67.5

Mounting axes (mm): 225 x 60

Mounting with 4 x M5 screws

Thickness at mounting points: 4 mm

For more information, see Appendix 1 : Specification Drawing.

3.2 Device environment

- The distance between 2 MOL81 devices must be at least 2 meters.

- MOL81 485 1337: The presence of metal in the device vicinity must be strictly controlled:

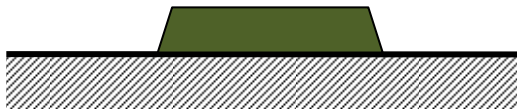


Fig. 1

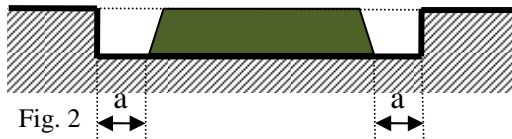


Fig. 2

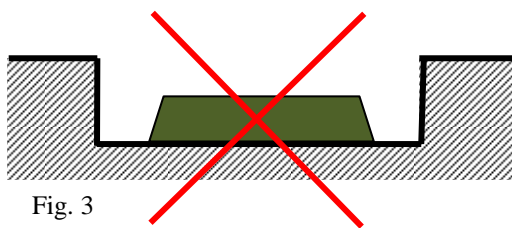


Fig. 3

In order to guarantee correct range:

- The device must be mounted directly onto a metallic plate which extends at least 10cm (a) beyond the base in both directions
- Beyond this distance, the device can be recessed (see figure 2), but not deeper than the height of the case

- MOL81 485 1312:



Fig. 1

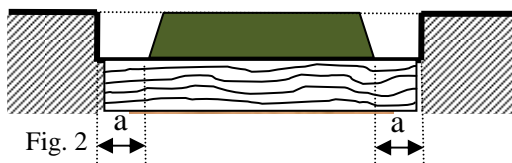


Fig. 2

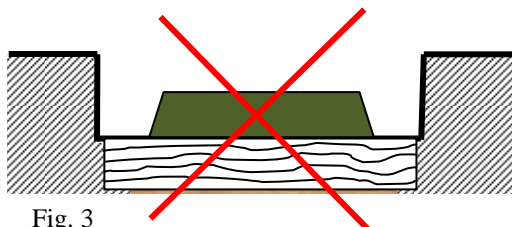


Fig. 3

In order to guarantee correct range:

- The device must not be installed directly on metal and can be mounted directly onto wooden sleepers. Metallic masses shall be distant of at least 10 cm (a).
- Beyond this distance, the device can be recessed (see figure 2), but not deeper than the height of the case.

4 CONFIGURATION

4.1 User settings

One parameter stored in non-volatile memory can be changed by the user:

- MODBUS slave address – values from 1 to 254

It can be modified using the command "Write Parameters" (see §6.7)

The default value is:

- MODBUS slave address: 1

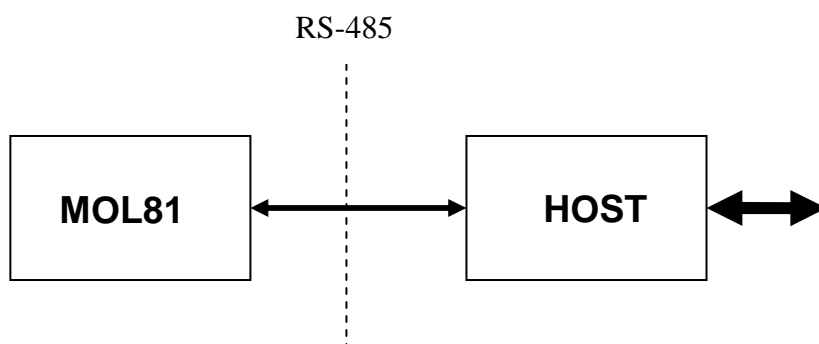
After first startup, the default Modbus address is applied and the EEPROM is not initialized until the slave address is modified. Thus, the EEPROM status bit is still 0 until a write parameters command is processed by the MOL81.

This parameter is set to 1 in factory.

5 CONNECTION TO HOST

5.1 Introduction

The reader is connected to a host using a serial asynchronous two-wire RS 485 link. Other devices can be connected on the same link.



5.2 Transmission characteristics

Baudrate and format are fixed:

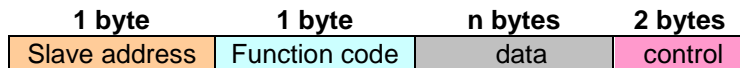
19200 bits/s

8 data bits, no parity, 1 stop bit

6 MESSAGES RECEIVED BY READER

6.1 MODBUS Protocol

This is a master/slave protocol. Each exchange is initiated by the master and consists, except in one case (broadcast message), of an exchange of two frames - a command issued by the master and a reply from the slave. All frames have the following structure:



→ The MOL1312 is a slave on a MODBUS network

The commands issued by the master are either addressed to one slave (identified by its address) or to all slaves on the network (broadcast).

Each message or frame contains 4 fields:

- The slave address (1 byte):
Specifies the destination, from 1 to 254. If the address is 0 (zéro), it is a broadcast message. In this case there is no reply.
- the function code (1 byte):
Determines the type of action to be performed (read, write, bit, word) and, in the reply, indicates if the message was received correctly.
- The data field (n bytes):
Contains the parameters associated with the function: command code, number of bytes, values.
- Control field (2 bytes):
For error detection (CRC 16).

The MODBUS protocol defines 12 functions (second field in frame). Two of them are implemented on the MOL81:

- function code 3 or 4 - read n words (*)
- function code 16 - write n words

(*) for reading n words, the MOL 81 accepts function codes 3 and 4.

If the message is received with errors (CRC incorrect), the reader does not reply. If the message is received correctly but the reader cannot process it, an error message is sent. This error message has its function code field modified, (the msb is set to 1) and the data field contains one byte, an error code with the following values:

Error type	Error code
Function code unknown	1
Command unknown	2
Data incorrect	3
System non ready	4
Execution failure	8

Figure 6-1: MODBUS error codes

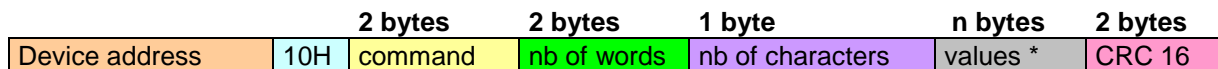
The maximum time allowable between the reception of two characters is a protocol parameter which allows a slave to resynchronise to a frame-start, if transmission is interrupted. If this time is exceeded, the slave rejects the frame currently being received.

For the MOL81 MODBUS this time is 2ms.

A general description for the two implemented MODBUS functions is given here. See the following chapters for a more detailed description of each command.

Write n words (function code 16)

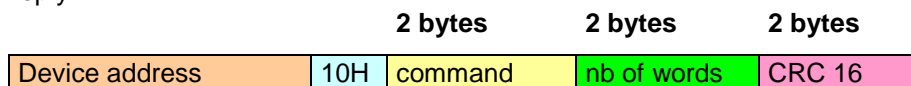
- Command



* words to be written, in order

A word consists of two bytes, high-order byte first

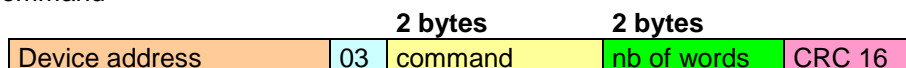
- Reply



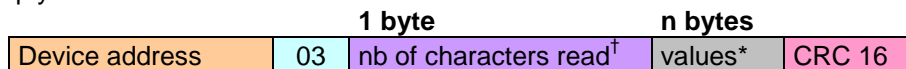
If the address is 00H, all the devices process the command without sending a reply.

Read n words (function code 3 or 4)

- Command



- Reply



* bytes read, in order

[†] number of characters read = 2 X number of words in Command (always even)

6.2 MODBUS Commands

These commands either perform an action (WRITE) or retrieve information (READ).

The following table contains all commands that can be sent to the device:

N°	Commands	Fct code	Command (hex)	Data sent	Data received
1	Read status	3 or 4	0040	1 word status	nb words = 1
2	Read tag	3 or 4	0042	3 words	nb words = 3
3	Emission 125KHz	16	0043		1 word emission
4	Reset device	16	0045		1 byte (0 = reset)
5	Read firmware version	3 or 4	0049	1 word version	nb words = 1
6	Write Setup	16	004B		1 word config
7	Write Outputs	16	0052		1 word sortie

6.3 Command: Read last tag code

This command will retrieve the most recently read tag. The reply contains 3 words.

Command: 01 CF 00 42 00 03 C1 C2
 Reply: 01 CF 06 00 ST CH CL CV CI C1 C2

where CF = 3 or 4

ST = status byte (for details see §6.6).

CH = tag code, high-order byte.

CL = tag code, low-order byte.

CV = counter for valid tag sightings.

CI = counter for invalid tag sightings.

CV and CI counters are reset when:

- A new code is read twice (i.e. on VA and NC status bits rising edge).
- The same tag disappears and appears again.

Examples:

Command: 01 03 00 42 00 03 A5 DF
 Reply: 01 03 06 00 8D 33 34 20 30 C1 C2 (new valid code = 0x3334)

Command: 01 04 00 42 00 03 10 1F
 Reply: 01 04 06 42 81 00 00 00 00 C1 C2 (no code available)

6.4 Command: 125 KHz emitter control

This command will activate or deactivate the 125 kHz emitter. The command can be sent at any time..

Command: 01 10 00 43 00 01 01 EM 00 C1 C2
 Reply: 01 10 00 43 00 01 F0 1D

where EM contains one useful bit:

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0	0	VE

VE : Activate emission (0 = activate, 1 = deactivate)

Example:

Command: 01 10 00 43 00 01 01 01 00 59 33 (deactivate emission)
 Reply: 01 10 00 43 00 01 F0 1D

Command: 01 10 00 43 00 01 01 00 00 58 A3 (activate emission)
 Reply: 01 10 00 43 00 01 F0 1D

6.5 Command: Read Firmware Version

This command reads the firmware version.

The reply contains one word **version** (2 bytes, high-order byte first).

D15	D12	D11	D8	D7	D4	D3	D0
type			version		major revision		minor revision

where **type** identifies the equipment. Only one value is currently defined:

11 (0xBH) – MOL1312

The other 3 nibbles define the version number coded in BCD, e.g. 012H corresponds to 0.1.2

Command: 01 CF 00 49 00 01 C1 C2
 Reply: 01 CF 02 B1 23 C1 C2 (MOL1312, version 1.23)

where CF = 3 or 4

6.6 Command: Read Device Status

This command will read the device status. The reply contains one byte **status**.

Command: 01 CF 00 40 00 01 C1 C2
 Reply: 01 CF 02 00 ST C1 C2

where CF = 3 or 4

ST has the following structure:

7	6	5	4	3	2	1	0
125	0	0	0	VA	NC	AC	EE

EE: EEPROM OK, active 1.
 AC: a tag is present, active 1.
 NC: new code available, active 1.
 VA: a new code is valid.
 125: 125 kHz emitter state, active 1.

The following table describes the conditions of activation/deactivation of this flags, on the MOL81-1312 and the MOL81-1337:

Flag	1	0
125	MOL81-1312: The 125 KHz emitter is operational. MOL81-1337: The MOL81 is installed on a metal plate and the 125 KHz emitter is operational.	MOL81-1312: The 125 KHz emitter is not operational. MOL81-1337: The MOL81 is not installed on a metal plate or the 125 KHz emitter is not operational.
VA	The MOL81 has read the same code successfully twice	The MOL81 has read one new code successfully, not consolidated by a second reading.
NC	Set when VA is set (after 2 properly readings)	Reset when a new code has been read successfully but not consolidated by a new reading or, A Read Last Tag Code command was received.
AC	Set when a properly reading has been done.	Reset when no properly reading has been done.
EE	The configuration parameter has been modified with a "Write Parameters" command (see §6.7)	The non volatile memory is corrupted

Examples:

Command: 01 03 00 40 00 01 85 DE
 Reply: 01 03 02 00 89 78 24 (125 kHz active, A new code is valid, EEPROM ok)

6.7 Command: Write parameters

This command will write parameters into non-volatile EEPROM memory. Currently only one parameter has been defined:

- Parameter 1 = MODBUS address

Command: 02 10 00 4B 00 01 01 AD 00 C1 C2
 Reply: 02 10 00 4B 00 01 71 EC

AD = MODBUS address, can take on values from 1 to 254, other values will produce an error.

Examples:

Command: 02 10 00 4B 00 01 01 02 00 4C 7B (adresse = 2)
 Reply: 02 10 00 4B 00 01 71 EC

Command: 02 10 00 4B 00 01 01 00 00 4D 1B (address = 0)
 Reply: 02 90 03 FC 01 (error)

Nota: new parameters are applied after the reader's reset.

6.8 Command: Reset

This command will produce a hardware reset of the device. It can be sent at any time. After the reset, the device will be in the same state as after a power-up.

Command: 01 10 00 45 00 01 01 00 00 58 C5
 Reply: 01 10 00 45 00 01 10 1C

6.9 Command: Write digital outputs

This command allows testing the digital outputs (PRESENCE and 125 kHz). It can be sent at any time.

Command: 01 10 00 52 00 01 01 SP S1 C1 C2
 Reply: 01 10 00 52 00 01 A0 18

where SP = 0 to activate the PRESENCE output, any other value will deactivate.

where S1 = 0 to activate the 125 kHz output, any other value will deactivate.

Example:

Command: 01 10 00 52 00 01 01 00 FF 1B A2 (only PRESENCE output activated)
 Reply: 01 10 00 52 00 01 A0 18

Command: 01 10 00 52 00 01 01 00 00 5B E2 (both outputs activated)
 Reply: 01 10 00 52 00 01 A0 18

Command: 01 10 00 52 00 01 01 FF FF 5A 52 (both outputs deactivated)
 Reply: 01 10 00 52 00 01 A0 18

7 DIGITAL OUTPUTS

7.1 125 kHz OK

This output is active (high) at start-up.

It can be activated or deactivated with the "Write Digital Outputs" command.

7.2 Tag Presence

This output goes active as soon as a tag is detected and goes inactive 12 ms after the last successful tag detection.

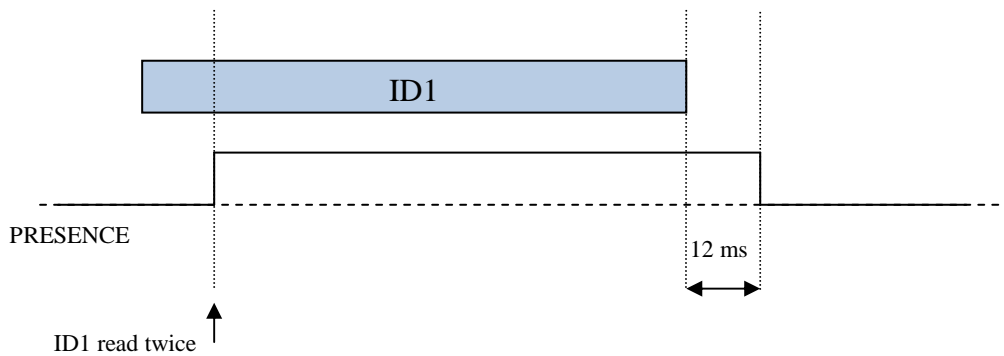


Figure 7.1 : the "PRESENCE" output.

Special case of two narrowly-separated tags

When a second tag is detected before the output "PRESENCE" for the first tag has fallen, then the output is forcibly deactivated for a fixed time of 20ms in order to indicate the detection of the second tag.

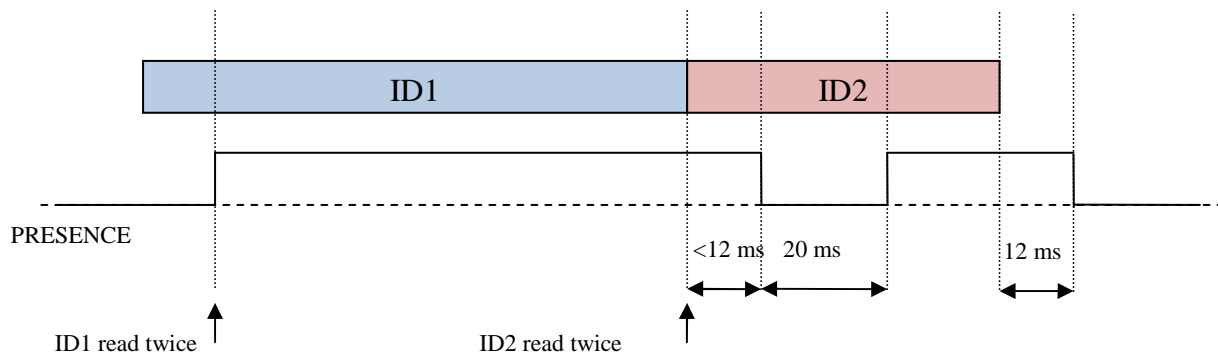


Figure 7.2 : the "PRESENCE" output with two closely spaced tags.

As soon as the second tag has been seen twice, the output falls (for 20ms) and the its ID becomes available for reading.

8 CONNECTORS

The connectors used belong to the SOURIAU UTO series, size 12, with 8 pins, IP67 watertight, with EMI-compatible shielding. These are metallic circular connectors with bayonet coupling.

8.1 Connector on case

The case connector is a panel-mount 8-pin plug with jam-nut receptacle.

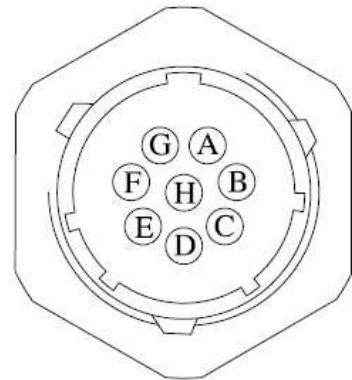
References:

- Plug: UTO71208PH
- Pins: RM20M12E8K

The pins have a diameter of 1.6mm.

The table shows the pin assignments:

Pin	Signal/Name
A	Power (+ 24V DC)
B	Line termination 120ohms (can be connected to E)
C	RS485 +
D	0 V
E	Line termination 120ohms (can be connected to B)
F	RS485 -
G	Output : PRESENCE
H	Output : 125 kHz OK



External view of connector
(rear-view of cable assembly connector)

The two-wire serial link uses pins C and F.

* For a 120ohm line termination, pins B and E can be connected together if necessary for RS485 long cable

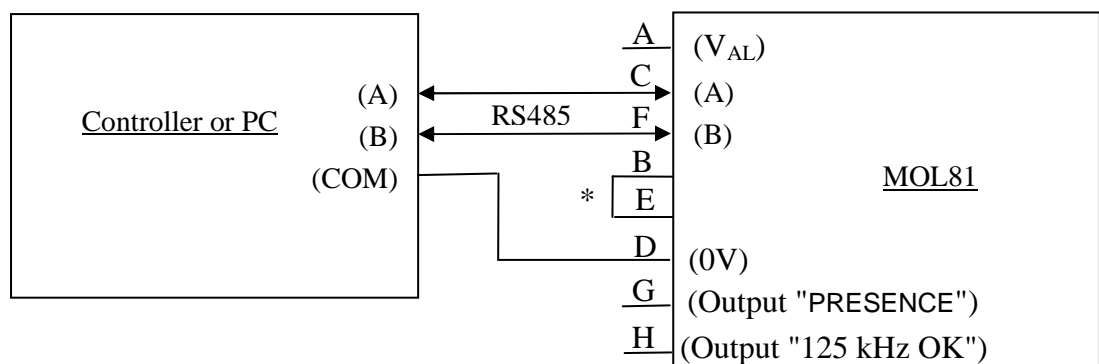


Figure 8-1: Connection diagram for normal RS485 operation with line termination

8.2 Connector for cable assembly

The connector for the cable belongs to the SOURIAU UTO series, size 12, with 8 pins

The socket connector references are:

- Shell: UTO6128SH
- Socket contacts: RC16M23K (e.g. for wires of 0.5mm² to 1.5mm² (AWG16 to AWG20))
- Hood and cable-gland: UTOS12JCSL (long version for cables from Ø13,5 to 18mm).

These references are examples, please check with the manufacturer for availability.

The socket contacts must be chosen according to individual wire size gauges. The above reference is for wire sizes from 0.5mm² to 1.5mm² (AWG16 to AWG20). See SOURIAU documentation for other references.

The hood for the female socket must be chosen according to the outside diameter of the cable. The above reference is for cable sizes from 8mm to 12.5mm. See SOURIAU documentation for other references.

8.3 Type of cable to use

The cable to be used must be shielded with the following characteristics:

- 6 wires:
 - Power : 2 wires
 - Serial link RS485 : 1 twisted pair 120Ω (*)
 - Outputs : 2 wires
 - Shield : 360° contact to connector
- Wires are connected using crimping; wire cross-section: 0.5 to 1.5 mm²
- Outside cable diameter: 8 to 12.5 mm
- Max length for RS485 cable: 1200 m.
- Max length for power supply cable : 100 m.

(*) MOL81 485 line termination to be connected if necessary, pins B to E.

9 MAINTENANCE

9.1 Regular maintenance

The MOL81 requires no regular maintenance.

The unit should be regularly cleaned to avoid accumulation of dirt.

The unit should be regularly checked for:

- cracks in the case
- broken mounting points
- missing mounting screws
- screws tightened with specified torque
- connectors correctly locked

MOL81 operation should be regularly checked according to the above procedure.

9.2 Device replacement

If the MOL81 needs to be replaced, the procedure is as follows:

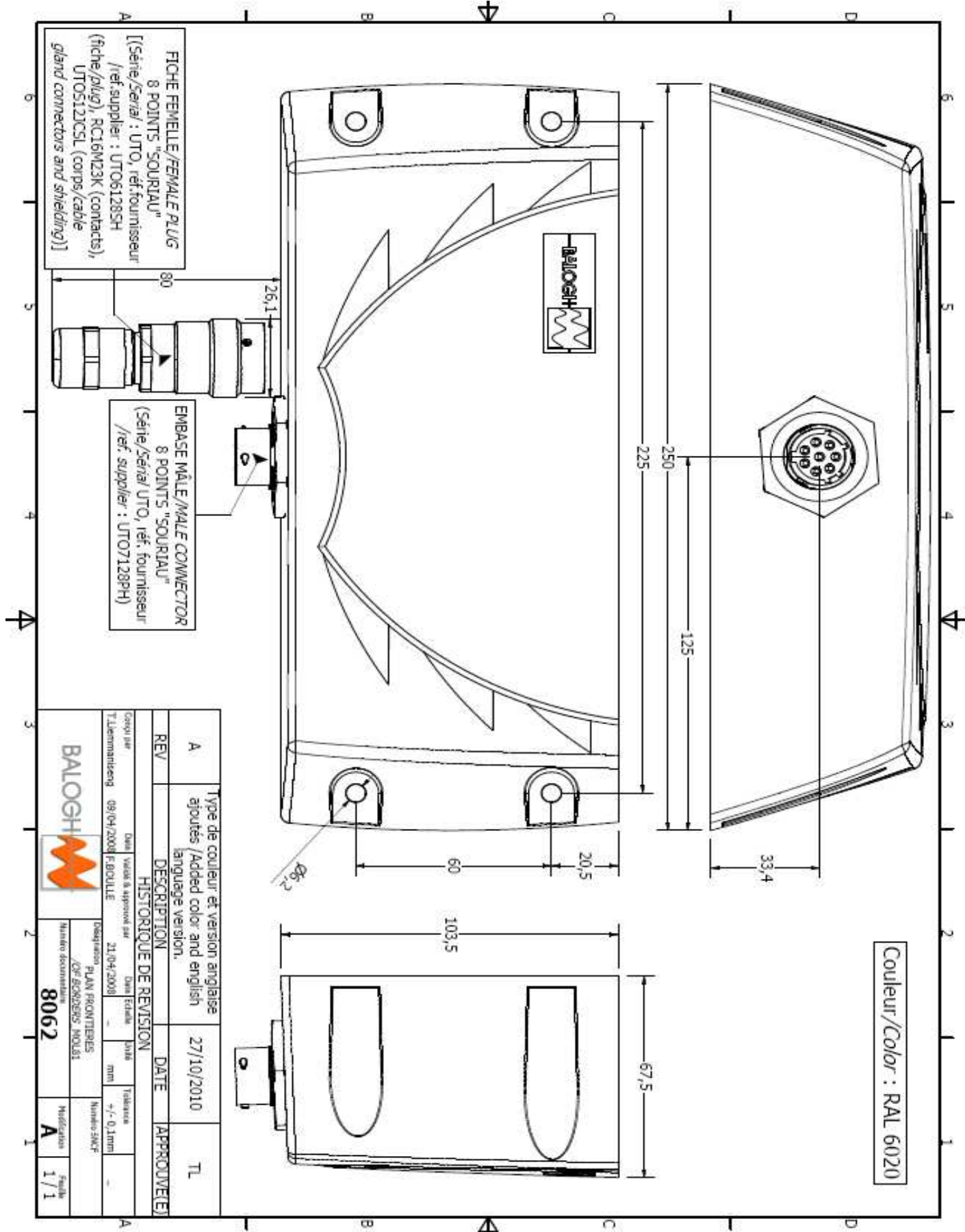
- Turn the knurled ring of the plug anti-clockwise (1/3 turn) to unlock the connectors
- Remove the 4 mounting screws and dismount the unit, taking care to record the orientation
- Place the new MOL81 in the same position, insert the 4 mounting screws and tighten to the specified torque
- Insert connector and turn the knurled ring clockwise (1/3 turn) until locked.

Check for correct operation according to the procedure above.

9.3 Recycling

All decommissioned units must be returned to BALOGH SA for appropriate recycling according to directive D3E.

Appendix 1 : Specification Drawing



Appendix 2 : Important note about FCC rules

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

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.