Dokument tittel:	Installation Manual for MD 5850 MultiReader				
Dokument nummer:	645-054-1999				
Filnavn/Path:	Arkiv/…/645-054-1999.doc				
Revisjon nummer:	1	2	3	4	
Forfattet/revidert dato:	06.09.99	29.10.99	15.06.00	01.08.01	
Forfattet/revidert av:	ES	ES	STo	FV	
Sjekket av:	STo	STo	ES	STo	
Godkjent dato:	21.09.99	29.10.99	15.06.00	01.08.01	
Godkjent av:	STo	STo	STo	STo	

Revisjonshistorie

Rev.2: Han-Modular connector pos. C pin 9 and 11 signals exchanged to correspond with I/O Filter Schematic.

Rev.3: Changed pflash instruction for serial flashing.

Rev.4: MVME168P preparations and flashing added.

Installation Manual
for
MD 5850 MultiReader

This equipment complies with part 15 of the FCC rules. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Table of Content

1 INTRODUCTION

1.1 Abbreviations

CPU	Central Processing Unit
LED	Light Emitting Diode
LHC	Left Hand Circular.
MR	MultiReader
OBU	On Board Unit
RF	Radio frequency. In this document RF means microwave frequencies in the 5.8 GHz band.
RX	Receiver/Receive signal
TPC	Toll Plaza Computer
TX	Transmitter/Transmit signal

2 MULTIREADER HARDWARE INSTALLATION

2.1 MultiReader Cabinet Installation

The **Q-FREE® MultiReader (MD 5850)** has two connector options, 10-pin circular and Han-Modular connector.

Four M8x40 screws at the rear of the cabinet make it easy to design a mechanical interface to gantries, walls, bridges, etc.

An optional Universal mounting bracket may be delivered as shown in fig.2.1.1.

This chapter is a guide to the mechanical and wiring installation of the MD 5850 MultiReader.

The instructions in this manual are based upon the use of the stainless steel 2-piece universal bracket made by MD, MD part no. 11000013. This bracket is not included in the MD 5850, and must be ordered separately.

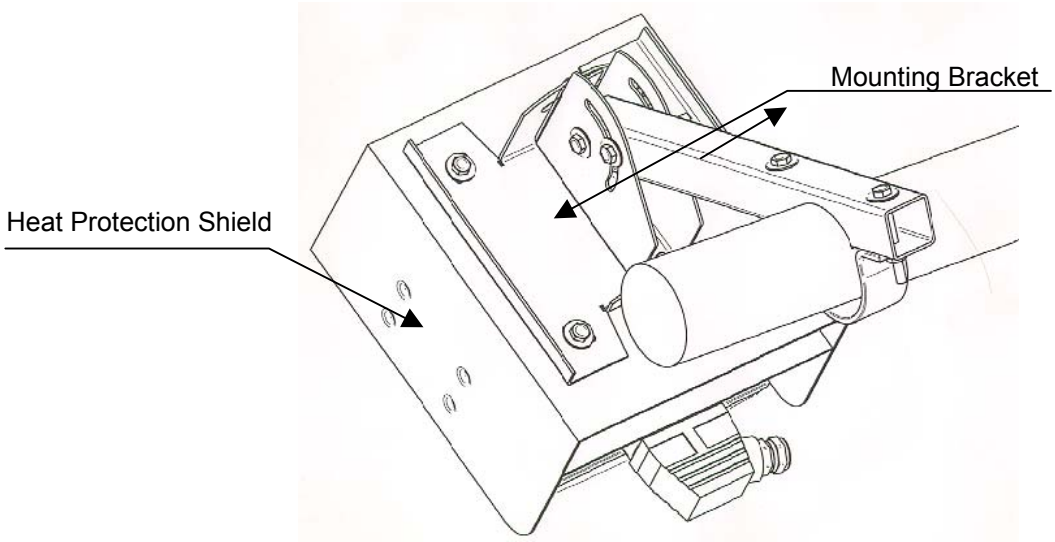


Fig.2.1.1 Optional Universal-Mounting bracket for MD 5850.

Q-Free can on request provide a special designed mounting bracket. The bracket is made of stainless steal and allows the MultiReader to be adjusted both sideways and vertically for maximum Flexibility.

2.2 Installation site

2.2.1 Toll plaza superstructure

The normal configuration at toll plaza with separate lanes, is to have the MR installed hanging from the toll plaza superstructure. Mounting the MR under the superstructure also provides protection from rain, snow, sun heat radiation etc.

In some cases, a gantry or pole will be more suitable for mounting the MR, but then there is no protection from, rain, snow, sun heat radiation etc.

2.3 Basic installation

2.3.1 Mounting height and angle

The normal mounting height is 5.5 to 6m above the road, and the normal mounting angle is 45° down from vertical (fig.2.3.1). Optimum performance is obtained when the MultiReader (MR) is mounted above the middle of the lane.

If the centre of the antenna lobe must correspond with the centre of a magnetic loop, it is preferred that magnetic loop is installed in a position, which gives a normal MultiReader angle.

In vehicle access control systems with physical barrier where the magnetic loop vehicle detection and OBU transactions has to be matched, the optimum-mounting angle could be between 25° and 45° relative to the vertical plane through the MR. It is not recommended to have a mounting angle (pointing angle) below 25° because then it is possible that overhanging roof of special vehicles could shadow the tag.

An angle below 45° will reduce the communication zone length. This must be considered when the vehicles are passing at a high speed.

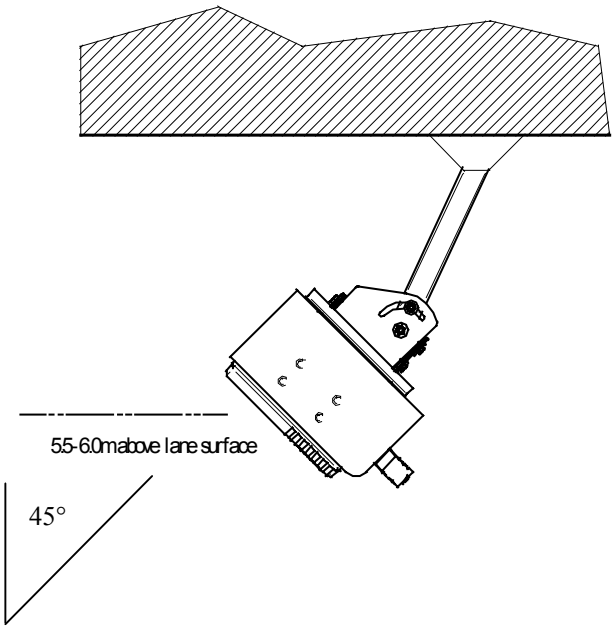


Figure 2.3.1 Side view of MR mounted hanging from concrete superstructure

2.4 Square tube from customers construction

2.4.1 Requirements for using the Uni-bracket

The bracket accepts 2x2" or 50x50mm square tube. The customer must obtain the square tube and fix it to the suitable superstructure, gantry or pole. At the end of the square tube, there must be drilled holes with 11mm diameter for the bolts that fix the Uni-bracket to the tube.

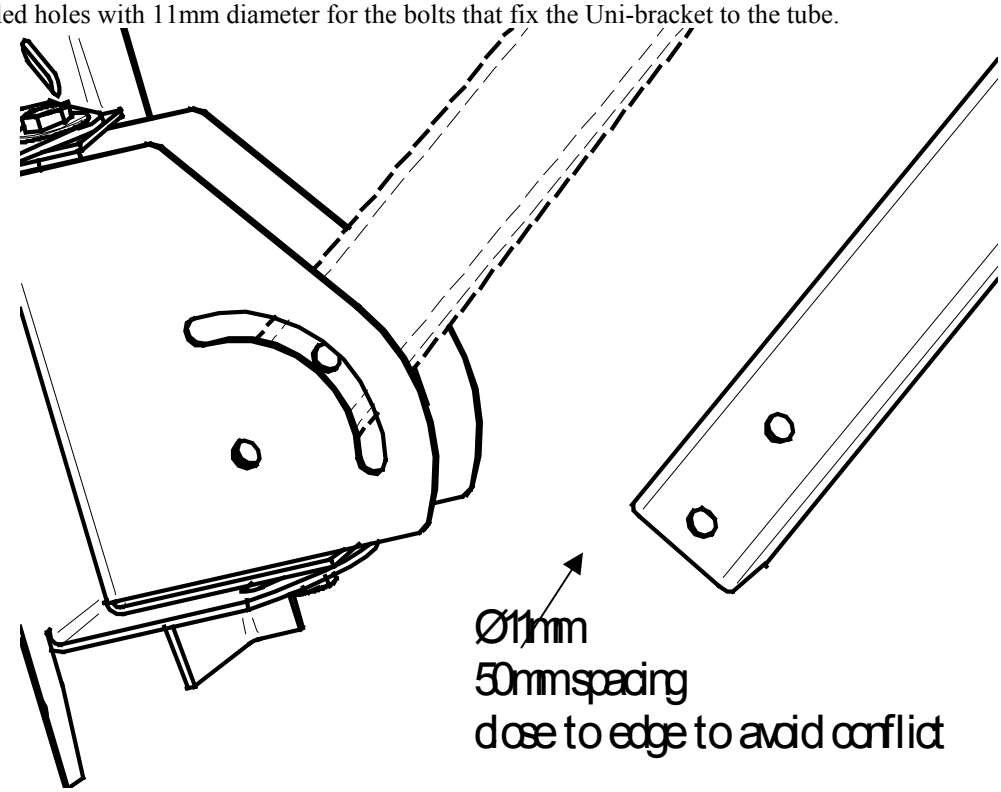


Figure 2.4.1 Square tube construction

2.4.2 Fixing the square tube

The customer should assure that the square tube is rigidly fixed and will not sway or yaw in wind and will not deflect from original position over time.

2.4.3 Square tube angles

The square tube can be mounted in different angles, from vertical to horizontal in the longitudinal axis of the lane. The Uni-bracket is fixed to the MR with 4 M8 bolts that are in a 200mm square pattern. The bracket can therefore be inverted on the MR in order to accept different angles of the square tube.

2.5 Square tube sideways angles

The Uni-bracket also provides for sideways adjustment.

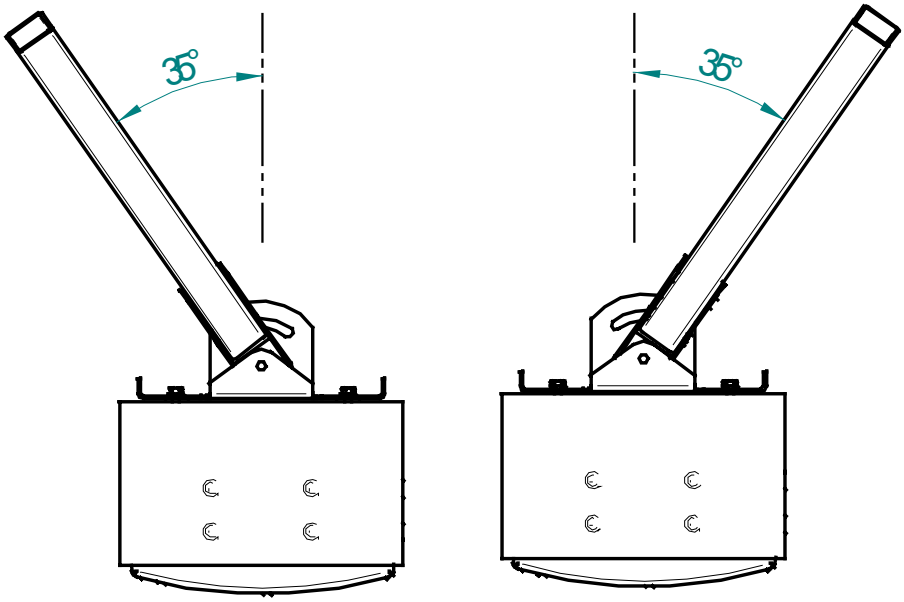


Figure 2.5.1 Top view of MR, showing sideways adjusting range

3 MULTIREADER CABLE INTERFACE

3.1 MultiReader Power Supply and Data Interface

The cable interface to the MultiReader is dependent on which option and version that is delivered. 24VDC, with 48VDC and 12VDC as options can power the MultiReader.

The normal data interface is as follows:

Circular connector:

RS422 (RS232)

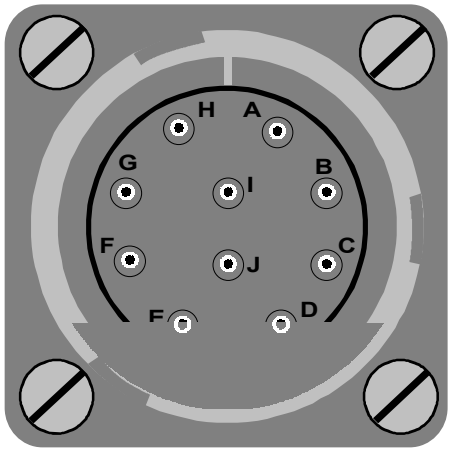
Han-Modular connector:

RS422 combined with twisted pair, optical or coaxial Ethernet.

Information on how and where the different signals are located in the interface connectors is given below (Fig. 3.2.1 and 3.3.1).

3.2 Circular Chassis Connector

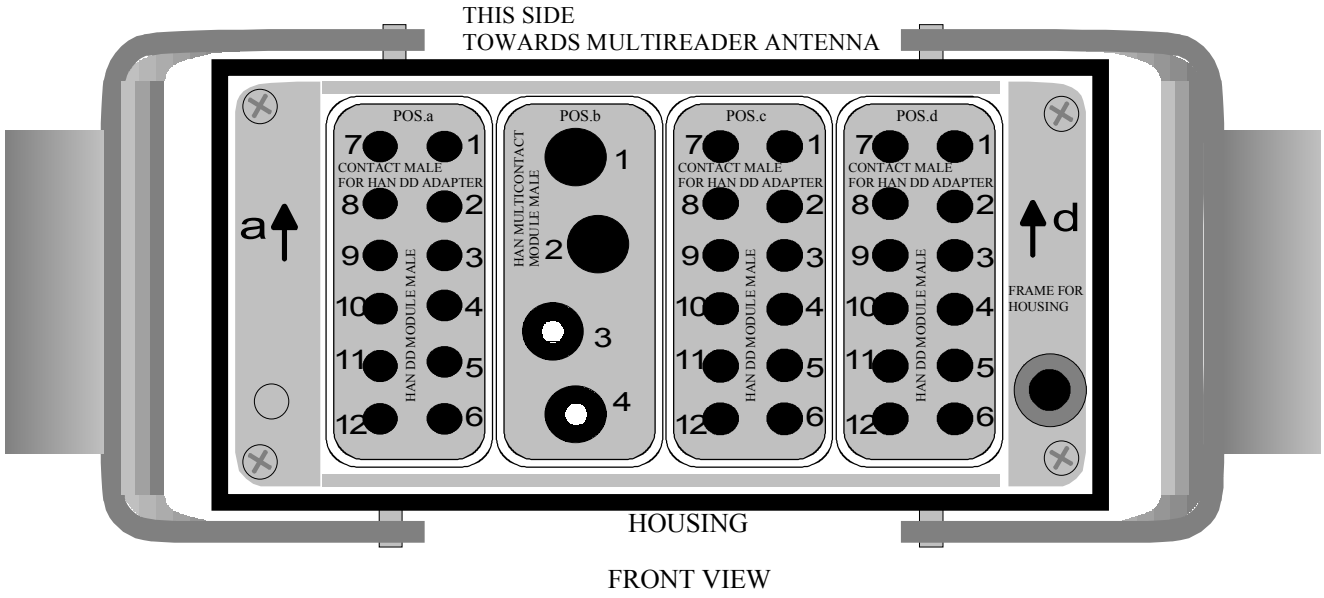
Signal configuration for the standard 10 pin circular Chassis Connector with bayonet lock



POWER SUPPLY &	
PIN A	+VDC
PIN B	+VDC
PIN C	-VDC
PIN D	-VDC
PIN E	-RX
PIN F	+RX
PIN G	-TX
PIN H	+TX
PIN I	+VDC
PIN J	-VDC

Fig.3.2.1 Circular Chassis Connector pin configuration.

3.3 Han-Modular Connector



POS. a POWER

PIN 1	+48 VDC	Option
PIN 2	+48 VDC	Option
PIN 3	+48 VDC	Option
PIN 4	+12 VDC	Option
PIN 5	+12 VDC	Option
PIN 6	+12 VDC	Option
PIN 7	+24 VDC	Standard
PIN 8	+24 VDC	Standard
PIN 9	+24 VDC	Standard
PIN 10	- IVDC	Standard
PIN 11	- IVDC	Standard
PIN 12	- IVDC	Standard

POS. b FIBRE OPTIC & COAXIAL Eth.net

PIN 1	TX FIBRE
PIN 2	RX FIBRE
PIN 3	TX/RX COAXIAL 1
PIN 4	TX/RX COAXIAL 2

POS. c RS232/RS422/Eth.net twisted pair

PIN 1	+IERX	(Eth.net tw. pair)
PIN 2	+IETX	(Eth.net tw. pair)
PIN 3	ITXD	(RS232)
PIN 4	+ITX	(RS422)
PIN 5	NC	
PIN 6	+IRX	(RS422)
PIN 7	- IERX	(Eth.net tw. pair)
PIN 8	- IETX	(Eth.net tw. pair)
PIN 9	IRSGND	(RS232)
PIN 10	- ITX	(RS422)
PIN 11	IRXD	(RS232)
PIN 12	- IRX	(RS422)

POS. d PIO Signals

PIN 1	IOA1	VDC signals
PIN 2	IOB1	from/to
PIN 3	IOA2	a PIO board
PIN 4	IOB2	relé switch.
PIN 5	IOA3	
PIN 6	IOB3	
PIN 7	IOA4	
PIN 8	IOB4	
PIN 9	IOA5	
PIN 10	IOB5	
PIN 11	IOA6	
PIN 12	IOB6	

Fig.3.3.1 Han-Modular Connector pin configuration.

3.4 Han-Modular connector assembly parts

(see Harting Catalogue "Heavy Duty Han® Connectors" and http://www.harting.com/)

Connector Specifications

Harting Connector assembly parts

Identification	MD Part No.	Harting Part No.	Mounting part
Cable Clamp EMC (IP68):	2A1MCC01	09 62 000 5008	Cable
Hood (standard):	2A1MHD01	09 30 016 0520	Cable
Han DD Module Male:	2A1MDD01	09 14 012 3001	Chassis
Han DD Module Female:	2A1MDD02	09 14 012 3101	Cable
Han Multicontact-Module Male	2A1MMM01	09 14 004 4501	Chassis
Han Multicontact-Module Female	2A1MMM02	09 14 004 4512	Cable
Contact Female 0.5mm Silver P.	2A1MS 001	09 15 000 6203	Cable
Contact Female 1.0mm Silver P.	2A1MS 002	09 15 000 6202	Cable
Contact Female 2.5mm Silver P.	2A1MS 003	09 15 000 6206	Cable
Frame for hood:	2A1MFH01	09 14 016 0301	Cable
Frame for Housing:	2A1MFS 01	09 14 016 0311	Chassis
Housing (standard):	2A1MHS 01	09 30 016 0301	Chassis
Contact Male for Han DD PCB adapter	2A1MS 004	09 15 000 6191	Chassis
Dummy module:	2A1MDM01	09 14 000 9950	Cable & Chassis
Han PCB Adapter	2A1MAD01	09 16 000 9905	PCB I/O Filter
FOC male contacts for fibre	2A1MFC01	20 10 125 4211	Cable Exterrnal
FOC female contact for fibre	2A1MFC02	20 10 125 4221	Cable Internal

Male 09 14 004 4501

Female 09 14 004 4512

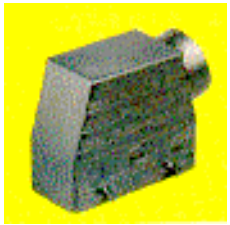
09 14 000 9950

09 14 012 3001

09 14 012 3101

Coaxial contacts 50 ohm

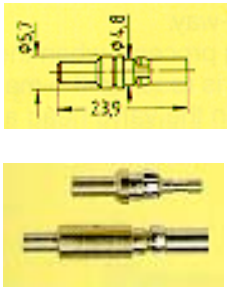
Male 09 14 000 6111
Female 09 14 000 6211



09 30 016 0520

Four module frame
09 14 016 0311

09 14 016 0301

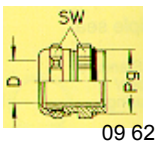


Male 20 10 125 4211
Female 20 10 125 4221

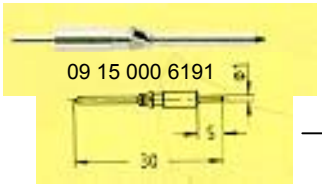
Fibre contacts for DIN 41 626 part 3

09 30 016 0301

09 16 000 9905



09 62 000 5008



3.5 Installation tools (preferred)

Tools for contacts **Han D** (09 15 . . .)

Identification	Part No.	Drawing / Dimensions in mm
HARTING-crimping tool	**09 99 000 0110**	Wire gauge 0.14 - 1.5 mm²
Locator	**09 99 000 0111**	order separately
HARTING-crimping tool	**09 99 000 0300**	Wire gauge 0.14 - 1.5 mm²
Locator as spare part	**09 99 000 0301**	Locator is supplied with the tool
BUCHANAN-crimping tool	**09 99 000 0001**	Wire gauge 0.37 - 2.5 mm²
Locator	**09 99 000 0311**	
Crimping tool depth adjustment gauge	**09 99 000 0203**[1]	0.14 + 0.25 mm² ø 1.00
	09 99 000 0125	0.37 mm² ø 1.30
	09 99 000 0007	0.5-1 + 2.5 mm² ø 1.55
	09 99 000 0008	1.5 mm² ø 1.80
For FOC contacts: crimping tool	20 99 000 1032	
Crimping tool depth adjustment gauge	20 99 001 1032	ø 1.45
HARTING-pneumatic crimping tool	**09 99 000 0314**	
Locator	**09 99 000 0311**	
Crimping tool depth adjustment gauge	**09 99 000 0125**	Wire gauge 0.37 mm² ø 1.30
	09 99 000 0007	0.5-1 + 2.5 mm² ø 1.55
	09 99 000 0008	1.5 mm² ø 1.80
Table fixing and foot switch for pneumatic crimping tool	**09 99 000 0309**	order separately
HARTING-semi-automatic crimping device		Wire gauge 0.14 - 1.5 mm²
Main drive foot-operated 230 V/50 Hz	**09 99 000 0246**	
crimping head	**09 99 000 0254**	
Locator	**09 99 000 0111**	order separately
Insertion tool for crimp contacts	**09 99 000 0059**	For crimp contacts with wires of less than 0.75 mm² it is recommended that an insertion tool is used. Contacts should be inserted from the wiring side and pushed down until a positive locking is achieved.
Removal tool for crimp contacts		. . 0012
Removal tool	**09 99 000 0012**	. . 0004
Replacement-tip for removal tool	**09 99 000 0004**	. . 0052
Removal tool	**09 99 000 0052**	A removal tool is necessary if contacts are to be replaced in the insert. It is inserted from the mating face and pushed over the contact until a stop is noticeable. Additional pressure unlocks the contact and pushes it out of the wiring side. In case of the removal tool (. . 0052) the unlocking process is achieved by pressure on the central rod.

Tools

12.02

[1] For wire gauge 0.14 and 0.25 mm² use only male contact 09 15 000 6107 or female contact 09 15 000 6207.

Stock items in bold type

4 EXTERNAL CABLE INTERFACE

4.1 Cable dimensions

Data (RS422 or 10Mbit Ethernet):	2 twisted pairs with outer screen (Max 150m)
Data (RS232):	2 pair 0,5 mm^2 (Max 10 meters)
Data through optical 10Mbit Ethernet:	2 optical fibres. (Max 2 km)
Data through coaxial 10Mbit Ethernet:	1 coax cable (Max 150 m)
Power Supply 24VDC (48VDC):	3 wires 0.8 mm^2 (Max 150m) for +VDC and - V DC
Power Supply 12VDC:	3 wires 0.8 mm^2 (Max 10m) for +VDC and - V DC

4.2 Circular connector

Connecting Power

To be able to use a cable which is 150m long with 0.8 mm^2 wire size, it is necessary to use at least 3 wires for both minus (-) and plus (+) 24V supply to be sure that the voltage does not drop below 20V at the input of the DC-DC converters.

The connection of the cable to the circular connector is shown in fig.5.1.1. The cable should have at least 10 wires including two twisted pairs for data transfer. The minimum Supply Voltage depends on how large voltage drop there is through the cable. As mentioned before the input voltage to the MultiReader must not be below +18V (Preferable not below +20V) with +24V power supply. As an example the cable wires for the VDC must have a square of 0.8mm², if the cable has a length of 150m.

Because of "in rush current" when turning on the power, the roadside supply should be able to deliver 100W at 24VDC (48VDC or 12VDC).

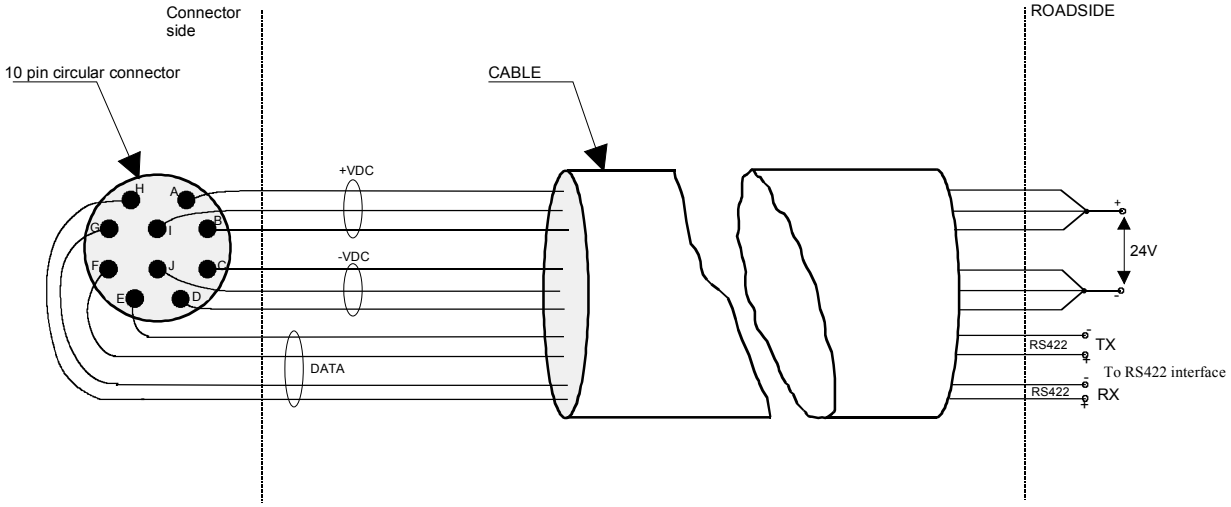


Fig.5.1.1 Power and data cable interface to circular connector.

Connecting Data

The data communication is performed through twisted pairs. Transmit (TX) signals on pin G &H and receive signals (RX) on pin F&E referred to the RS422 circular connector interface at the MultiReader.

The maximum length of data transmission on twisted pairs depends of the cable category. Category 5 is recommended. NB! The TX at the connector side is coupled to the RX at the

Roadside Transceiver, and RX at the connector side is coupled to TX at the Roadside Transceiver.

4.3 Han-Modular connector

By using the Han-Modular connector there are a lot of interface possibilities. In fig.A.1 all the standardised interfaces are shown assembled in a test interface cable.

The specification for the cable wires is of course the same as for the cable wires used with the circular connector. It is recommended to use 0.8mm² for the VDC wires and category 5 cable for the twisted pair RS422 and Ethernet data wires. If the cable length is less than 150m, the VDC wires cross section may be reduced proportional to the length reduction.

The RS232 interface is only meant for short range (<10m) test interface to the CPU console port. Because there is no galvanic isolation this interface should not be used in a permanent installation.

The twisted pair Ethernet signal wires are usually connected to a Hub or a twisted pair Ethernet Transceiver through a RJ45 connector.

The external Ethernet Optical Fibre Cables TX and RX (part no. 133FIBRE) is plugged into module B (pos. 1and 2) at the Han-Modular cable connector. An Ethernet Fibre Optic Transceiver must be used at the roadside for converting to and from electric signals.

To avoid opening the MultiReader cabinet it is possible to use special test cables (appendix A), with or without data transceivers, designed to fit to the circular connector or to the Han-Modular connector. The PC/Terminal is then connected to the D-sub connector at the interface box.

5 MULTIREADER SOFTWARE INSTALLATION

5.1 How to flash the MV162-12 and MVME162P CPU-card through the serial port (console).

Unless specified the description below apply to the MV162-12 CPU-card.

Preparations MV162-12:

- Turn off power.
- Open the READER by unscrewing the four bolts on the back of the READER.
- Loosen the CPU-card by unscrewing two screws on the front of the CPU-card.
- Take out the CPU-card.

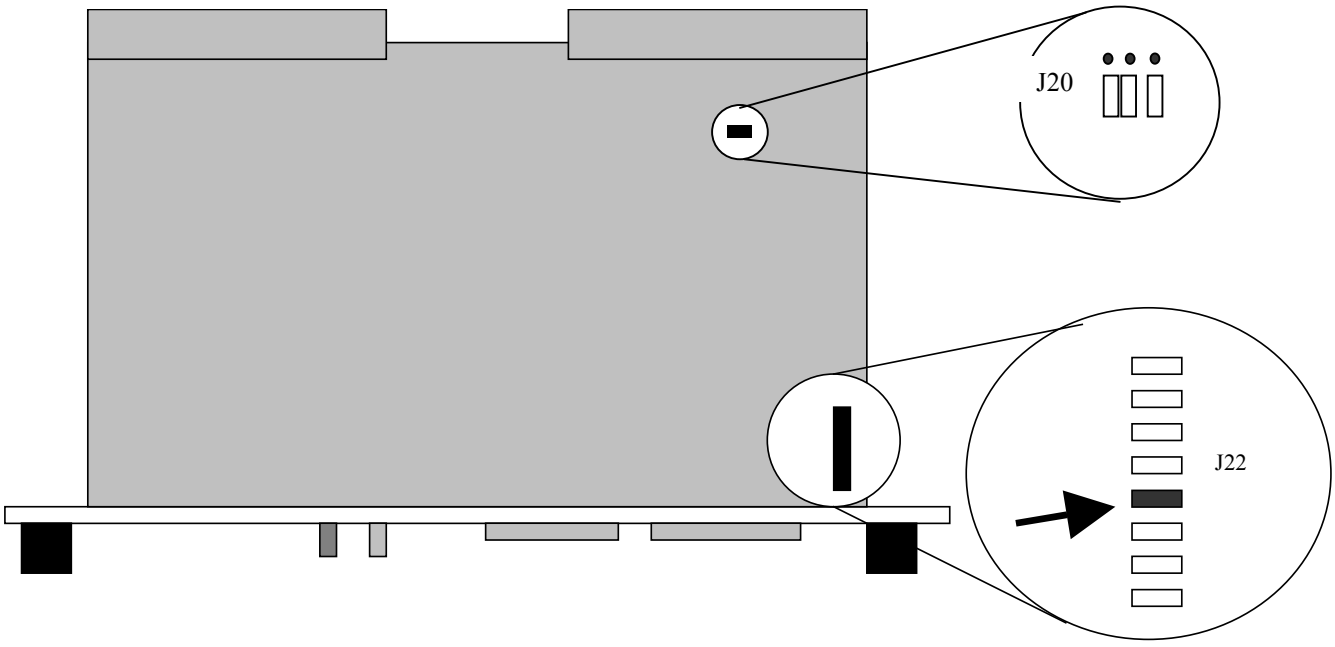


Fig.5.1.1 CPU-card.

- Remove the jumper indicated on the figure above. (That is jumper number 4 from the front of the card in the jumper row called J22)
- If this is a new CPU-board from factory, 2 jumpers that are settled under the memory module (jumper row J20) must be moved so they are standing equal to the third jumper. They shall all close the two pins nearest the centre of the board.
- Insert the card into the backplane again; do not tighten or use the screws yet.
- Proceed to 5.1.1

Preparations MVME162P:

- Turn off power.
- Open the READER by unscrewing the four bolts on the back of the READER.
- Loosen the CPU-card by unscrewing two screws on the front of the CPU-card.
- Take out the CPU-card.
- Move (if necessary) jumper from pin 2-3 to pin 1-2 on J1 (CPU card as system controller)
- Move (if necessary) jumper from pin 1-3 to pin 3-5, and jumper from pin 2-3 to pin 4-6 on J22 (onboard battery as primary and secondary power source for SRAM)
- Set switch S4 on dipswitch 5 in position "OFF".
- Insert the card into the backplane again; do not tighten or use the screws yet.

5.1.1 Loading the software and flashing.

- Connect a PC/Terminal with e.g. HyperTerm or TeraTerm (configured to 9600,8,N, 1) to the serial port 1 (console) with a serial cable.
- Turn on the power on the READER. After s few seconds you will see something like this (output text is in "Italic" while input text is in "***Italic Bold face***"):

```
Copyright Motorola Inc. 1988 - 1995, All Rights Reserved

MVME162 Debugger/Diagnostics Release Version 2.3 - 09/06/95
COLD Start

Local Memory Found =00400000 (&4194304)

MPU Clock Speed =25Mhz

162-Bug>
```

- To make the transfer faster you can set the baud rate to 38400 with the command '***pf 0***'. (to get out of this menu type '**.**' as shown below.)

```
162-Bug>pf 0

Baud Rate [110,300,600,1200,2400,4800,9600,19200,38400] = 9600? 38400
Even, Odd, or No Parity [E,O,N] = N?
Character Width [5,6,7,8] = 8?
Stop Bits [1,2] = 1?
Auto Xmit enable on CTS* [Y,N] = N?
Auto negate RTS* when Recv FIFO full [Y,N] = N?
XON/XOFF Protocol [Y,N] = Y?
XON = $11=^Q?
XOFF = $13=^S?
Baud Rate [110,300,600,1200,2400,4800,9600,19200,38400] = 38400? .

OK to proceed (y/n)? y
Update Non-Volatile RAM (Y/N)? N
```

- Turn the HyperTerm off and on (due to a bug in the HyperTerm SW) and thereafter the terminal must be set to the same baud rate as in frame above. (Choose properties and configure to change baud rate).
- Type the command ***'lo 0 10000'*** and press enter (***lo*** = letters) The CPU-card gives no response and no prompt to this command, it is waiting for the software.
- Select the menu 'Transfer' and 'Send Text File' on the HyperTerm.
- As filename select the application software (hex format) from the SW archive, PC hard disc or from the supplied diskette.
- The HyperTerm program gives no indication that it is sending the file and the READER shall not print out anything either. If you try to select a menu then the response is very slow indicating that the program is working.
- The loading of the file will take between 10-15 minutes.
- After the loading is finished then you can press ***'enter'*** to get the *'162-BUG->'* prompt.
- Now type ***'pflash 10000 10ffff ffa00000'***. [1]
- The response from the CPU-card should be something like this:

```
162-Bug>pflash 10000 10ffff ffa00000

Source Starting/Ending Addresses      =00010000/0010FFFF
Destination Starting/Ending Addresses =FFA00000/FFAFFFF7
Number of Effective Bytes             =000FFFFF (&1048575)

Program FLASH Memory (Y/N)?
```

- Type ***'Y'*** and enter to start the flashing.

```
Zeroing Block Number     =00 ($FFA00000)
Zeroing Block Number     =01 ($FFA40000)
Zeroing Block Number     =02 ($FFA80000)
Zeroing Block Number     =03 ($FFAC0000)
Erasing Block Number     =00 ($FFA00000)
Erasing Block Number     =01 ($FFA40000)
Erasing Block Number     =02 ($FFA80000)
Erasing Block Number     =03 ($FFAC0000)
Programming Block Number =00 ($FFA00000)
Programming Block Number =01 ($FFA40000)
Programming Block Number =02 ($FFA80000)
Programming Block Number =03 ($FFAC0000)
FLASH Memory Programming Complete

162-Bug>
```

- The number of blocks depends on the type of application software.

5.1.2 Closing up.

- Now you have to turn off power and replace the jumper removed earlier. On MVME162P set switch S4 on dipswitch 5 in position "ON". Leave the other jumpers in positions described in 5.1.
- Turn the HyperTerm off and on (due to a bug in the HyperTerm SW) and thereafter the terminal must be set to baud rate 9600.
- Now turn on the power and check that the software boots before you close the box. There might be some Errors at this point, but you should have the prompt.
- Fasten the CPU-screws, close the box and fasten the bolts.

[1] pflash 10008 10ffff ffa00000 for sw older than 1999.

5.1.3 Make new startup file

- From prompt type in the startup script. The script is unique for each software.
- Contact Q-Free® if you don't know which script to use.
- The startup file could have any name but must be the same as set in "bootChange"

Example of startup script:

```
> copy 0,"startup"
sp InitAriadneLdr
taskDelay 500
sp con2
^D
>
```

5.1.4 bootChange

- Write -> ***bootChange*** ↵
- Then the following example list has to be completed:

boot device	***ei****(Ethernet or)* ***ppp=/tyCo/1,38400*** *(Serial)*
processor number	***0***
host name	***boothost***
file name	*Path and filename to load able OS system (if necessary)*
inet on ethernet	***xxx.xx.xxx.xx:yyyyyyyy*** *(IP address and netmask for this unit, example:* ***192.168.0.50:fffffe00****)*
inet on backplane	*(Not used)*
host inet	***xxx.xx.xxx.xx*** *(IP address for host unit, example:* ***192.168.0.30****)*
gateway inet	***xxx.xx.xxx.xx*** *(gateway address if necessary)*
user	*User name for host*
ftp password	*Password for host*
flags	***0x88***
target name	*MultiReader name (example:* ***MR1_410_4****)*
startup script	*Path and filename to startup script*
other	*(Not used)*

- Now you have to reset the CPU either by typing ***HwReset***, pushing the ***reset push button*** on the CPU board, or by turning the ***power off and on***.
- Observe that the CPU is booting and that it ends with "**Done executing start-up script ….**".

5.2 How to flash the MultiReader via Ethernet.

- Move jumper number 4 out of 8 in a row at the corner of the CPU-board counted from the front plate, so that it is open (fig.5.1.1). On MVME162P set switch S4 on dipswitch 5 in position "OFF".
- If this is a new CPU-board from factory, 2 jumpers that are settled under the memory module must be moved so they are standing equal to the third jumper (fig.5.1.1). They shall all close the two pins nearest the centre of the board. For MVME162P see 5.1 **Preparations MVME162P:**.
- Put the CPU-board in and turn on the power. The terminal that is connected to the console port (port 1) on the MultiReader will reply:

```
162-bug>
```

- Set time on the card with the command **"set mmddyyhhmm"**(month, day, year, hour, minute).

- Set IP addresses for the card and the host with the command **"niot".** You will now get some questions. They are all going to be answered by *enter* key, except from 2 questions (example addresses):
  Client IP address? Set: **"192.168.0.50"**
  Host IP address? Set: **"192.168.0.31"**
- Now you have to push *enter* key until you get the "162-bug>"prompt.

- After that is done the software have to be loaded down over the net with the command **"niop".** Here you have to answer one question; File name? Your answer should be path and filename for your (example):**"/home/ecopoint/mr/tornado.st_bin",** then push enter until there are no questions left. It takes about 15 seconds to load the program.

- The program is flashed with the command **"pflash e000 10dfff ffa00000".**Then you have to answer "y", to a question about if you really want to do this. You will get information about the progress. First it says "Erasing block 0...1", after that "Zeroing block 0...1"and at last "Programming block 0...1". Disconnect power and remove the card, put jumper 4 so that it is closed.

- If the new software require changes in the boot parameters, restart the MultiReader and type the command **"bootChange".** Afterwards you have to answer these questions:

boot device	**ei**(Ethernet or) **ppp=/tyCo/1,38400** (Serial)
processor number	**0**
host name	**Boothost**
file name	*Path and filename to load able OS system (if necessary)*
inet on ethernet	***xxx.xx.xxx.xx:yyyyyyyy*** *(IP addressand netmask for this unit, example:* ***192.168.0.50:fffffe00****)*
inet on backplane	*(Not used)*
host inet	***xxx.xx.xxx.xx*** *(IP address for host unit, example:* ***192.168.0.30****)*
gateway inet	***xxx.xx.xxx.xx*** *(gateway address if necessary)*
user	*User name for host*
ftp password	*Password for host*
flags	**0x88**
target name	*MultiReader name (example:* ***MR1_410_4****)*
startup script	*Path and filename to startup script*
other	*(Not used)*

6 TEST WITH APPLICATION SW

6.1 PC/ Terminal Connection to MultiReader

Connect a 0 modem cable to the console port on the MultiReader CPU board. Here it is possible to use special test cables, with or without data transceivers, designed to fit to the circular connector or to the Han Modular connector.

Switch on the Power Supply. After the booting process is finished, the prompt " >" appears if connected to serial port 1/console or "COMMAND >" when connected to serial port 2. Then the MultiReader is ready for communication with transponders intended for the loaded application SW.

6.2 PC/ Terminal connection to MultiReader through a TPC

Connecting a PC to the TPC can be done by using the Ethernet or the serial port 1/console port on the TPC's CPU board. If the serial port 1/console port is used, the communication cable should be a 0-modem cable. Connect the cable between the PC's serial port (9pin) and the 25pin console port on CPU board.

The PC must have a terminal program e.q. HyperTerminal. Set the communication settings to: 9600,N,8,1.

When connecting the 0-modem cable, the TPC login prompt appears on the screen. Type the login name and password. The MultiReader can now be reached by using i.e.FTP commands.

6.3 Testmode

This document describes the format of the printout on the console after a Tag transaction. Typing the following command on the console enables the functionality:

Testmode 1

To disable this testmode:

Testmode 0

The printout from the MR is provided after the transaction, so it doesn't use resources that delay the DSRC transaction.

6.4 Format

Below the sequence of the parameters:

<START> <UNIX time> <Trans status> <Trans time> <Country> <Issuer> <CS1-serialNo> <ManufId> <CS2-serialNo> <Status> <Freetext> <STOP>

Table 1 Parameter explanation

START:	*S	
STOP:	endline, corresponds to \n\r	
UNIX time:	Time since 01.01.1970 (nS)	
Trans status	DSRC; OK/ NOT OK	
Trans time	How long to finish transaction (uS)	
Country:	ITA2 representation	
Issuer:	Also called contract provider	
CS1-serialNo:	Serial number belonging to CS1	
ManufId:	Defined in ISO 14816	
CS2-serialNo:	Serial number belonging to CS2	
Status:	Status fields read from Tag	
Freetext	Contains message whose length and content is chosen by the programmer of the MR application.	

Each parameter is separated by white space. An example of a printout after communication with a MD5888 Tag, is shown below (no leading zeroes):

```
*S 935503232920068000 ok 32000000 245 8 230018 - - 102103 'Purse =
34000. LicensePlate = XV22334, Hello world'
```

Notice that the Tag has country Malaysia = 245 and issuerId = 8.

CS2 is usually not read from the Tag unless the housekeeping application (EID0) is read. Below we see the CS1 field is unknown and therefore the ContractSerialNumber is missing. The Country and Issuer parameters are however read from the VST.

```
*S 935503232920068000 ok 32000000 245 8 - 6 2742 102103 'Purse =
34000. LicensePlate = XV22334. Hello world'
```

If the value of a parameter for some reason is unknown the location is replaced with "-". This must also be the case for the free-text area. For a LDR Tag the example above might be:

```
*S 935503232920068000 ok 32000000 245 8 230018 - - 102103 'Purse =
34000. LicensePlate = -. LDR Tag. Hello world'
```

7 TEST WITH TEST TAGS AND INSTRUMENTS

7.1 Downlink signal test

Before the test: Check that the MultiReader software is loaded and that the communication between the MultiReader and the RSU is running properly. (Ref. chapter 6.1 and 6.2)

The downlink signal may either be tested by using a special test tag with two indication LED's, one indicating signal level above a certain threshold and one for correct downlink data reception. Or by using a spectrum analyser showing the signal level and modulation power spectrum.

7.1.1 Test Tag measurements.

The test tag has a red LED that lights up when the received signal level is above the "awake" threshold of the tag. When the tag recognise correct data from the MultiReader transceiver, a green LED lights up.

No LED's light:
The tag is not "awake". There is no communication with the MR.

The red LED lights and the green LED is off:
The tag is "awake". This indicates that the tag is receiving data frames, but the data is incomprehensible so the tag does not respond. This indicate that the signal to noise ratio is too low.

Both the red and green LED's light:
The tag is "awake", and it is responding the data frames. The system downlink is OK.

7.1.2 Measuring the MultiReader footprint with a test tag.

Use the test Tag to find the MR's footprint:

- **Directly towards MR direction (starting farthest off from MR):**
  Point the test tag towards the MR and hold it 1 m above the ground. Start walking right towards the MR. When the red LED lights, mark this point (1) (example shown in fig.7.1) on the ground. Continue towards MR, and when the green LED starts blinking, put a mark (2) on the ground. Carry on towards MR and notice that both LED's light. When the green LED starts blinking, put a mark (3) on the ground. Proceed until the red LED shuts down. Put a mark (4) here.

- **Sideways direction , (starting in the centre of the footprint):**
  Point the test tag towards the MR and hold it 1 m above the ground. Both LED's are light. Start moving the tag sideways until the green start blinking. Put a mark (5) on the ground. Continue sideways until both LED's shut down. Put a mark (6) here.

  Start from centre and move sideways to the other direction. Use the same procedure as above. Put two marks (7 and 8) here.

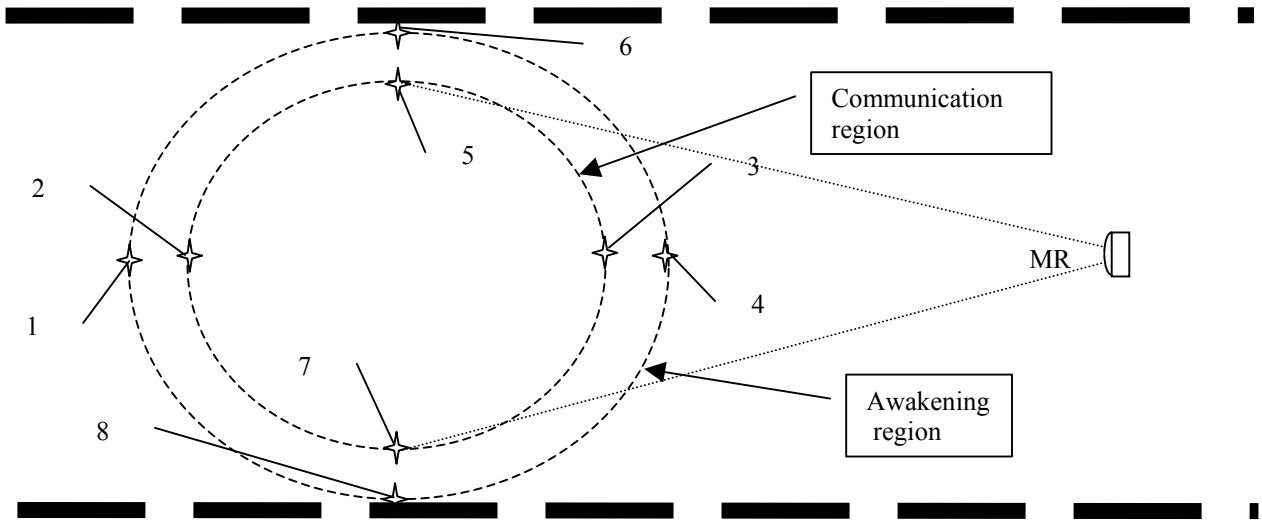


Fig.7.1 MultiReader footprint measurements.

- **Guiding measurements:**
  Maximum length of communication zone: > 3 m (Distance 2 to 3)
  Maximum width of communication zone: > 3 m (Distance 5 to 7)

7.1.3 Spectrum Analyser measurement.

The spectrum analyser must be connected to a left-hand circular polarised antenna with a low loss coaxial cable. The antenna gain (G) and the cable loss (L) must be known. By pointing the pickup antenna at the MultiReader at the centre of the TX antenna lobe the maximum signal level is measured.

Example: It is assumed that the MultiReader is mounted 6 m above the road and the antenna angle is 45 degree, with the pickup antenna 1m above the road. The centre of the antenna lobe should then be about 5 m from the projection point of the MultiReader in the horizontal plane through the pickup antenna.

7.1.4 The spectrum analyser settings should be:

Centre frequency:	5.7975, 5,8025, 5.8075 or 5.8125 GHz
Span:	5.0 MHz
Reference level:	-10 dBm
Specification:	Maximum signal level: > -35 dBm +G –L at 8 m distance.

7.1.5 Measurement of the MultiReader footprint with a Spectrum Analyser.

- **Directly towards MR pointing direction:**
  With the pick-up antenna (1m above ground) pointing at the MR move it to and from the MR and make a mark on the road where the signal level has fallen 3-dB from the maximum level.

- **Sideways direction:**
  Start moving the pick-up antenna (pointing at the MR) sideways from the lobe centre, and make a mark on the road where the signal level has fallen 3 dB form the maximum level.

- **Guiding measurements:**
  Maximum length of - 3 dB zone: > 2 m
  Maximum width of -3 dB zone: > 2 m

7.2 Uplink signal test

7.2.1 MultiReader without level detection.

The uplink is tested with a special test tag, which is responding each time that it is polled. By pointing the tag against the MultiReader and moving the tag around 1m above the road in the footprint region of the MultiReader TX and RX antenna, it is possible to measure the total communication region.

Here it is necessary to have a PC/Terminal connected to the console port of the CPU, to see when the communication with the tag is running.

- **Guiding measurements:**
  Maximum length of communication zone: > 3 m
  Maximum width of communication zone: > 3 m

7.2.2 MultiReader with level detection.

If the MultiReader is loaded with signal level detection software, it is possible to have a continuous surveillance of both the downlink and the uplink. The signal level detected from each passing of a tag is stored, and the level is compared with a nominal value found from the reading of a test tag passing in the middle of the antenna footprints.

This nominal value should be measured at the installation of the MultiReader as for example the average of 10 tag transactions. If a certain change in the average signal level value from the daily registrations of tag passing is discovered, an alarm is sent to the central, and it is recommended that the installation test be repeated. When the fault reason is found it is possible that some parts in the MultiReader has to be exchanged.

The MultiReader HW is prepared for this feature but it is not implemented in the application SW yet.

8 APPENDIX A

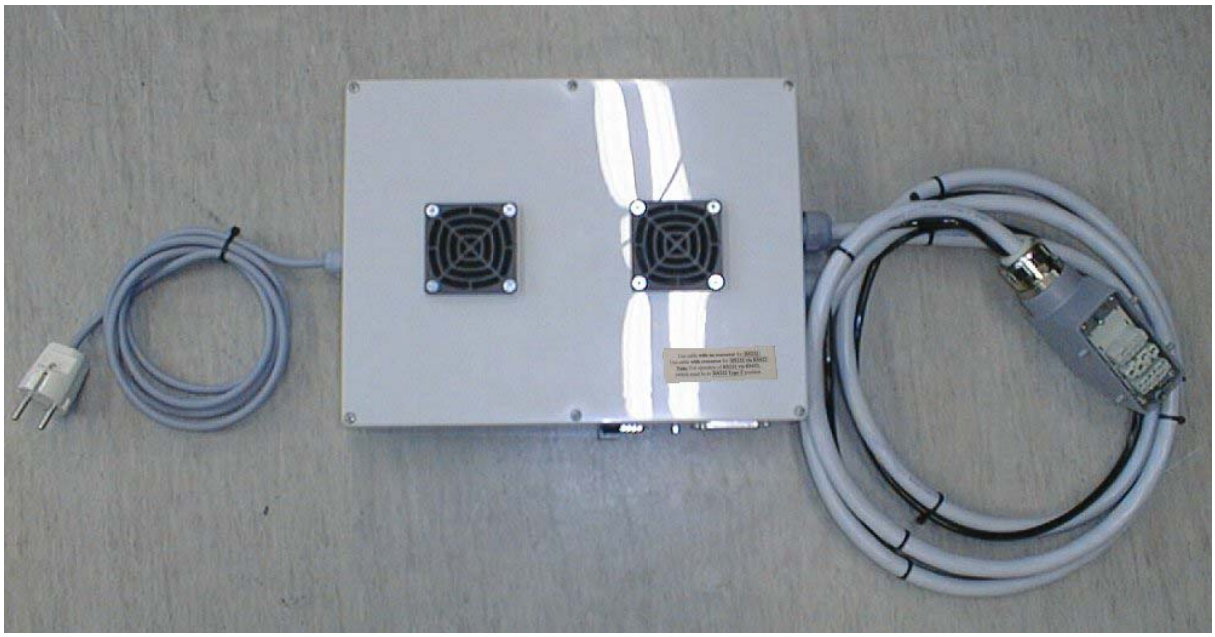


Fig.A.1 MultiReader 220VAC & Data Interface for Han-Modular connector (Part no. 014N0MR1).