THOMSON-CSF COMMUNICATIONS	Département Communications Hyperfréquences	ORIGINE / ISSUED	
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HYPER X

INSTALLATION MANUAL

Modular Readers

LML_3013 ; LML_3033 ; LVM_4033

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EVOLUTIONS SUCCESSIVES / SUCCESSIVE CHANGES

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NON	Code Fabricant / Manufact. Code	Numéro / Number	Code Doc / Doc. Code	Tome / Volume	Indice / Revision Index	Langue Language	

TABLE OF CONTENTS

1. General Information

1.1 Characteristics and Performance

HYPERX™ is a multi-tag dynamic identification system using microwaves. A 'reader' emits microwaves up to a distance of one or more meters, depending on model. When a tag enters this zone, it modulates this radiation, thereby sending its code back to the reader, which then processes the received signal and extracts the code.

The readers LML_3013 , LML_3033 and LVM_4033 are modular readers comprising of electronic modules assembled within a chassis. The antenna is external to the chassis, connected with two coaxial cables. The principal characteristics are :

- Hands-free Reader LML_3013, range 2 m (7 feet) and passing speeds up to 20 Km/h (15 mph).
- Hands-free Reader LML_3033, range 8 m (25 feet) and passing speeds up to 20 Km/h (15 mph).
- Hands-free Reader LVM_4033, range 5 m (16 feet) and passing speeds up to 100 Km/h (60 mph).
- Range adjustment by potentiometer
- Directive Microwave beam :
  - ◊ Virtually insensitive to environmental interference
  - ◊ Can be pointed to illuminate a particular area
  - ◊ Installation on metallic surface with no performance reduction
- Simultaneous identification of 5 tags in 1 second
  - ◊ Several tags can be present in identification zone, intentionally or not
- Identification in nearly all tag positions:
  - ◊ Back / Front
  - ◊ Horizontal / Vertical.
- Coexistence of 31 readers in same zone
  - ◊ access with successive access
  - ◊ acess points close together
- Précautions
  - ◊ Human bodies and metallic objects between tag and antenna can obstruct identification
  - ◊ Close contact (<5 mm) between tag and body or with metallic surface can reduce reading range

1.2 Specifications

• Chassis dimensions	240 x 170 x 170 mm
• Chassis weight (with modules) LML_3013; LML_3033; LVM_4033	4,2 kg
• Antenna weight for LML_3013 (AT1)	0,8 kg
• Antenna weight for LML-3033 ; LVM_4033	3 kg
• Power Supply	12 VDC

• Power consumption (max)	900 mA
• Band centre frequency	2,450 GHz
• Reading channels	31
• Data transmission rate between tag and reader	30 000 bits/s
• Error detection	HDLC
• Error rate of incorrect identifications	1 E-7
• Identification failure rate (dans les conditions normales d'utilisation)	1 E-4
• Radiated Power LML_3013	20 mW E.I.R.P.†
• Radiated Power LML_3033	75 mW E.I.R.P.
• Radiated Power LVM_4033	75 mW E.I.R.P.
• Performance LML_3013	2 meters / 15Km/h
• Performance LML_3033	8 meters / 40Km/h
• Performance LVM_4033	5 meters / 100Km/h
• Réglage de portée	yes
• Antenna beamwidth LML_3013	90°
• Antenna beamwidth LML_3033	45°
• Antenna beamwidth LVM_4033	45°
• Relay	24 VDC et 1 A

† : E.I.R.P. : Equivalent Isotropic Radiated Power

Environment :

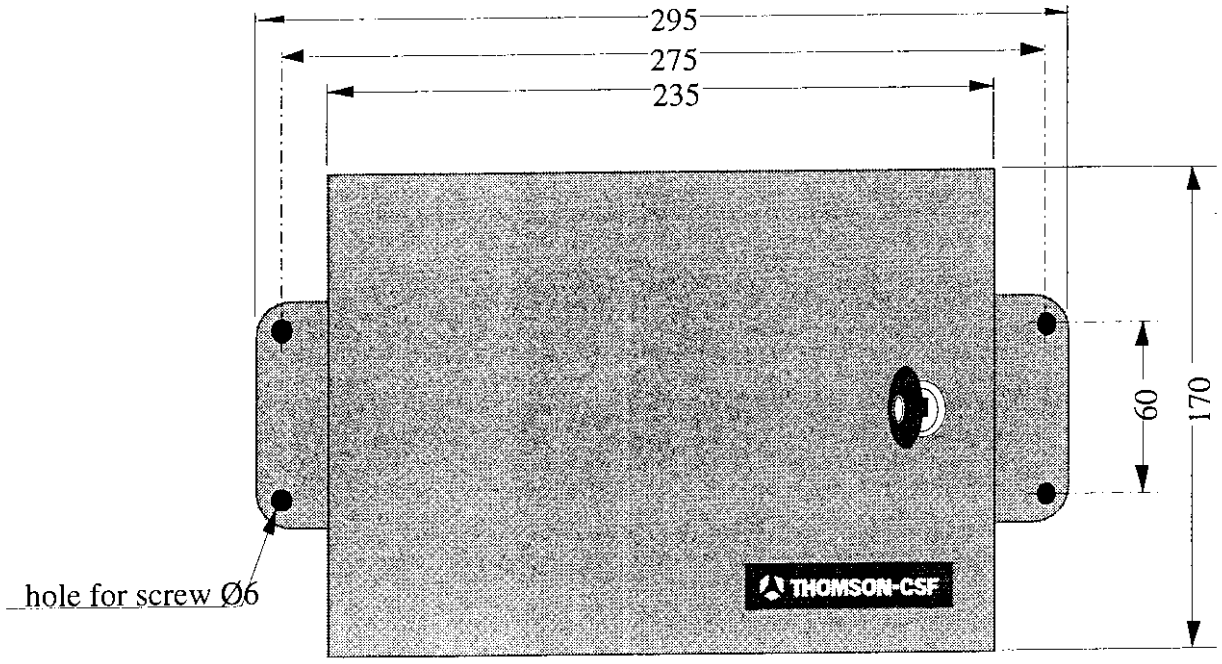
• Operating temperature	-20°C à +70°C
• Storage temperature	-25°C à +80°C
• Relative humidity	90% non condensing
• Water Protection	IP55

1.3 Installation

The HYPER X™ modular readers consist of a watertight enclosure containing different combinations of modules depending on the model. The reading antenna is connected to the enclosure via two cables. The enclosure has a door and is equipped with a lock and key.

The modules in the box perform all the main functions : power supply, microwave emission and reception, signal processing.

The box can be fixed to a wall or mounted on a mast by means of four 6mm holes.



Chassis installation, in particular the electrical connection, must comply with appropriate standards in destination country. Dimensions are in mm.

1.3.1 Reader constituents

1.3.1.1 Modular reader LML_3013

Comprises :

- 1 antenna AT1_2709
- 1 chassis CHS_2019
- 1 microwave source SHF_2339
- 1 receiver module SAM_2419
- 1 CPU + communications interface SPI_2110
- 1 power supply module FSM_2550

1.3.1.2 Modular reader LML_3033

Comprises :

- 1 antenna AT3_2749
- 1 chassis CHS_2019

- 1 microwave source SHF_2339
- 1 receiver module SAM_2419
- 1 CPU + communications interface SPI_2110
- 1 +12 Vdc power supply module FSM_2550

1.3.1.3 Modular reader LML_4033

Comprises :

- 1 antenna AT3_2749
- 1 chassis CHS_2019
- 1 microwave source SHF_2339
- 1 receiver module LAM_2429
- 1 CPU + communications interface SPI_2110
- 1 +12 Vdc power supply module FSM_2550

1.3.2 Module mounting

1.3.2.1 Inserting modules into rack

The modules consist of printed circuit boards perpendicularly mounted behind a metallic front panel.

The enclosure contains a standard-size rack for Europe-size boards. To insert a module into the desired position, place the board edges in the guiding rails and push slowly until contact is made with the back panel. Push firmly home to insure correct contact. The front panel is now aligned with the top and bottom horizontal rack bars and can be fixed in place with 2 or 4 screws (depending on module).

In general, the modules are already installed upon delivery.

1.3.2.2 Module positions

The rear panel is divided into two halves :

- a left half for the power supply module
- the right half for the remaining modules

The **FSM** module must be in the left-most position.

All other modules must be situated to the right of the FSM module as follows :

- LML_3013 and LML_3033

  SHF to the right of FSM

  SAM to the right of SHF

SPI to the right of SAM.

- LVM_4033

  SHF to the right of FSM

  LAM to the right of SHF

  SPI to the right of LAM.

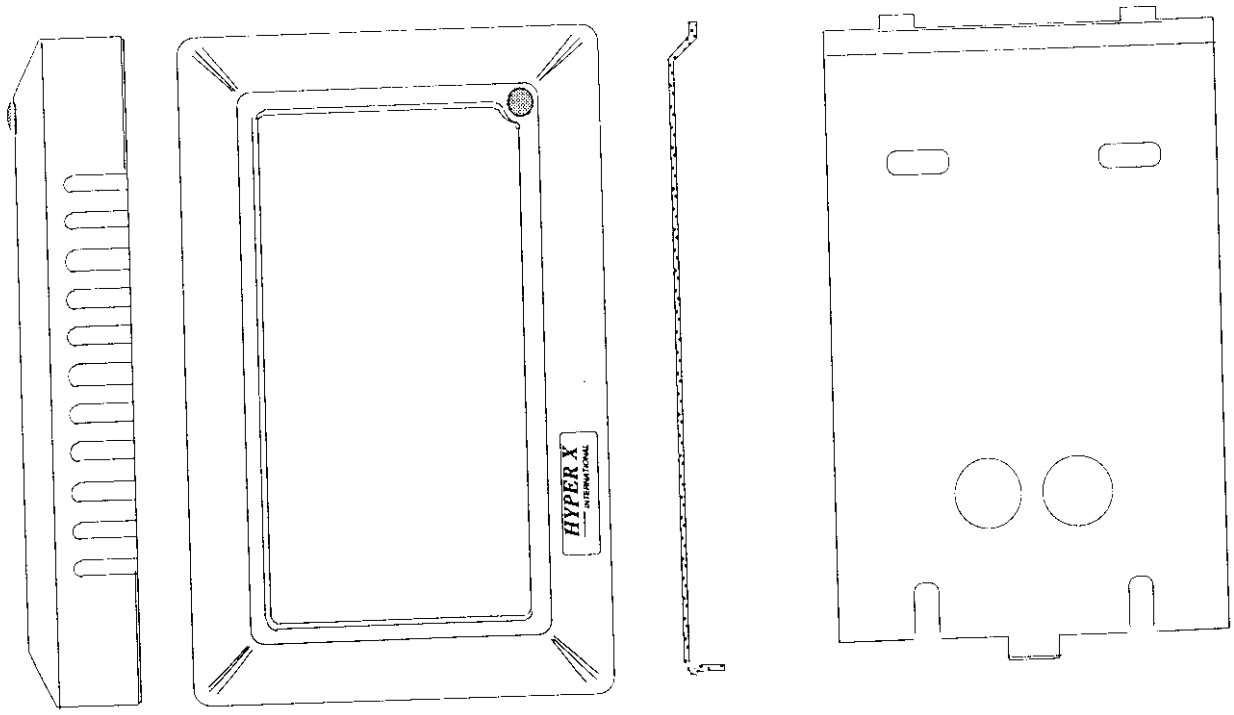
1.3.3 Mounting the antenna

The antenna emits and receives microwaves for the purpose of tag identification, so the antenna must be correctly oriented towards an obstacle-free identification zone.

1.3.3.1 Antenna AT1_2709

The antenna has two parts :

- a plastic enclosure containing the printed circuit board, connected to two coaxial cables
- a wall-mounting plate in chromed steel



Antenna enclosure and mounting plate

The antenna cables are 5 m long and can leave the box at the bottom (if the cables are to run along the wall) or leave out the back through the two holes in the mounting plate (if the cables are to pass through a wall).

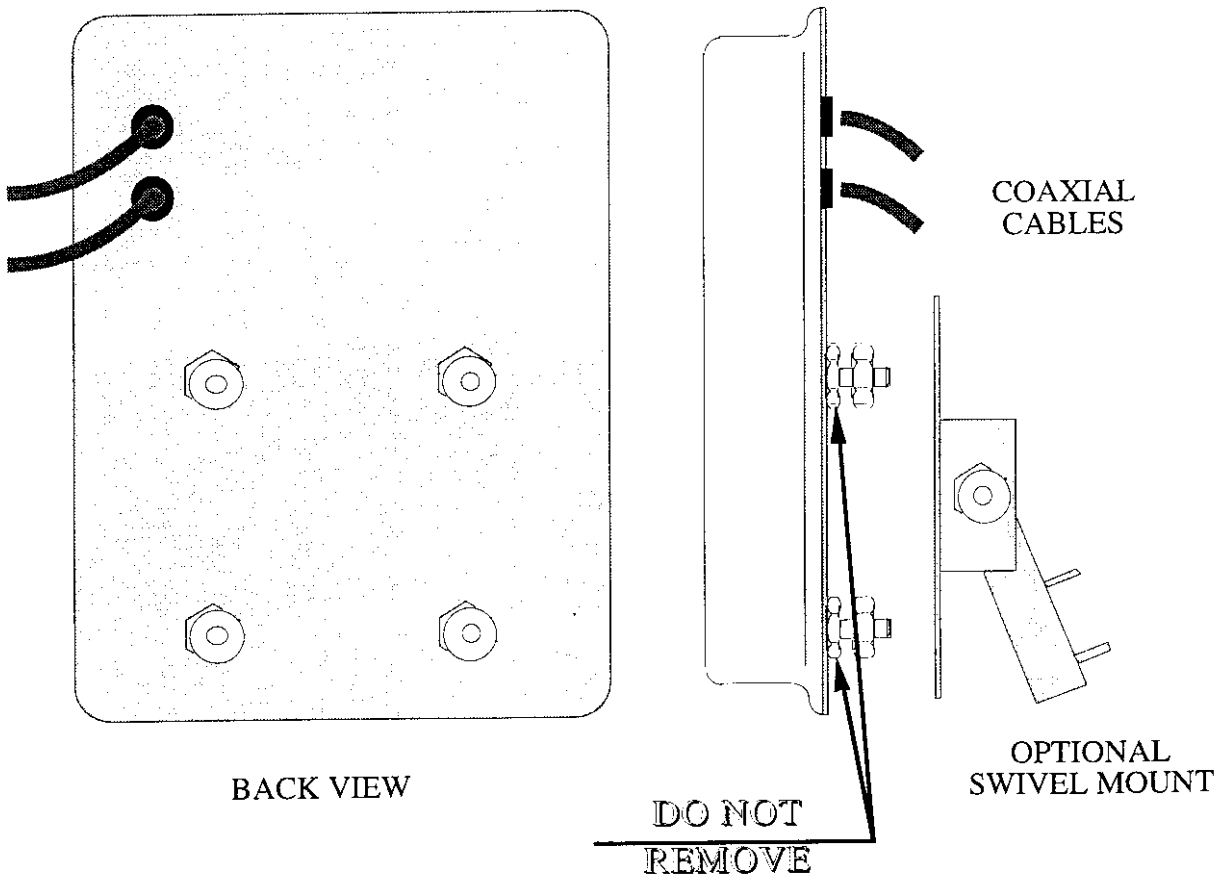
Tha antenna must be positioned so that the front-panel lamp is in the upper right-hand corner.

The mounting plate is first fixed with 2 or 4 screws (not supplied). Once this is in place, then the housing is attached and fixed into place with a small screw on the underside.

1.3.3.2 Antenna AT3_2749

This is an antenna in a watertight enclosure with two 5 m cables exiting at the rear.

Four Ø8 mm bolts with nuts for mounting are provided at the rear of the antenna.



The antenna can be fixed to a Ø 50 mm mast using a swivel mount (option ACS-2733) which is attached to the four bolts. This allows optimal pointing adjustment (azimuth and elevation).

The use of this swivel mount is strongly recommended.

It is however possible to mount the antenna on any appropriate support. The four bolts are located at the corners of a 120 mm square.

Warning: Do not remove the lower nuts which fix the bolts onto the metal plate. Only the upper nuts must be used for antenna mounting.

1.4 External Connections

Connections to the reader are of two types :

- coaxial cables with BNC connectors for microwave signals
- small-gauge wire with screw-terminal connectors for DC supply and data signals

1.4.1 Connection of microwave signals

1.4.1.1 Cables

All cables for microwaves, for connections between modules and between chassis and antenna, are supplied with the reader.

These coaxial cables have a fixed known impedance, are relatively stiff and must not be bent (restrictions on bending radius).

1.4.1.2 BNC Connectors

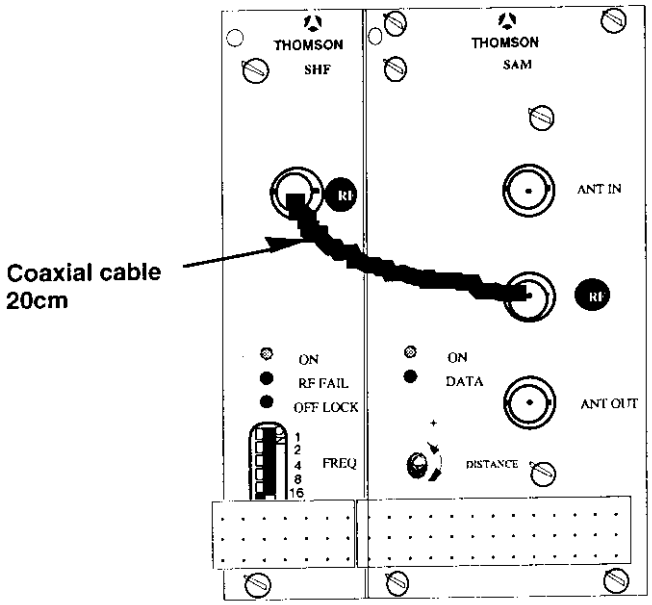
Cable ends have male BNC connectors. Modules are equipped with female BNC connectors.

The two connectors must be properly locked together (push in then turn) in order to insure a good connection.

The enclosure door should be locked (with key) in order to prevent cable disconnection.

1.4.1.3 Connection of modules SHF and SAM (or LAM)

The SHF module must be connected to the SAM module (or LAM depending on the model) using the short coaxial cable supplied. The two connectors are identified with a white "RF" marking in a black circle (see diagram below).



1.4.1.4 Connection of antenna to module SAM or LAM

The antenna has 2 cables terminated in male BNC connectors. The cable ends bear the following inscriptions :

For reception : "ANT IN" or "I"

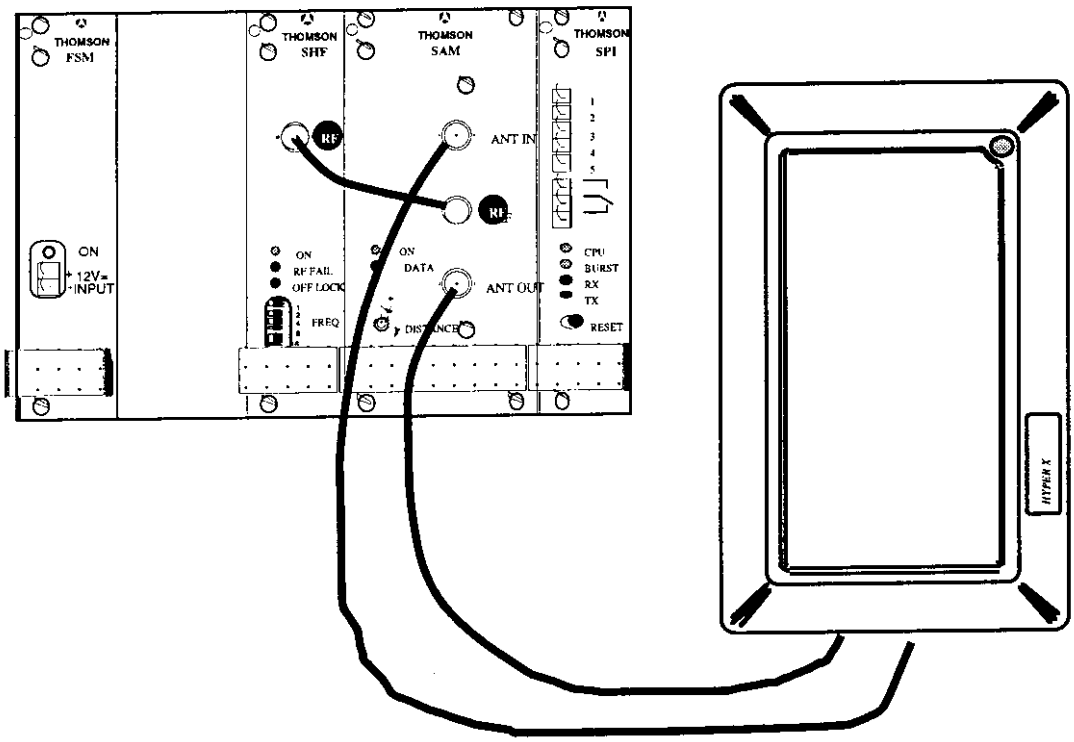
For emission : "ANT OUT" or "O"

The corresponding BNC connectors on the SAM (LAM) front panel are also labelled "ANT IN" and "ANT OUT".

Be sure to make the right connections : "ANT IN" on cable to "ANT IN" on front panel.

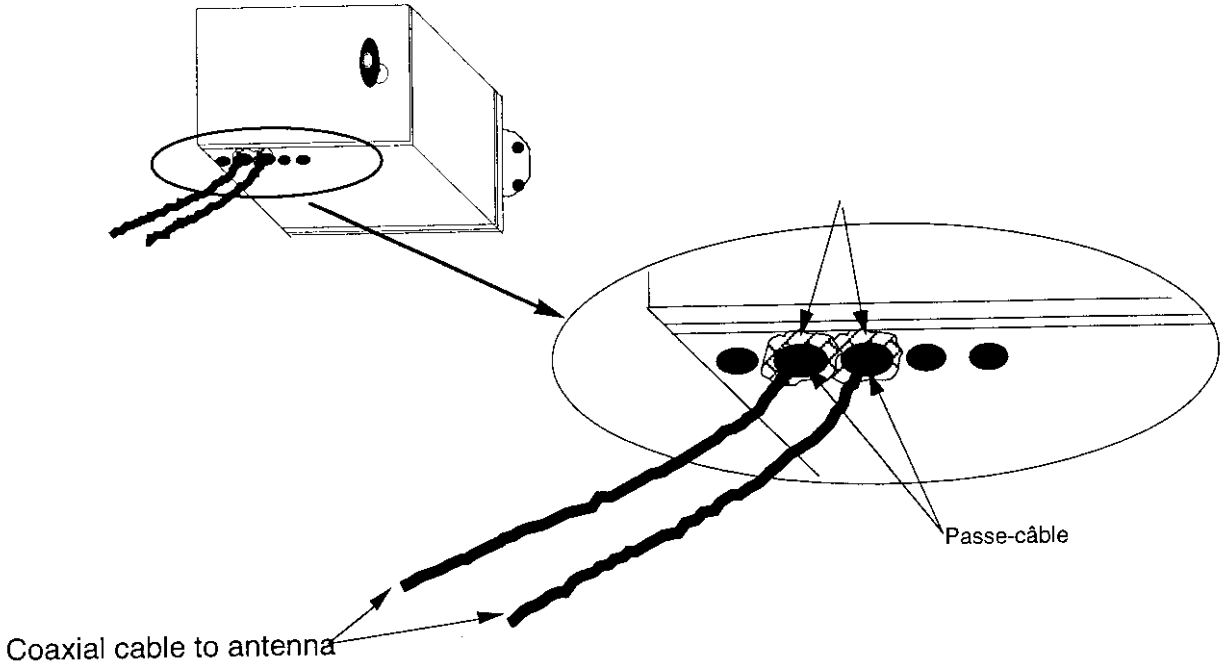
In case the cable markings are not present or have come off, the "ANT IN" cable has a black ring at its end and the "ANT OUT" cable a red ring.

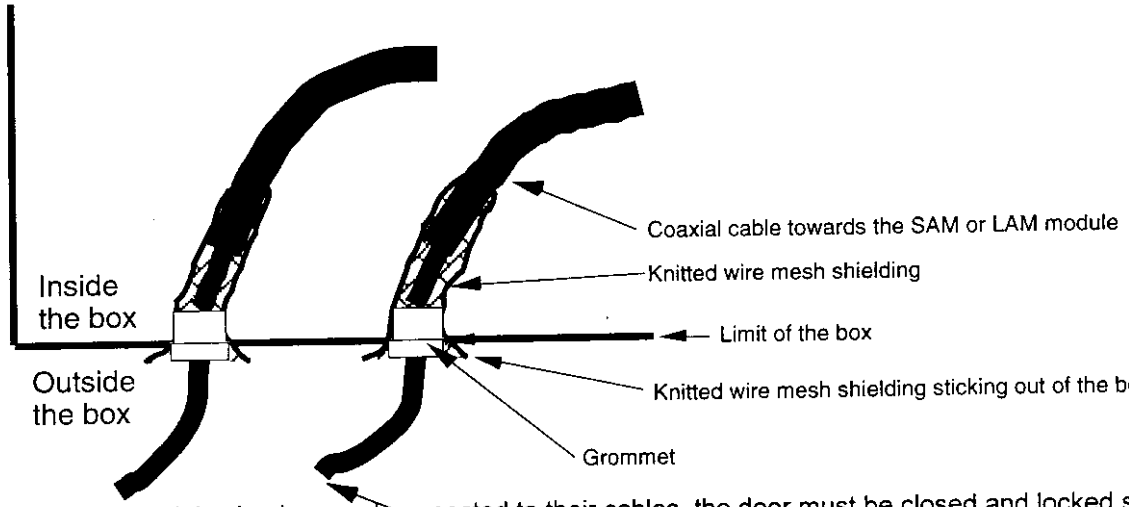
Inverting the cables will cause the reader to malfunction.



Coaxial cable connections

Before connecting the antenna cables, they must be passed through the appropriate holes in the bottom of the reader enclosure. After connecting the cables to the BNC connectors on the modules, the cable grommets must be positioned on the cable so that they can be covered by the wire mesh shielding. The cable is then manoeuvered into place with the grommet firmly in place in the enclosure hole and the mesh sticking out as shown in the diagram below.



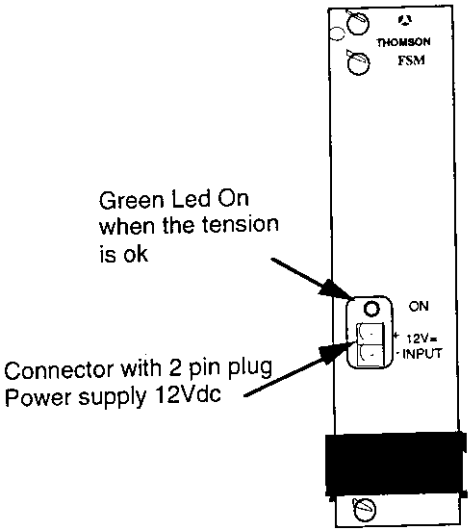


With all modules in place and connected to their cables, the door must be closed and locked so that the antenna cannot be disconnected.

1.4.2 Connecting power supply and communications to host

1.4.2.1 12V Power Supply

Power is supplied via a 2-pin plug (supplied). The plug has screw terminals to which the two wires are connected :



Pin	Name
+	+12Vdc
-	0V

Power consumption for the whole reader is typically 700 mA / 12 V .

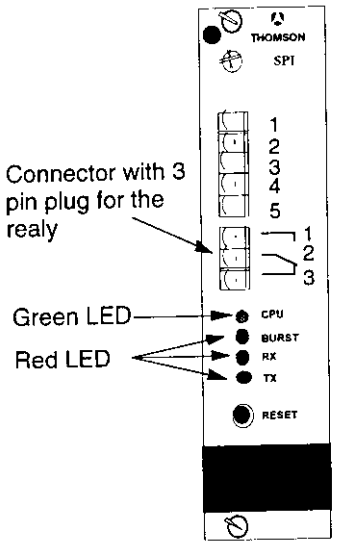
Wires (copper) used must be minimum 1.5 mm_ (AWG 15).

For long wires, voltage drop may be significant. It should be checked that input voltage at the FSM connector lies within 11.5 V and 15 V. Noise and hum should be less than 50 mVrms.

For the readers LML_3033 and LVM_4033, the supply wires must be equipped with a ferrite bead, located on the cable portion inside the enclosure (ref Steward : 28B2029-0A0 or equivalent).

1.4.2.2 Connection of relay on SPI module

Relay connection is via a 3-pin plug (supplied). The plug has screw terminals to which the three wires are connected :



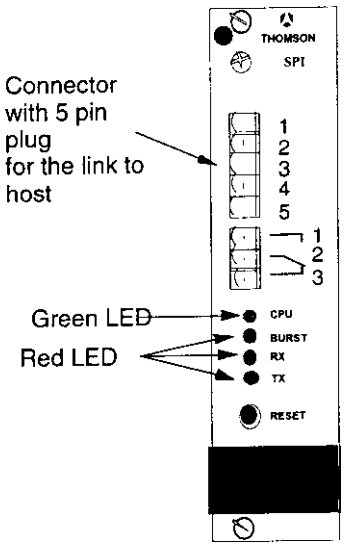
Pin	Name	I/O
1	Make	O
2	Common	I
3	Break	O

The relay is energised by on-board software. When it is not energised, pins 2 and 3 are connected, when it is energised, pins 1 and 2 are connected.

NOTE: This relay is designed to switch only 24 VDC / 1 A. In order to switch mains circuits, an external relay must be used.

1.4.2.3 Link from SPI to host

The reader end of the cable connection to host is made with a 5-pin screw-terminal plug (supplied). This cable type typically uses AWG22 wire and must be shielded.



Pin	Name	I/O
1	O1	I/O
2	O2	I/O
3	O3	I/O
4	O4	I
5	GND	

Pins O1 to O4 are associated with different signals depending on the type of link :

Name	RS-232	RS-422	RS485	ISO2	WIEGAND
O1	TX	TX+	+V	STROBE	DATA '1'
O2	--	TX-	-V	MDATA	DATA'0'
O3	--	RX+	--	PRES BADGE	--
O4	RX	RX-	--	--	--
O5	GND	GND	GND	GND	GND

The shielding braid must be connected to the chassis with a terminal of type 'fast-on' doubly-crimped.

For the readers LML_3013, LML_3033 and LVM_4033, this cable must be equipped with a ferrite bead, located on the cable portion inside the enclosure (ref Steward : 28B2029-0A0 or equivalent).

1.4.3 Power-up

Power may be applied once all modules are inserted and all cables connected.

Correct operation of each module can be determined by checking the lamps on each module's front panel :

For the LML_3013 :

FSM	lamp "ON" is green
SHF	lamp "ON" is green
SAM	lamp "ON" is green
SPI	lamp "CPU" is green and slowly blinking
AT1	green and regular blinking

For the LML_3033 :

FSM	lamp "ON" is green
SHF	lamp "ON" is green
SAM	lamp "ON" is green
SPI	lamp "CPU" is green and slowly blinking

For the LML_3033 :

FSM	lamp "ON" is green
SHF	lamp "ON" is green
LAM	lamp "ON" is green
SPI	lamp "CPU" is green and slowly blinking

1.5 Installation and connection procedures for the asynchronous links

1.5.1 Electrical specifications

- **Interface RS-232** :

Input (RX)	Input voltage range	- 30V min, + 30V max
	VIL threshold	1,2V typ
	VIH threshold	1,7V typ
Output (TX)	Output voltage	± 5V min, ± 9V typ

- **Interface RS-422** :

Input (RX)	Common-mode voltage	± 7V max
	Differential-mode voltage	± 12V max
	V_{IH} threshold	2V min
	V_{IL} threshold	0,8V max
Output (TX)	$V_{OH}(I_{OL} = -20mA)$	2.5V min
	$V_{OH}(I_O = 0)$	5V
	V_{OL} (I_{OL} = 48mA)	0.5V max
	V_{OL} (I_O = 0)	0V
	Differential voltage V_{OD1} (I_O = 0)	2V min, 5V max
	Differential voltage (R_L = 100Ω)	$0.5V_{OD1}$ (2V min)
	Common-mode voltage (R_L = 100Ω)	±3V max

- **Interface RS-485** : Identical to RS-422

1.5.2 Cables

The reader end of the cable connection to host is made with a 5-pin screw-terminal plug (supplied). This cable type typically uses AWG22 wire and must be shielded.

The cable's shielding braid must be fastened to the chassis with a doubly-crimped 'fast-on' terminal.

For the readers LML_3013, LML_3033 and LVM_4033, this cable must be equipped with a ferrite bead, located on the cable portion inside the enclosure (ref Steward : 28B2029-0A0 or equivalent).

1.5.3 Line Termination

For a simplex link, the termination (if present) should be placed at the receiving end of the line.

For a duplex link, the termination (if present) should be placed at the each end of the line.

For baud rates less than 1200 bauds, no termination is necessary. For baud rates greater than 9600 bauds and line lengths greater than 1000 metres, a resistor equal to the line impedance (120 ohms) is usually necessary. For cases in-between, there is no clear-cut rule and depends on individual installations (combination of baud-rate, line-length, cable quality, emitter/receiver characteristics).

1.5.4 Electrical connections

For an RS-232 link, wiring up is straightforward, the TX and RX lines of both equipments are connected together.

For a differential link (RS-422 or RS-485), the polarities are not always clearly defined. Normally the "+" line is at a high level at rest and is active low. For the "-" line, the opposite is true. This is the case for the differential interface for the HYPERX readers. However if the differential signals are generated by a converter acting on RS-232 signals, then the "+" line can be at a low level at rest and active high. In this case, the "+" line of one equipment must be connected to the "-" line of the other equipment.

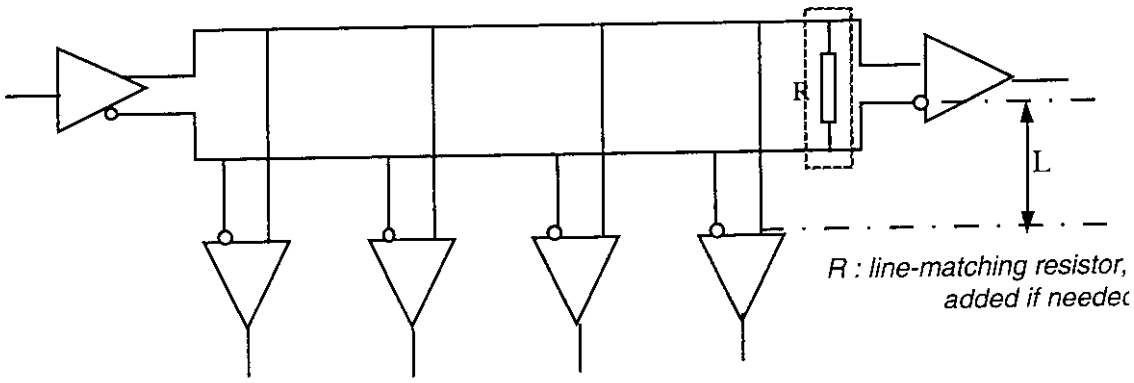
Connection of 0V

Whether this is necessary or not, depends on the installation. If host and reader are distant with different local ground potentials, then an RS-232 link may not work if the 0V references are not connected. However connecting them will cause ground currents to circulate. In general, for large link lengths, a differential link should be used. This also tolerates a large common-mode voltage difference.

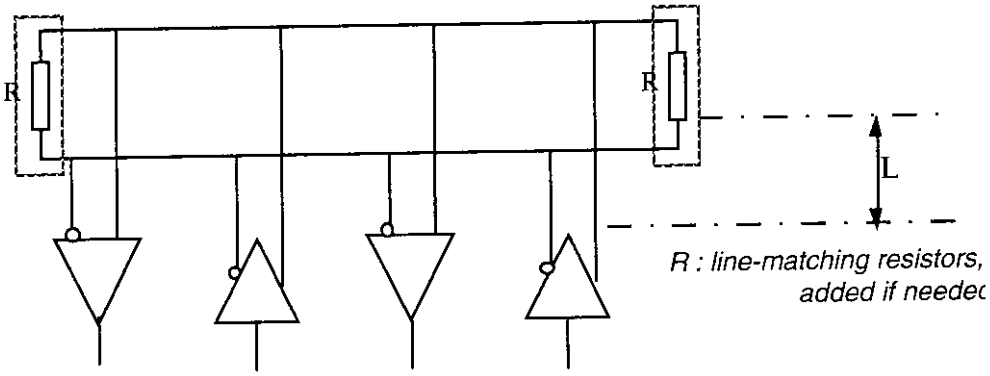
1.5.5 Networking

1.5.5.1 Topologies

The preferred topology is the bus.



Simplex link



Half duplex link

The length of the derivation should be as short as possible (< 30 cm).

The maximum length allowed can be calculated from the cable characteristics using the equation below.

$L < 1300 / (Z_0 \times C_L)$ L in metres, Z_0 in ohms and C_L in pF/m

1.5.5.2 Line biasing

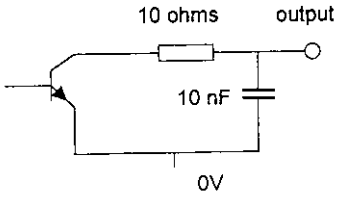
For RS-422 and RS-485, line biasing may prove necessary and must be done externally and only at one point on the line.

The line "+" is connected to +5V via a 4.7KΩ resistor.

The line "-" is connected to 0V via a 4.7KΩ resistor.

1.6 Output circuit for Open-collector interface

Circuit diagram for open-collector output stage :



These links require the connection of an external resistance at the receiving end of the link.

For connecting to a +5V supply, use a 470 Ω resistor.

For connecting to a +12V supply, use a 1 KΩ resistor.

1.7 FCC Notice

This equipement has been tested and found to comply with the limits for a classB digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If the equipement does cause harmful interference to radio or television reception, which can be determined by turning the equipement off and on, the user is encouraged to try to correct the interference by one or more of the following measures :

- Reorient or relocate the receiving antenna.
- ncrease the separation between the equipement and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

2. Visual Interface

2.1 Control Lamps

If one or more front-panel lamps are on, then the reader is powered up.

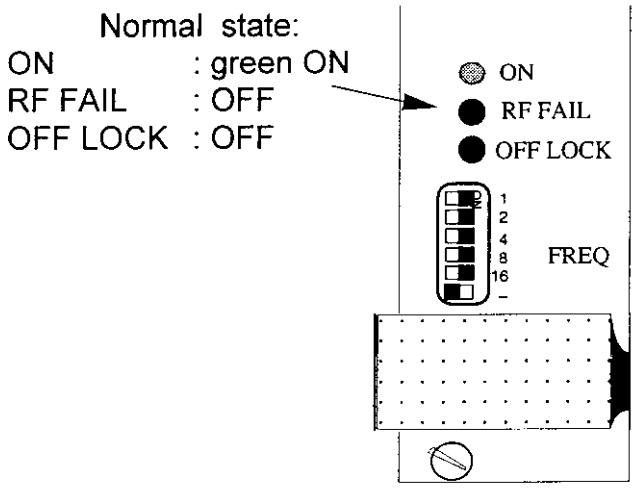
2.1.1 Module FSM

A green lamp indicates that the reader is correctly powered.

2.1.2 Module SHF

The SHF module has 3 lamps :

- a green lamp 'ON' indicating that power is on
- a red lamp 'RF FAIL' indicating that microwave power out is incorrect
- a red lamp 'OFF LOCK' indicating that there is a problem with the microwave frequency channel



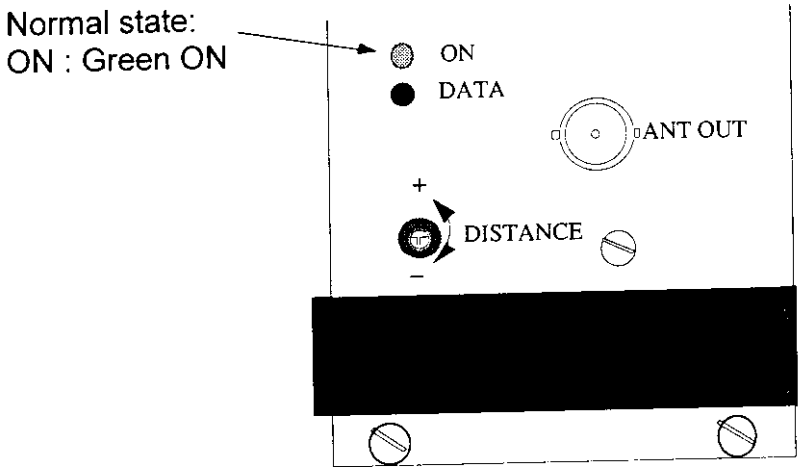
For correct operation :

- the 'ON' lamp is on (green)
- the 'RF FAIL' lamp is off
- the 'OFF LOCK ' lamp is off

2.1.3 Module SAM or LAM

The SAM (or LAM) module has 2 lamps :

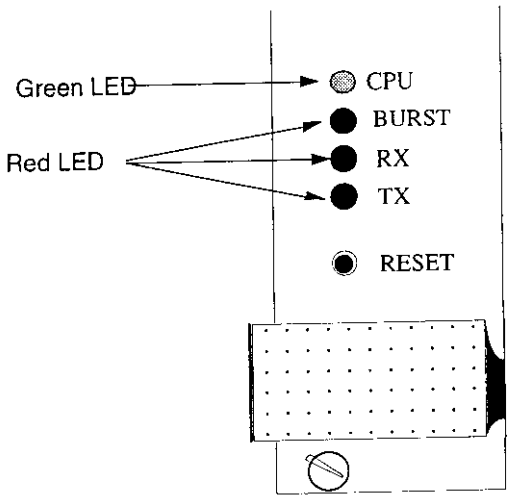
- a green lamp 'ON' indicating that power is on
- a red lamp 'DATA' indicating the presence of a data signal



For correct operation :

- the 'ON' lamp is on (green)
- the 'DATA' lamp can be on or off (this lamp presents no useful user information)

2.1.4 SPI Module



Four leds indicate the state of the module and tag activity.

- **Processor LED (CPU)**

  This green LED can have one of two flashing rates :

  ◊ slow, roughly 0.5s on 0.5s off, indicating all modules are working normally.

  ◊ fast, roughly 0.05s on 0.05s off, indicating a problem with one of the modules in the rack.

  Any other behaviour indicates faulty processor operation.

  NB : If the reset button is held down, this LED should be on.

- **Tag activity (BURST)**

  This red LED flashes (50 ms) to indicate that a tag has been detected by the reader.

- **Sending message (TX)**

  This red LED indicates electrical activity on the front panel connector line 01 (TX for the RS-232/422/485 link). It is permanently on in the case of the interfaces ISO2 and WIEGAND.

- **Receiving message (RX)**

  This red LED indicates electrical activity on the front panel connector line 04 (RX for the RS-232/422/485 link).

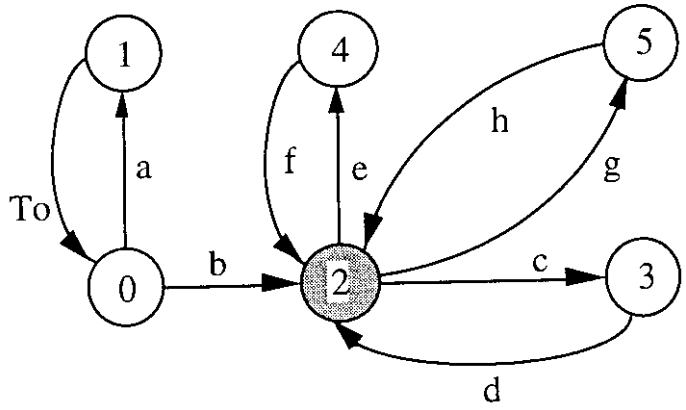
2.1.5 Antenna AT1 (LML_3013)

The antenna AT1 has a two-coloured lamp in the upper right corner. When the reader box is closed, this is the only visible signal that the user perceives. The lamp is under reader-software control, either in automatic mode or controlled by the host via the serial link.

Normal operation is a slow blink (0.5 s on, 0.5 s off) with the lamp remaining off for 1 second when a tag is first detected.

The state diagram below shows the different possible states during power-up (or after a processor rest) and their meaning.

State Diagram :



Events :

a. internal hardware fault detected
b. autotest OK
c. module fault detected
d. module fault disappears
e. internal hardware fault detected
f. internal hardware fault disappears
g. received command "turn reader off"
h. received command "turn reader on"

State	Name	Antenna LED	Emission	CPU LED	status word	
					ds	dm
0	Test	red, fixed	off	on	nd[2]	nd
1	Hardware fault	see note 1	off	fast blink	0	nd
2	Normal	green, regular blink	on	slow blink	1	1
3	Module fault	green, irregular blink	on	fast blink	1	0
4	Reader not ready	red, slow blink	off	fast blink	0	x[3]
5[4]	Reader OFF	off	off	slow blink	x	x
6[5]	Tag detected	off	off	x	1	x

Notes :

1. The LED behaviour and the timeout duration depend on the nature of the fault. In the case of a faulty configuration, the reset is immediate and the LED stays red. For a hardware fault, reset takes place after 4 seconds.
2. nd = not defined
3. x = don't care
4. This state only exists for the modular readers.
5. This state is not shown in order not too overload the diagram. It lasts for 1 second, then normal operation resumes.

2.2 Buzzer

The buzzer is located on the SPI module and is under reader software control. It sounds at power-up and on processor reset (for about 2 seconds).

When enabled, the buzzer emits a short sound (duration 50 ms) each time a tag is read. Thus, for a tag that remains in the reading area, the buzzer will sound continuously. This is independent of issuer-code filtering (see §3.6).

Buzzing on tag detection can be disabled by user switches (see §3.5).

2.3 Reset button

The reset button is on the front panel of the SPI module. Pushing it causes a processor reset (the button does not need to be held in) which lasts about 2 seconds. During this time, both 'CPU' and 'BURST' lamps light up. Upon reset, any user settings loaded by the host via the serial link are lost.

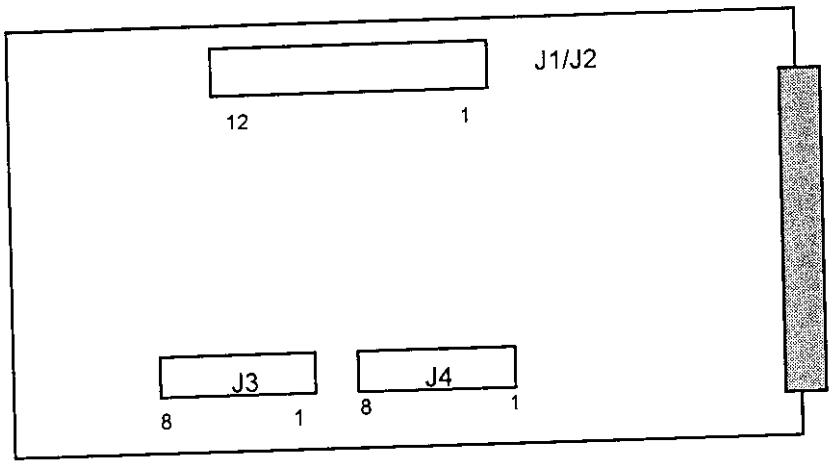
3. Reader Configuration

Except for Reading Range and Channel Operation all other configuration takes place on the SPI module. Here, the different operating modes are selected using switches which are either :

- ON or
- OFF

They are identified by their positions on four connectors:

- J1/J2 12 positions 1 to 12 (electrical interface)
- J3 8 positions 1 to 8 (operating parameters)
- J4 8 positions 1 to 8 (transmission parameters)



The serial link to a host can be one of two types :

- Open-Collector (ISO2 or Wiegand)
- Asynchronous RS 232, RS 422 and RS 485.

NB: Only one of these interfaces can be active at a time

Certain switch combinations are forbidden. If these combinations are detected during the initialisation period (immediately following a reset), an internal reset is generated after a period of 4 seconds. The following combinations are forbidden :

- Message mode 3 together with WIEGAND interface
- Message mode 2 together with POLLING mode

3.1 TTL interfaces : ISO2 et Wiegand

3.1.1 ISO2 Interface

Positions 1 to 4 of **J4** must be as follows :

4	3	2	1	Message length
OFF	OFF	OFF	OFF	variable
OFF	OFF	OFF	ON	fixed

3.1.2 Interface WIEGAND

Positions 1 to 4 of **J4** must be as follows :

4	3	2	1
OFF	OFF	OFF	ON

3.1.3 Tag persistence

Positions 5 and 6 of **J4** must be as follows :

6	5	Persistence time
ON	ON	1 s
ON	OFF	2 s
OFF	ON	5 s
OFF	OFF	10 s

3.1.4 Minimum Time Between Messages (MTBM)

Positions 7 and 8 of **J4** must be as follows :

8	7	MTBM
ON	ON	1000 ms
ON	OFF	100 ms
OFF	ON	200 ms
OFF	OFF	500 ms

3.1.5 Tag message repetition

Position 3 of **J3** must be as follows :

3	Repetition
OFF	disabled
ON	enabled

3.2 Asynchronous serial link

3.2.1 Address

The module's physical address is the logical slave address that the host application software uses to address the module.

The four positions 1 to 4 of **J4** determine the physical address:

4	3	2	1	Address
ON	ON	ON	ON	MINITEL
ON	ON	ON	OFF	1
ON	ON	OFF	ON	2
ON	ON	OFF	OFF	3
ON	OFF	ON	ON	4
ON	OFF	ON	OFF	5
ON	OFF	OFF	ON	6
ON	OFF	OFF	OFF	7
OFF	ON	ON	ON	8
OFF	ON	ON	OFF	9
OFF	ON	OFF	ON	10
OFF	ON	OFF	OFF	11
OFF	OFF	ON	ON	reserved use
OFF	OFF	ON	OFF	ISO2
OFF	OFF	OFF	ON	WIEGAND
OFF	OFF	OFF	OFF	ISO2

NB : A JBUS command message which has a slave address equal to 0 corresponds to a broadcast message, which explains why a reader cannot have an address of 0 for polling applications.

3.2.2 Character Format and Baud rate

Baud rate is chosen using positions 5 and 6 of **J4**:

6	5	Baud rate
ON	ON	9600 Baud
ON	OFF	4800 Baud
OFF	ON	1200 Baud
OFF	OFF	19200 Baud

Format is chosen using positions 7 and 8 of **J4**:

8	7	Format
ON	ON	7 bits data 1 bit even parity
ON	OFF	7 bits data 1 bit odd parity
OFF	ON	8 bits data no parity
OFF	OFF	not used

3.2.3 Protocol : polling or interrupt

The type of protocol, polled or by interrupt, is chosen with position 5 on **J3** :

5	Protocol
OFF	Interrupt
ON	Polling

3.2.4 Frame format

Position 8 on J3 determines the frame format, ASCII text or JBUS (binary).

	frame format
OFF	Test - ASCII text
ON	Normal - JBUS frame

The test format allows connection to a dumb terminal for easy on-site display.

3.3 Message mode

The mode is chosen using positions 1 and 2 on **J3** . The mode determines in what cases the detection of a tag causes a message to be transmitted to the host.

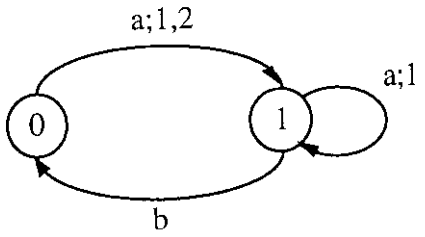
Type 0 - Each time a tag is detected, a timer is armed (nominal value = 1s). Tag detection only causes a message to be transmitted if this timer is not active. Each tag detected has a timer associated with it.

Type 1 - This mode is no longer supported

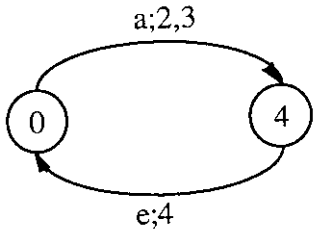
Type 2 - At each tag detection, a message is transmitted to host. During message transmission, microwave emission is switched off. Only available for the ISO2 interface and the asynchronous start/stop interface in the interrupt mode.

Type 3 - When a tag "disappears" (is removed from internal memory), an extra message is transmitted to host which includes the tag's code as well as the number of times that the badge was detected. This number cannot be greater than 99. Not available for the Wiegand interface. Otherwise identical to type 0.

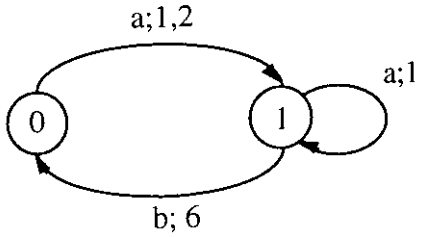
2	1	message mode
OFF	OFF	Type 3
OFF	ON	Type 2
ON	OFF	Type 1 - no longer supported
ON	ON	Type 0



Type 0



Type 2



Type 3

Events		**Actions**	
a :	tag is detected	1 :	arm anti reread timer
b :	timeout anti reread	2 :	start message transmission
e :	message is sent	3 :	turn off reader
		4 :	turn on reader
		6 :	send tag disappearance message

Flow Graph describing the three message transmission modes

3.4 Relay operation

When a tag is detected, the relay operates. The switch in position 3 on **J3** determines one of two modes of deactivation (for ISO2 and Wiegand, deactivation is automatic) :

- automatic relay deactivation after 2 second delay
- relay deactivation controlled by host via JBUS

J3 n°3	Deactivation
OFF	Automatic
ON	Under host control via J-BUS

3.5 Buzzer operation

The switch in position 4 on **J3** activates or deactivates the buzzer on tag detection. When enabled, the buzzer emits a short sound (duration 50 ms) each time a tag is read.

J3 n°4	Buzzer
OFF	Enabled
ON	Disabled

When enabled, the buzzer sounds for 50 ms at every tag detection.

3.6 Code filtering with the Distributor code

The switch in position 6 on **J3** enables or disables this feature. A description is given in chapter ?. Applies only to ISO2 and asynchronous interfaces. For the WIEGAND interface this feature is automatically enabled.

6	Filtering
OFF	Disabled
ON	Enabled

3.7 Electrical interface

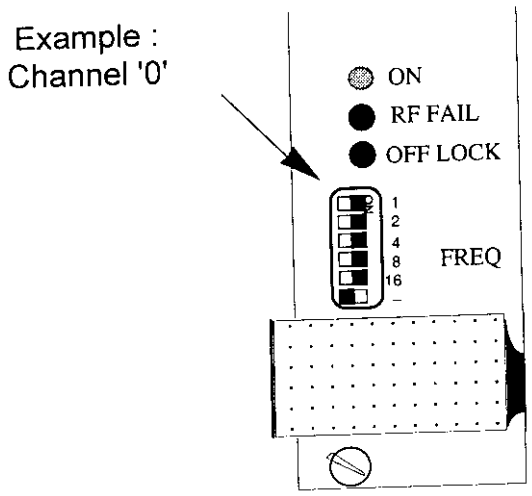
The switch in position 7 on **J3** enables or disables this feature. A description is given in chapter ?. This feature must be disabled for single readers.

Type	Position J1 and J2
RS-232	1 , 11
RS-422	2 , 4 , 9 , 10 , 12
RS-485	2 , 4 , 6 , 7 , 12
ISO2	3 , 5 , 8
WIEGAND	3 , 5 , 8
Minitel	2

3.8 Reading range

This can be performed but is not recommended, the factory setting is for the maximum reading range.

3.9 Operating Channel

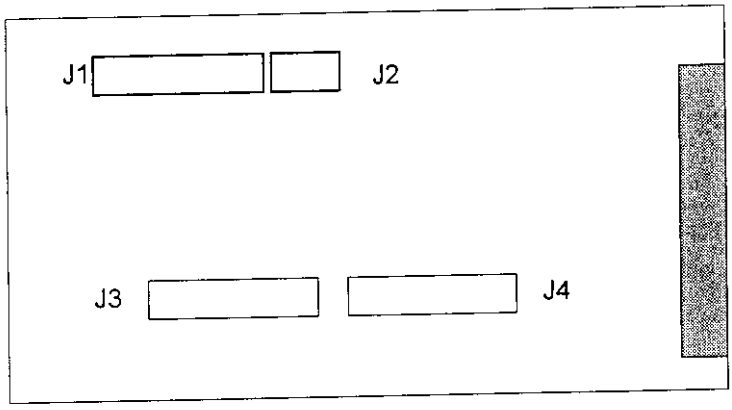


The reader can operate using 31 different channels. Each channel corresponds to a separate microwave frequency band. This is useful when several readers must be positioned close together. Using different channels on each reader eliminates mutual interference. The SHF module has 6 small switches on the front panel allowing a selection of 31 different channels (switch 6 is not used and 2 channels - 0 and 9 - are identical and use the same frequency).

Channel selection for the module SHF_2339 (the OFF position for switches are indicated by a blank in order to make the table more readable):

-	16	8	4	2	1	Channel
x	ON	ON	ON	ON	ON	0
x	ON	ON	ON	ON	-	1
x	ON	ON	ON	-	ON	2
x	ON	ON	ON	-	-	3
x	ON	ON	-	ON	ON	4
x	ON	ON	-	ON	-	5
x	ON	ON	-	-	ON	6
x	ON	ON	-	-	-	7
x	ON	-	ON	ON	ON	8
x	ON	-	ON	ON	-	9
x	ON	-	ON	-	ON	10
x	ON	-	ON	-	-	11
x	ON	-	-	ON	ON	12
x	ON	-	-	ON	-	13
x	ON	-	-	-	ON	14
x	ON	-	-	-	-	15
x	-	ON	ON	ON	ON	16
x	-	ON	ON	ON	-	17
x	-	ON	ON	-	ON	18
x	-	ON	ON	-	-	19
x	-	ON	-	ON	ON	20
x	-	ON	-	ON	-	21
x	-	ON	-	-	ON	22
x	-	ON	-	-	-	23
x	-	-	ON	ON	ON	24
x	-	-	ON	ON	-	25
x	-	-	ON	-	ON	26
x	-	-	ON	-	-	27
x	-	-	-	ON	ON	28
x	-	-	-	ON	-	29
x	-	-	-	-	ON	30
x	-	-	-	-	-	31

4. Annexe A : Switch Settings



Address

J2

8 7 6 5 4 3 2 1

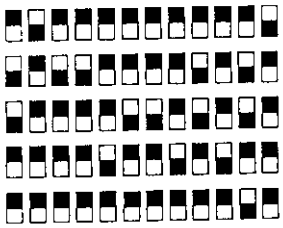
ASYNCHRONOUS

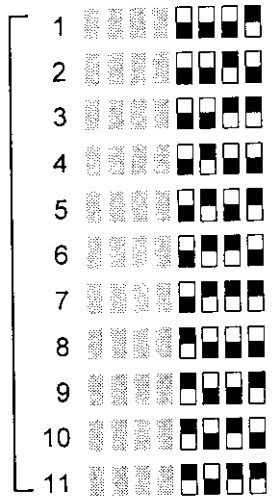
ISO2 / WIEGAND

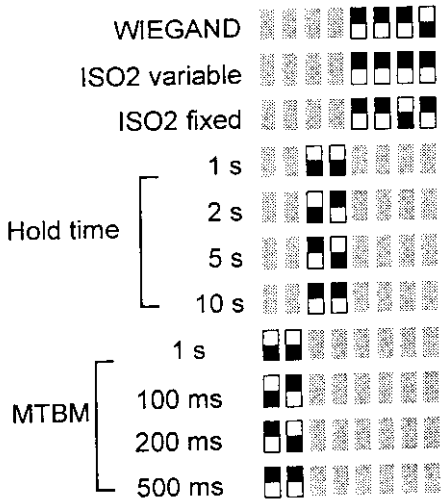
Interface

J1

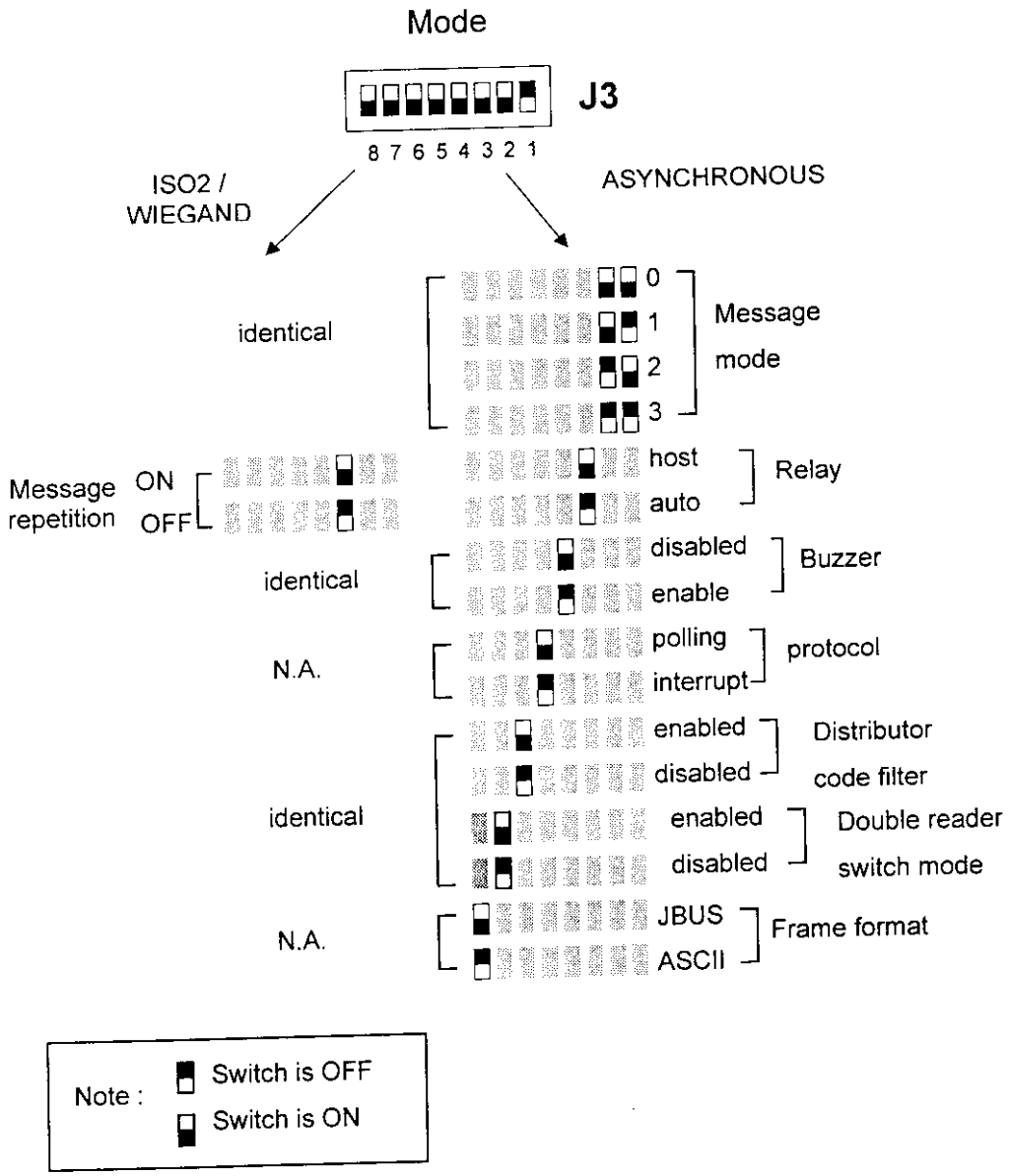
12 11 10 9 8 7 6 5 4 3 2 1







Note :
- Switch is OFF
- Switch is ON



Note :
- Switch is OFF
- Switch is ON

5. Annexe B : Special Modes (Test Mode And Minitel Mode)

Test Mode

This mode is configured using switch 8 of J3 (see 3.2.4)

The information transmitted from the reader to the host normally uses a JBUS frame format.. During system installation, the host computer may not yet be connected or available. For this reason , an ASCII transmission mode exists, allowing the connection of a dumb terminal in order to visualise the messages sent and thus to verify correct system operation. This is called **test** mode and is enabled using a board jumper configuration

This mode has the following characteristics :

- interrupt mode is used (the tag-code is sent immediately)
- tag persistence = 1 second
- frame structure = 24H / status tag / 20H / code / 0DH / 0AH
- transmission characteristics (baud rate and character format) must be configured

Example:

During system installation, the reader is put into test mode. A terminal is connected to the reader via an RS-232 link. Transmission characteristics of reader and terminal are matched, and tags are held in front of antenna. The terminal will display messages of the type :

$0 001ABCDEF-100

$2 XYZHYPER X.007

The messages have the following structure :

$ <status badge>(space) <distributor code> <user code>

where status badge : 0 = antenna 1, tag battery good
1 = antenna 1, tag battery low
2 = antenna 2, tag battery good
3 = antenna 2, tag battery low

distributor code : nnn where n is a digit (0 à 9)

user code : from 1 to 30 characters

message	antenna	battery	distr. code	user code
0 001ABCDEF-100	1	good	001	ABCDEF-100
2 XYZHYPER X.007	2	good	XYZ	HYPER X.007

Mode Minitel

This mode is configured using switches 1 to 4 of J4 (see §3.2.1)

This mode is similar to test mode, in that the messages sent have the same format (see above), yet it takes the specific nature of minitel operation into account. On a reader reset, special codes are sent which :

- clear the screen
- position the cursor in the upper left corner
- configure the minitel in scroll mode

Additionally, transmission characteristics are fixed independently of switches 5 to 8 of J4 : 1200 baud, 7 bits data, even parity. Only switches 1 to 4 of J4 need to be set.

This is a simplex link, reader to minitel, and needs switch 2 of J1 to be ON.

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		TOULOUSE	DCH

INTERFACE MANUAL

FOR HYPERX READERS

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Approuvé par / Approved by : P. Gobrecht

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EVOLUTIONS SUCCESSIVES / SUCCESSIVE CHANGES

INDICE / REVISION INDEX	DATE	MODIFIE PAR / CHANGED BY	OBJET / DESCRIPTION
A	05 Nov 1997	W. Löbert	Création (filchier MAN_INT.DOC)
B	02 Dec 1997	W. Löbert	Corrections mineures, modif MTBM §3.1.4

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Description of the HYPERX readers

HYPERX™ is a multi-tag dynamic identification system using microwaves. A 'reader' emits microwaves up to a distance of one or more meters, depending on model. When a tag enters this zone, it modulates this radiation, thereby sending its code back to the reader, which then processes the received signal and extracts the code.

There are two types of readers, modular (different modules assembled in a rack) and compact. For the modular readers, SPI is the reader module which provides the host interface. SPI performs digital processing of the signal received from the microwave receiver module (SAM or LAM) and communication functions with a host. It plugs into a custom rack for single-Europe size boards, taking up a slot of width 6E. A custom backplane provides interconnection between the modules. The compact reader is a compact version of the basic modular reader in the form of a single box. It performs basically the same functions as the modular reader, with differences in performance (see the appropriate product specifications).

Basic functions performed are :

- tag detection
- relay 24V/1A for external circuit-switching (controlled via host),
- communication interfaces:
  - asynchronous serial link (RS 232, RS 422 or RS 485) using JBUS™ / MODBUS™ protocol (polled or interrupt)

  or

  - compatible magnetic stripe card format "ISO-7811/2"

  or

  - compatible WIEGAND tags

Certain functions described in this document are only relevant to recent firmware versions. Identify the version you are equipped with and make sure the desired function is supported.

1.2. Basic operation

Tags are encoded with a HYPERX™ programming device. They can contain a user code of up to 30 characters (digits, uppercase letters and some punctuation symbols). They also contain a 3-character distributor code.

When a tag is first detected, it is stored in an internal buffer and remains present for a time Tr. After this time, the tag is removed from memory. At first detection, a message for the host interface is generated and the relay is activated. In most cases (ISO2, Wiegand, asynch link interrupt mode) this message is immediately sent, in one case (asynch link polling mode) the message is only sent on request by the host. If a tag is detected by the reader and it is still in memory (two detections of same tag within the time Tr), a new message is not normally generated (exception is message mode 2, see chapter 3.3). The timer associated with this tag is then reset so that the tag remains present for a further time Tr. Thus, for a tag which is presented to the reader and remains there, only one message is generated after the initial detection. The tag must be removed for a time greater than Tr in order for a second message to be generated.

In the case of an asynchronous link to the host, the default value for Tr is 1 second, however this value can be changed via a JBUS command. In the case of an ISO2 or Wiegand interface, the value is determined by board jumper settings. The time Tr is hereafter referred to as the tag persistence time.

Once a second, the status of the reader is monitored. This information is available to a host connected by a serial JBUS link. It also affects the flashing rate of the CPU led on the front panel and the colour and flashing rate of the antenna indicator lamp (see chapter 2.3).

In the case of the modular reader, an SPI module can accommodate up to two receivers, each with its own antenna. In this case, all modules making up the two receivers are present in the same wide bay. This is known as a Double Reader. When a tag is detected, status information in the message to the host indicates at which antenna the tag was detected. This information is only available if an asynchronous serial link connects the reader to the host.

For the Double Reader, in some cases signal feed-through on the antenna cables can cause a tag detected by one antenna to be "seen" by both receivers. This produces two detection messages, one corresponding to each antenna. In order to counter this effect, if it occurs, a special switching mode of operation can be used whereby only one of the two receivers is active at a time, switching taking place every 150ms. This means however that during the 150ms, one of the antennas will not detect tags that may be present and this may reduce its reading efficiency, especially for high-speed or multi-tag applications.

1.3. Power Supply

The acceptable input voltage range for both types of readers is 10VDC to 25VDC. The compact reader consumption is roughly 250 mA at 12 VDC. The consumption for modular readers depends on their composition

WARNING : Live insertion or withdrawal of the SPI module can cause irreversible damage !

2. OVERVIEW

2.1. Connectors

There are several PHOENIX - type connectors:

- The 5-pin connector is for the serial link to a host.
- The 3-pin connector allows switching (using the internal relay) of an external circuit
- For the compact reader only, a 2-pin connector is for the DC power supply

(See chapter 7 for the wiring instructions)

For the modular reader, the connectors are accessible on the front panel of the SPI module. For the compact reader, the connectors are àccessible from the back at the top.

2.2. Front Panel

2.2.1. Modular reader

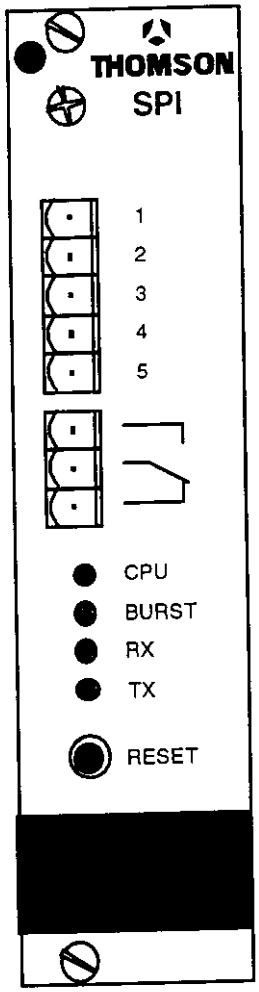


Figure 2-1: Front Panel of module SPI, comprising 2 Connecteurs, 4 leds and 1 Reset button

2.2.1.1. Indicator lamps for maintenance

Four leds indicate the state of the module and tag activity.

Processor LED (CPU)

This green LED can have one of two flashing rates :

- slow, roughly 0.5s on 0.5s off, indicating all modules are working normally.
- fast, roughly 0.05s on 0.05s off, indicating a problem with one of the modules in the rack.

Any other behaviour indicates faulty processor operation.

NB : If the reset button is held down, this LED should be on.

Tag activity (BURST)

This red LED flashes (50ms) to indicate that a tag has been detected by the reader.

Sending message (TX)

This red LED indicates electrical activity on the front panel connector line 01 (TX for the RS-xxx link). It is permanently on in the case of the interfaces ISO2 and WIEGAND.

Receiving message (RX)

This red LED indicates electrical activity on the front panel connector line 04 (RX for the RS-xxx link).

2.2.1.2. Reset Button

Pushing this button applies a hardware reset to the processor.

NB : While the button is held in, the processor is in a reset state and the CPU and BURST LEDs are on. Once released, the processor restarts.

2.2.2. Compact reader

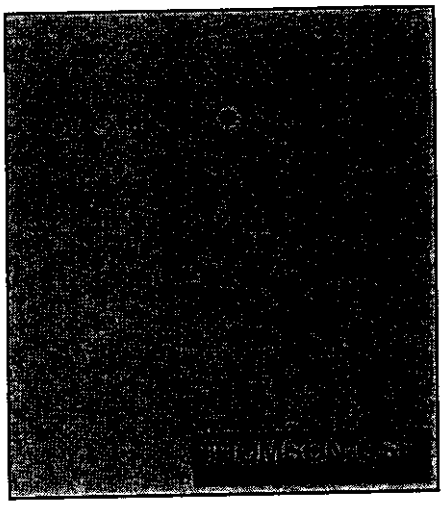


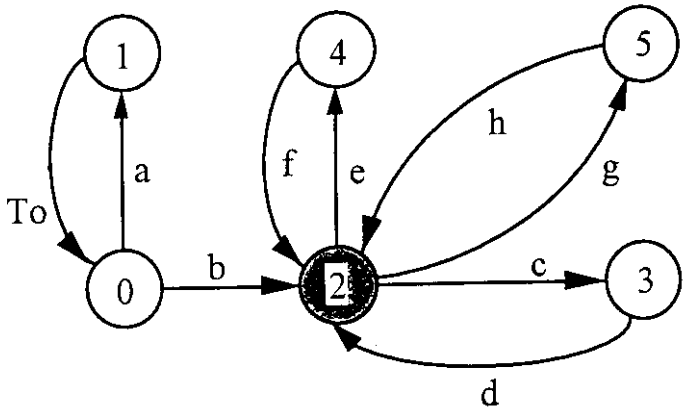
Figure 2-2 : Front panel of Compact reader

A single red/green light is situated in the top-centre of the panel (see chapter 2.3 below).

2.3. Antenna Indicator Light

The LED on the antenna (or in the case of the compact readers, on the front panel) indicates the state of the reader. It is under reader software control. It can also be controlled by the host using the JBUS protocol on an asynchronous serial link. The state diagram below shows the different possible states during power-up (or after a processor reset).

State Diagram :



Events :

a. internal hardware fault detected
b. autotest OK
c. module fault detected
d. module fault disappears
e. internal hardware fault detected
f. internal hardware fault disappears
g. received command "turn reader off"
h. received command "turn reader on"

State	Name	Antenna LED	Emission	CPU LED	status word	
					ds	dm
0	Test	red, fixed	off	on	nd[2]	nd
1	Hardware fault	see note 1	off	fast blink	0	nd
2	Normal	green, regular blink	on	slow blink	1	1
3	Module fault	green, irregular blink	on	fast blink	1	0
4	Reader not ready	red, slow blink	off	fast blink	0	x[3]
5[4]	Reader OFF	off	off	slow blink	x	x
6[5]	Tag detected	off	off	x	1	x

Notes :

1. The LED behaviour and the timeout duration depend on the nature of the fault. In the case of a faulty configuration, the reset is immediate and the LED stays red. For a hardware fault, reset takes place after 4 seconds.
2. nd = not defined
3. x = don't care
4. This state only exists for the modular readers.
5. This state is not shown in order not too overload the diagram. It lasts for 1 second, then normal operation resumes.

3. CONFIGURING THE MODULAR READER

There are two versions of the module currently available, for simplicity hereafter referred to as the **old** version and the **new** version. The old version consists of a mother board and a smaller daughter board using traditional through-hole technology. Configuring is done using jumpers. The new version consists of a single board using surface-mount technology. Configuring is done using miniature switches. In order to correctly configure the module, you must identify the version you are installing. In the following paragraphs, text in *italics* refers to the old version.

For old versions only *- some jumpers do not change position :*

J1 - must be in position 2-3
J6 - must be present
J7 - must be absent
J13 - must be present in position 2-3

These four jumpers no longer exist on the new version.

The different operating modes are selected using switches/*jumpers* which are either :

- ON *(present)* or
- OFF *(absent)*

They are identified by their positions on four connectors:

- J1 (8 positions 1 to 8) */ J3 (10 positions 1 to 10)*
- J2 (4 positions 9 to 12) */ J8 (2 positions 11 to 12)*
- J4 (8 positions 1 to 8) */ J4 (8 positions 1 to 8)*
- J3 (8 positions 1 to 8) */ J5 (8 positions 9 to 16)*

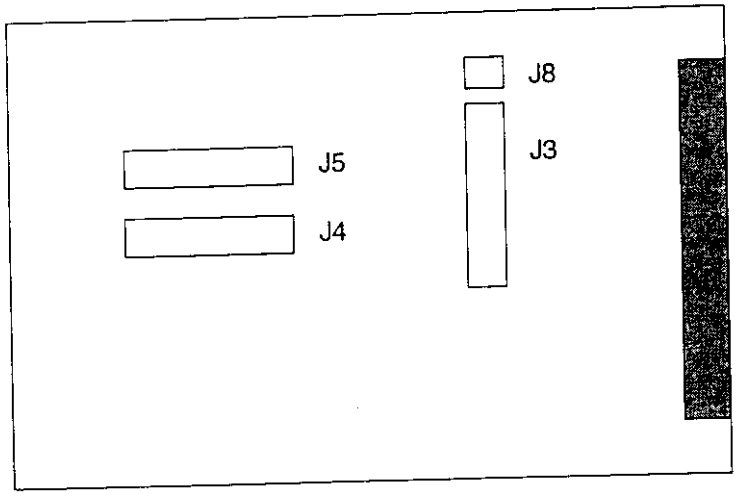


Figure 3-1 : Connector locations for SPI module - old board

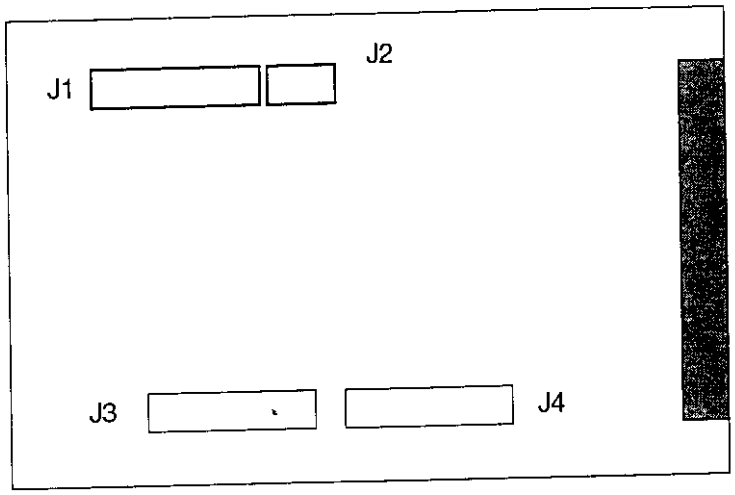


Figure 3-2 : Connector locations for SPI module - new board

The serial link to a host can be one of two types :

- Open-Collector (ISO2 or Wiegand)
- Asynchronous RS 232, RS 422 and RS 485.

NB: Only one of these interfaces can be active at a time

Certain switch / *jumper* combinations are forbidden. If these combinations are detected during the initialisation period (immediately following a reset), an internal reset is generated after a period of 4 seconds. The following combinations are forbidden :

- Message mode 3 together with WIEGAND interface
- Message mode 2 together with POLLING mode

3.1. ISO2 and WIEGAND Interfaces

3.1.1. ISO2 Interface

Positions 1 to 4 of J4 must be as follows :

4	3	2	1	message length
OFF	OFF	OFF	OFF	variable
OFF	OFF	ON	OFF	fixed

3.1.2. WIEGAND Interface

Positions 1 to 4 of J4 must be as follows :

4	3	2	1
OFF	OFF	OFF	ON

3.1.3. Tag persistence

Positions 5 and 6 of J4 must be as follows :

6	5	Persistence
ON	ON	1 s
ON	OFF	2 s
OFF	ON	5 s
OFF	OFF	10 s

3.1.4. Minimum Time Between Messages (MTBM)

Positions 7 and 8 of J4 must be as follows :

8	7	MTBM
ON	ON	1000 ms
ON	OFF	100 ms
OFF	ON	200 ms
OFF	OFF	500 ms

3.1.5. Tag message repetition

Position 3 of J3 / *11 of J4* must be as follows :

	repetition
OFF	disabled
ON	enabled

3.2. Asynchronous serial link

3.2.1. Address

The module's physical address is the logical slave address that the host application software uses to address the module (see 6.3).

The four positions 1 to 4 of J4 determine the physical address:

4	3	2	1	Address
ON	ON	ON	ON	reserved use
ON	ON	ON	OFF	1
ON	ON	OFF	ON	2
ON	ON	OFF	OFF	3
ON	OFF	ON	ON	4
ON	OFF	ON	OFF	5
ON	OFF	OFF	ON	6
ON	OFF	OFF	OFF	7
OFF	ON	ON	ON	8
OFF	ON	ON	OFF	9
OFF	ON	OFF	ON	10
OFF	ON	OFF	OFF	11
OFF	OFF	ON	ON	12
OFF	OFF	ON	OFF	see 3.1.1 ISO2
OFF	OFF	OFF	ON	see 3.1.2 WIEGAND
OFF	OFF	OFF	OFF	see 3.1.1 ISO2

NB : A JBUS command message which has a slave address equal to 0 corresponds to a broadcast message, which explains why a reader cannot have an address of 0 for polling applications.

3.2.2. Character Format and Baud rate

Baud rate is chosen using positions 5 and 6 of J4:

6	5	Baud rate
ON	ON	9600 Bauds
ON	OFF	4800 Bauds
OFF	ON	1200 Bauds
OFF	OFF	19200 Bauds

Format is chosen using positions 7 and 8 of J4:

8	7	Format
ON	ON	7 bits data 1 bit even parity
ON	OFF	7 bits data 1 bit odd parity
OFF	ON	8 bits data no parity
OFF	OFF	not used

3.2.3. Protocol : polling or interrupt

The type of protocol, polled or by interrupt, is chosen with position 5 on J3 */ 13 on J5 :*

	protocol
OFF	interrupt
ON	polling

3.2.4. Frame format

Position 8 on J3 / *16 on J5* determines the frame format, test (ASCII) or JBUS (binary).

	frame format
OFF	Test - ASCII message
ON	Normal - JBUS frame

The test format allows connection to a dumb terminal for easy on-site display. For a description see chapter 11.

3.3. Message mode

The mode is chosen using positions 1 and 2 on J3 / *9 and 10 on J5*. The mode determines in what cases the detection of a tag causes a message to be transmitted to the host.

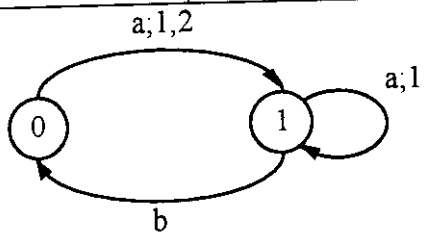
Type 0 - Each time a tag is detected, a timer is armed (nominal value = 1s). Tag detection only causes a message to be transmitted if this timer is not active. Each tag detected has a timer associated with it.

Type 1 - This mode is no longer supported

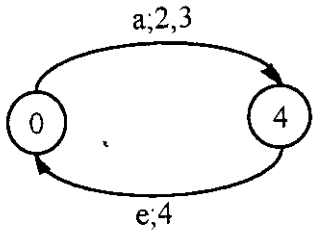
Type 2 - At each tag detection, a message is transmitted to host. During message transmission, microwave emission is switched off. Only available for the ISO2 interface and the asynchronous start/stop interface in the interrupt mode.

Type 3 - When a tag "disappears" (is removed from internal memory), an extra message is transmitted to host which includes the tag's code as well as the number of times that the badge was detected.This number cannot be greater than 99. Not available for the Wiegand interface. Otherwise identical to type 0.

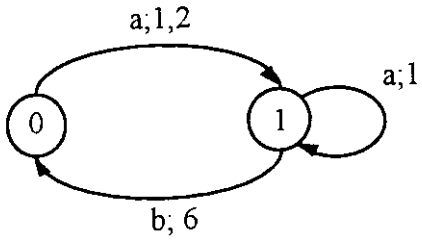
2 (10)	1 (9)	message mode
OFF	OFF	Type 3
OFF	ON	Type 2
ON	OFF	Type 1 - no longer supported
ON	ON	Type 0



Type 0



Type 2



Type 3

Events

a :	tag is detected
b :	timeout anti reread
e :	message is sent

Actions

1 :	arm anti reread timer
2 :	start message transmission
3 :	turn off reader
4 :	turn on reader
6 :	send tag disappearance message

Figure 3-3 : Flow Graphs describing the three message transmission modes

3.4. Relay operation

When a tag is detected, the relay operates. The switch / *jumper* in position 3 on J3 / *11 on J5* determines one of two modes of deactivation (for ISO2 and Wiegand, deactivation is automatic) :

- automatic relay deactivation after 2 second delay.
- relay deactivation controlled by host via JBUS

	Deactivation
OFF	automatic
ON	under host control

3.5. Buzzer operation

The switch / *jumper* in position 4 on J3 / *12 on J5* activates or deactivates the buzzer on tag detection. When enabled, the buzzer emits a short sound (duration 50 ms) each time a tag is read.

	Buzzer
OFF	Enabled
ON	Disabled

When enabled, the buzzer sounds for 50ms at every tag detection.

3.6. Code filtering with the Distributor code

The switch / *jumper* in position 6 on J3 / *14 on J5* enables or disables this feature. A description is given in chapter 5.2.3. Applies only to ISO2 and Asynchronous interfaces. For the WIEGAND interface this feature is automatically enabled.

	Filtering
OFF	Disabled
ON	Enabled

3.7. Switching mode for Double reader

The switch / *jumper* in position 7 on J3 / *15 on J5* enables or disables this feature. A description is given in chapter 1.2. This feature must be disabled for single readers.

	Switch mode
OFF	Disabled
ON	Enabled

3.8. Electrical Interface

The following positions on J1 and J2 / *J3 and J8* determine the electrical interface to the host, by fixing which lines are physically routed through to the front-panel connector.

Type	Position
RS-232	1, 11
RS-422	2, 4, 9, 10, 12
RS-485	2, 4, 6, 7,12
ISO2	3, 5, 8
WIEGAND	3, 5, 8

4. CONFIGURING THE COMPACT READER

The different operating modes are selected using switches which are either :
- ON or
- OFF

They are identified by their positions on four connectors:
- J1 (12 positions 1 to 12)
- J2 (8 positions 1 to 8)
- J3 (8 positions 1 to 8)
- J4 (8 positions 1 to 8)

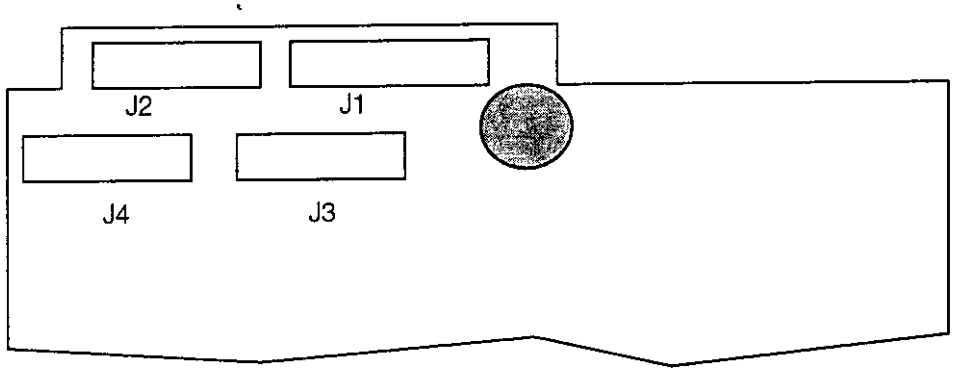


Figure 4-1 : Switch locations for configuration of Compact reader

The serial link to a host can be one of two types :
- Open-Collector (ISO2 or Wiegand)
- Asynchronous RS 232, RS 422 and RS 485.

NB: Only one of these interfaces can be active at a time

Certain switch combinations are forbidden. If these combinations are detected during the initialisation period (immediately following a reset), an internal reset is generated after a period of 4 seconds. The following combinations are forbidden :

- Message mode 3 together with WIEGAND interface
- Message mode 2 together with POLLING mode

4.1. ISO2 and WIEGAND Interfaces

4.1.1. ISO2 Interface

Positions 1 to 4 of J2 must be as follows :

4	3	2	1	message length
OFF	OFF	OFF	OFF	variable
OFF	OFF	ON	OFF	fixed

4.1.2. WIEGAND Interface

Positions 1 to 4 of J2 must be as follows :

4	3	2	1
OFF	OFF	OFF	ON

4.1.3. Tag persistence

Positions 5 and 6 of J2 must be as follows :

6	5	Persistence
ON	ON	1 s
ON	OFF	2 s
OFF	ON	5 s
OFF	OFF	10 s

4.1.4. Minimum Time Between Messages (MTBM)

Positions 7 and 8 of J2 must be as follows :

8	7	MTBM
ON	ON	1000 ms
ON	OFF	100 ms
OFF	ON	200 ms
OFF	OFF	500 ms

4.1.5. Tag message repetition

Position 3 of J3 must be as follows :

	repetition
OFF	disabled
ON	enabled

4.2. Asynchronous serial link

4.2.1. Address

The module's physical address is the logical slave address that the host application software uses to address the module (see 6.3).

The four positions 1 to 4 of J2 determine the physical address:

4	3	2	1	Address
ON	ON	ON	ON	MINITEL
ON	ON	ON	OFF	1
ON	ON	OFF	ON	2
ON	ON	OFF	OFF	3
ON	OFF	ON	ON	4
ON	OFF	ON	OFF	5
ON	OFF	OFF	ON	6
ON	OFF	OFF	OFF	7
OFF	ON	ON	ON	8
OFF	ON	ON	OFF	9
OFF	ON	OFF	ON	10
OFF	ON	OFF	OFF	11
OFF	OFF	ON	ON	12
OFF	OFF	ON	OFF	see 3.1.1 ISO2
OFF	OFF	OFF	ON	see 3.1.2 WIEGAND
OFF	OFF	OFF	OFF	see 3.1.1 ISO2

NB : A JBUS command message which has a slave address equal to 0 corresponds to a broadcast message, which explains why a reader cannot have an address of 0 for polling applications.

4.2.2. Character Format and Baud rate

Baud rate is chosen using positions 5 and 6 of J2:

6	5	Baud rate
ON	ON	9600 Bauds
ON	OFF	4800 Bauds
OFF	ON	1200 Bauds
OFF	OFF	19200 Bauds

Format is chosen using positions 7 and 8 of J2:

8	7	Format
ON	ON	7 bits data 1 bit even parity
ON	OFF	7 bits data 1 bit odd parity
OFF	ON	8 bits data no parity
OFF	OFF	not used

4.2.3. Protocol : polling or interrupt

The type of protocol, polled or by interrupt, is chosen with position 5 on J3:

	protocol
OFF	interrupt
ON	polling

4.2.4. Frame format

Position 8 on J3 determines the frame format, test (ASCII) or JBUS (binary).

	frame format
OFF	Test - ASCII message
ON	Normal - JBUS frame

The test format allows connection to a dumb terminal for easy on-site display. For a description see chapter 11.

4.3. Message mode

The mode is chosen using positions 1 and 2 on J3. The mode determines in what cases the detection of a tag causes a message to be transmitted to the host.

Type 0 - Each time a tag is detected, a timer is armed (nominal value = 1s). Tag detection only causes a message to be transmitted if this timer is not active. Each tag detected has a timer associated with it.

Type 1 - This mode is no longer supported

Type 2 - At each tag detection, a message is transmitted to host. During message transmission, microwave emission is switched off. Only available for the ISO2 interface and the asynchronous start/stop interface in the interrupt mode.

Type 3 - When a tag "disappears" (is removed from internal memory), an extra message is transmitted to host which includes the tag's code as well as the number of times that the badge was detected.This number cannot be greater than 99. Not available for the Wiegand interface. Otherwise identical to type 0.

2	1	message mode
OFF	OFF	Type 3
OFF	ON	Type 2
ON	OFF	Type 1 - no longer supported
ON	ON	Type 0

For a graphical representation of how the modes work, see Figure 3-3.

4.4. Relay operation

When a tag is detected, the relay operates. The switch in position 3 on J3 determines one of two modes of deactivation (for ISO2 and Wiegand, deactivation is automatic) :

- automatic relay deactivation after 2 second delay.
- relay deactivation controlled by host via JBUS

	Deactivation
OFF	automatic
ON	under host control

4.5. Buzzer operation

The jumper in position 4 on J3 activates or deactivates the buzzer on tag detection. When enabled, the buzzer emits a short sound (duration 50 ms) each time a tag is read.

	Buzzer
OFF	Enabled
ON	Disabled

4.6. Code filtering with the Distributor code

The switch in position 6 on J3 enables or disables this feature. A description is given in chapter 5.2.3. Applies only to ISO2 and Asynchronous interfaces. For the WIEGAND interface this feature is automatically enabled.

	Filtering
OFF	Disabled
ON	Enabled

4.7. Electrical Interface

The following positions on J1 and J2 determine the electrical interface to the host, by fixing which lines are physically routed through to the connector.

Type	Position
RS-232	1, 11
RS-422	2, 4, 9, 10, 12
RS-485	2, 4, 6, 7,12
ISO2	3, 5, 8
WIEGAND	3, 5, 8

4.8. Reading Range

The reading range can be coarsely adjusted using switches 6 and 7 on J4. Three ranges are possible :

7	6	range
OFF	OFF	short
ON	OFF	short
OFF	ON	medium
ON	ON	long (normal)

4.9. Operating channel

The compact reader can operate using 29 different channels. Each channel corresponds to a separate microwave frequency band. This is useful when several readers must be positioned close together. Using different channels on each reader eliminates mutual interference. Positions 1 to 5 of J4 are used. The OFF position for switches are indicated by a blank in order to make the table more readable.

5	4	3	2	1	Channel
ON	ON	ON	ON		1
ON	ON	ON		ON	2
ON	ON	ON			3
ON	ON		ON	ON	4
ON	ON		ON		5
ON	ON			ON	6
ON	ON				7
ON		ON	ON	ON	8
ON		ON	ON		9
ON		ON		ON	10
ON		ON			11
ON			ON	ON	12
ON			ON		13
ON				ON	14
ON					15
	ON	ON	ON	ON	16
	ON	ON	ON		17
	ON	ON		ON	18
	ON	ON			19
	ON		ON	ON	20
	ON		ON		21
	ON			ON	22
	ON				23
		ON	ON	ON	24
		ON	ON		25
		ON		ON	26
		ON			27
			ON	ON	28
			ON		29

Table 4-1 : Microwave Channel selection

5. OPEN-COLLECTOR INTERFACES

5.1. Magnetic Stripe Card Interface «ISO2»

5.1.1. Description

Using this interface allows the reader to take the place of a standard magnetic stripe card reader. This interface consists of three signals, **MDATA** (negative logic) for the data , **STROBE** (active low) indicates when data are valid, and **PRES_BADGE** (active low) a signal encompassing message transmission as shown below. The characters are transmitted synchronously in a frame format at a rate of roughly 1000 bits/s.

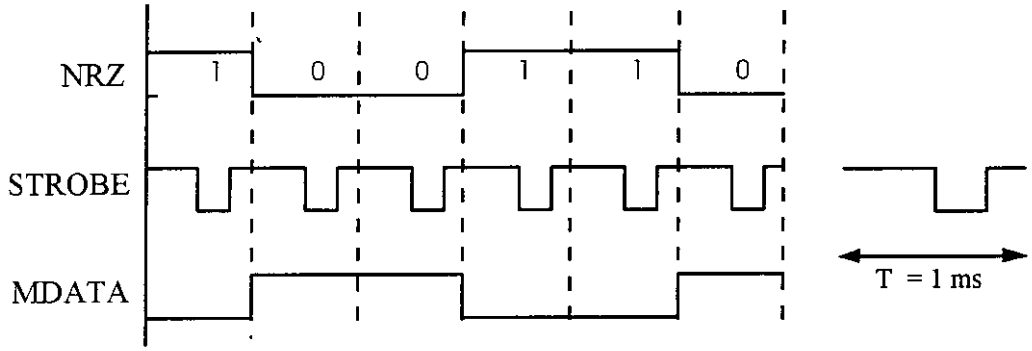


Figure 5-1: Signal timing for the ISO2 interface. Period for NRZ data is roughly 1 ms

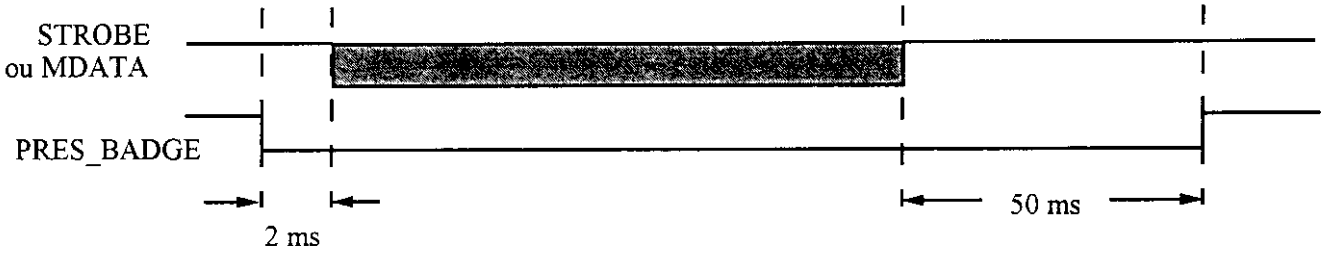


Figure 5-2 : Timing showing the signal "Presence Badge".

The STROBE and MDATA signals are open-collector outputs (circuit shown in Figure 7-3). For proper operation a pull-up resistor of about 1K ohm should be used.

5.1.2. Message format

A message consists of a preamble of 15 zeros (for receiver synchronisation), the data frame as described below, and a postamble of 10 zeros.The data (digits 0 to 9 only) are formatted into characters of 5 bits - 4 bits for a BCD coding plus one bit for odd parity. The data is framed as shown below.

1 Character		**1 Character**	**1 Character**
START	data	END	LRC

The checksum (LRC) is the result of an exclusive-or function performed on all the preceding characters.

START character = 0BH
END character = 1FH.

The contents of the data field depend upon the message mode chosen and the length. For a variable length frame, this field begins with a three-character distributor code, if no distributor-code filtering is enabled, followed by the user-code. For the fixed length frame, this field contains exactly 37 characters, the characters after the user-code, if there are less than 37, are all equal to 0DH.

In the case of message mode 3, the data also contains the number of times the tag was detected, a two-character field. The special separation character 0CH precedes this number.

The order of bit transmission for each character is LSB first.

Typical examples of the data field for a user code of length n digits :

message mode 0, length variable

distributor code	user code

length = 3 + n

message mode 3, length variable

distributor code	user code	0CH	nb. det

length = 3 + n + 3

message mode 3, length variable, distributor-code filtering

user code	0CH	nb. det

length = n + 3

message mode 0, length fixed

distributor code	user code	0DH	0DH ... 0DH

length = 37

message mode 3, length fixed

distributor code	user code	0CH	nb. det	0DH	0DH ... 0DH

length = 37

message mode 3, length fixed, distributor-code filtering

user code	0CH	nb. det	0DH	0DH ... 0DH

length = 37

5.1.3. Tag persistence

The tag persistence (the time that a tag is stored in internal memory) can be set to one of four values using the board configuration (see 3.1.3) : 1 s, 2 s, 5 s and 10 seconds.

5.1.4. Tag code transmission

Two separate parameters can be set using the board configuration.

The first is the minimum time between consecutive tag code transmissions (MTBM, see 3.1.4). This can be set to one of four values, 100 ms, 200 ms, 500 ms and 1 s, allowing interconnection to readers with different reaction times.

The second is the possibility of repeating the transmission of the tag code (see 3.1.5). This may be desirable in certain cases. If this option is enabled, the tag code is sent a second time after a time MTBM.

5.2. Wiegand compatible interface

5.2.1. Description

Using this interface allows the reader to take the place of a Wiegand-effect card reader. This interface comprises two signals, **DATA "0"** and **DATA "1"**. A logical 0 produces a negative pulse on the DATA_0 line and a logical one produces a negative pulse on the DATA_1 line. The timing is given in figure 5 below. The data is transmitted synchronously in a frame format at a rate of roughly 2000 bits/s

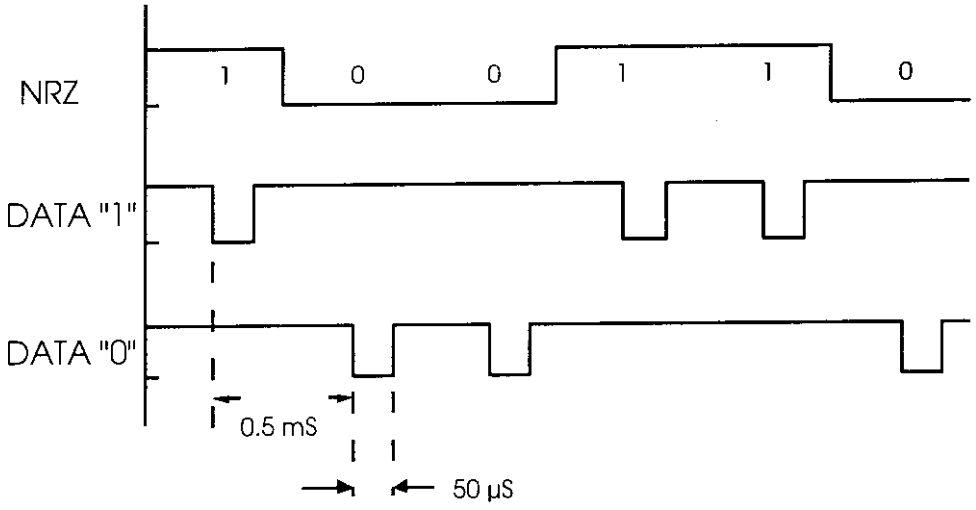
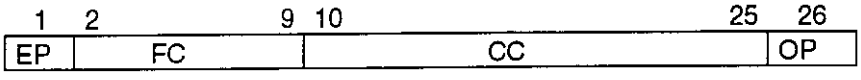


Figure 5-3 : Timing for WIEGAND Interface.

The DATA_0 and DATA_1 signals are open-collector outputs (circuit shown in Figure 7-3). For proper operation a pull-up resistor of about 1K ohm should be used.

5.2.2. Message format

The Wiegand message has a fixed length of 26 bits, and the following structure :



EP - *Even parity bit*
If the number of ones in the bits 2 to 13 is odd, then this bit is equal to 1, otherwise it is equal to 0.

FC - *Facility Code*

length = 8 bits (bits 2 to 9)
A number, 0 to 255, binary-coded using 8 bits, MSB is bit 2.

CC - *Card Code*
length = 16 bits (bits 10 to 25)
A number, 0 to 65535, binary-coded using 16 bits, MSB is bit 10.

OP - *Odd parity bit*
If the number of ones in the bits 14 to 25 is even, then this bit is equal to 1, otherwise it is equal to 0.

Message transmission begins with bit 1.

5.2.3. Distributor code auto-learn mode

This facility is automatically enabled if the Wiegand interface is selected. However, it can also be enabled for the other interfaces if desired.

As well as the user data field, which for Wiegand corresponds to the 26 bit frame described above, the HYPERX tag contains a three character distributor code which is unique for each installation. This code is automatically added when the tag is first programmed.

The distributor code contained in the first tag which is detected after a processor reset becomes the reference distributor code. It is memorized, and the distributor codes of all succeeding tags are compared to this reference. If they are the same, the tag is allowed, if not the tag is rejected. In the former case, the message transmitted to the host does not contain this distributor code.

The distributor code consists of three ASCII digits, 0 - 9, allowing 1 000 combinations.

5.2.4. Tag persistence

The tag persistence (the time that a tag is stored in internal memory) can be set to one of four values using the board configuration (see 3.1.3) : 1 s, 2 s, 5 s and 10 seconds.

5.2.5. Tag code transmission

Two separate parameters can be set using the board configuration.

The first is the minimum time between consecutive tag code transmissions (MTBM, see 3.1.4). This can be set to one of four values, 100 ms, 200 ms, 500 ms and 1 s, allowing interconnection to readers with different reaction times.

The second is the possibility of repeating the transmission of the tag code (see 3.1.5). This may be desirable in certain cases. If this option is enabled, the tag code is sent a second time after a time MTBM.

6. COMMUNICATION PROTOCOL FOR ASYNCHRONOUS INTERFACE

6.1. Introduction

Readers can be connected to a host using either a point-to-point configuration or a multipoint (bus) configuration. Furthermore, two types of protocol are possible : polling by host or interrupt.

The interrupt protocol uses either the JBUS™ frame format or the test mode format.

NB :

(1) The interrupt protocol can only be used on a point to point link.
(2) JBUS™ is registered by APRIL , MODBUS™ is registered by GOULD MODICON

A multipoint or network configuration using the standards for differential data transmission RS-485 (2-wire, 2-way) or RS-422 (4-wire, 2 for each way), is used if several readers are to be interconnected. In this case the polled JBUS protocol is implemented

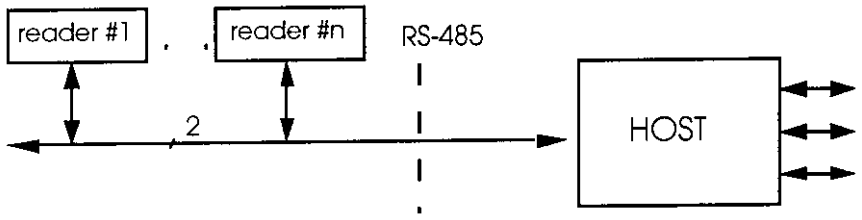


Figure 6-1 : Network topology using RS-485

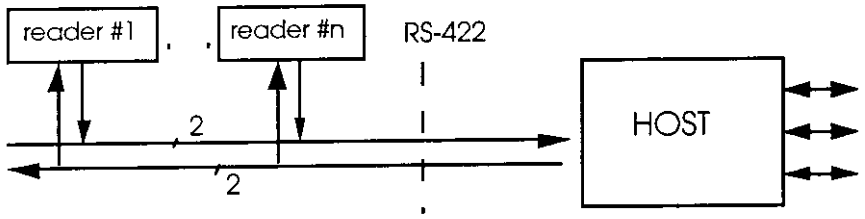


Figure 6-2 : Network topology using RS-422

If only one reader is to be connected, either of the three standards can be used. In this case either of the two protocols, polled (see chapter 6.3) or interrupt (see chapter 6.5), are possible.

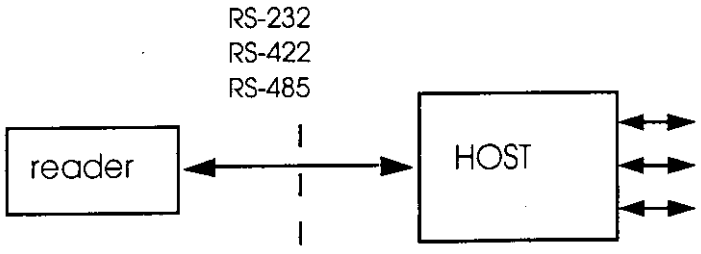


Figure 6-3 : Point-to-point topology

The table below summarizes the different combinations :

Protocol	Type of connection	
	point-to-point	multipoint
Interrupt	RS-232/422/485	—
Polling	RS-232/422/485	RS-422 or RS-485

6.2. Transmission characteristics

All protocols are character-oriented. The character formats are :

- 7 bits even parity / 1 stop bit
- 7 bits odd parity / 1 stop bit
- 8 bits no parity / 1 stop bit

Four baud-rates are possible :
- 1 200 bauds
- 4 800 bauds
- 9 600 bauds.
- 19 200 bauds

Choices are configured by user (see chapter 3.2.2).

NB : In practice, the JBUS protocol requires 8 bits / no parity. The other formats are used for special situations.

6.3. Reader in Polled Mode

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

Slave no.	function code	data	control

NB : A HYPER X reader is a JBUS™ slave.

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

The four fields have the following meanings :

- Slave number (1 byte) :
  Specifies the destination, from 1 to 12. If the number is 0, it is a broadcast message. In this case there is no reply.

- function code (1 byte) :
  Command : Determines the type of action to be performed (read, write, bit, word).
  Reply : Result (success or error).

- 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) - See chapter 12.

The JBUS™ protocol defines 12 functions (second field in frame). The following four of them are implemented on the HYPERX readers:

- function 3 : read n words
- function 5 : write one bit
- function 6 : write one word
- function 16 : write n words

The main difference between the reader's reply and the host's command is the content of the data field.

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

Example :

PC —> reader 01 03 00 39 00 01 54 07 (incorrect command)
reader —> PC 01 83 02 C0 F1

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 HYPERX reader, this time is equal to 20 ms except in the case of a baud-rate of 1200 bauds for which it is 30 ms.

6.3.1. Write one bit

- Command

		2 bytes	1 byte	1 byte	2 bytes
Address reader	05	command code	bit value	00	CRC 16

- if bit = 0, bit value = 00H,
- if bit = 1, bit value = FFH

- Reply

		2 bytes	1 byte	1 byte	2 bytes
Address reader	05	command code	bit value	00	CRC 16

The'Reply' frame is identical to the 'Command' Frame.
If the address is 00H, all the readers process the command without sending a reply.

6.3.2. Write one word

- Command

		2 bytes	2 bytes	2 bytes
Address reader	06	command code	value*	CRC 16

** A word consists of two bytes, msb first*

- Reply

		2 bytes	2 bytes	2 bytes
Address reader	06	command code	value*	CRC 16

The'Reply' frame is identical to the 'Command' Frame.
If the address is 00H, all the readers process the command without sending a reply.

6.3.3. Write n words

- Command

		2 bytes	2 bytes	1 byte	n bytes	2 bytes
Address reader	10H	command code	nbr of words	nbr of characters	values *	CRC 16

** words to be written, in order*

- Reply

		2 bytes	2 bytes	2 bytes
Address reader	10H	command code	nbr of words	CRC 16

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

6.3.4. Read n words

- Command

		2 bytes	2 bytes	
Address reader	03	command code	nbr of words	CRC 16

- Reply

		1 byte	n bytes	
Address reader	03	nbr characters read†	values *	CRC 16

** bytes read, in order*
† number of characters read = 2 X number of words in Command (always even)

6.4. Reader commands

The following commands can be sent to the reader by the host :

N°	Commands	function code	command code	command parameter	reply parameter
1	Get reader status	3	0040	nb words = 1	1 word status_l
2	Get modules status	3	0041	nb words = 1	1 word status_m
3	Get tag	3	0042	nb words = n	n words
4‡	Turn reader ON / OFF	6	0043	1 word emis	1 word emis
5	Relay control	5	0044	1 bit (0 =enable)	1 bit (0 =enable)
6	Reset reader	5	0045	1 bit (0 =reset)	1 bit (0 =reset)
7	Anti-reread time	6	0046	1 word time	1 word time
8	Antenna LED control	6	0047	1 word led	1 word led
9	Retransmit previous tag	3	0048	nb words = n	n words
10	Get init errors	3	004F	nb words = 1	1 word status_e
11*	Get EPROM version	3	0049	nb words = 1	1 word version (*)
12*	Get config	3	004A	nb words = 1	1 word config (*)
13†	Select channel	6	0050	1 word channel	1 word channel

Table 6-1 : Reader commands.
(*) Commands 11 and 12 are available as of EPROM version 4.00
(†) Command 13 is only available for the compact reader
(‡) Command 4 is onlyavailable for the modular reader

In order to read a tag (in polled mode), the host must first issue the command **get reader status**. The status word informs the host if a tag has been read, and if so, the length of the tag-code in bytes (see 6.4.3 below). In the latter case, the host then issues a second command **get tag**, indicating the number of words to be read.

NB : In interrupt mode, the command **get tag** is not used, since all tag-codes are sent immediately..

The words **status_l**, **status_m**, **status_e**, **led**, **emis**, **time**, **version, channel** and **config** are 16 bit words arranged as two bytes, msb first, lsb last.

6.4.1. Get reader status

This is a command of type **read n words**, code = 0040H. If the command parameter nb words is not equal to 1, the reader replies with the JBUS error 3 (Data incorrect).

The reader returns one word **status_l** (two bytes, MSbyte first).

status_l

D15							D8	D7							D0
BA	0	N5	N4	N3	N2	N1	N0	UC	AM	DP	MS	DM	E2	E1	RE

bit	name	modular reader	compact reader
D15	BA	0 = 1 tag has been read,1 = two or more tags have been read	
D13-D8	N5 .. N0	number of characters in tag (1 to 34), binary-coded in 6 bits	
D7	UC	User config, one or more parameters have been changed via a JBUS command (active 1)	
D6	AM	Fault in Power supply module	1
D5	DP	Tag memory overflow	
D4	MS	Fault with CPU	
D3	DM	Fault in one of the external modules	
D2	E2	Radio reception enabled for Antenna 2	1
D1	E1	Radio reception enabled for Antenna 1	
D0	RE	Relay activated	

- NB : When not specified, the bits are active low.

The length specified by the bits N5 ... N0 includes one byte for the tag's status, three for the distributor code and the rest for the user-code (see chapter 6.4.3). This number may be even or odd. However, when using the command **read n words** in order to read a tag-code, an even number of words must be specified and the reply always contains an even number of bytes, the last of which may not be significant.

If either of the bits AM or DM are active, the host should issue the command **read modules status** (chapter 6.4.2) in order to determine the cause. If the bit MS is active, the host should issue the command **read init errors** (chapter 6.4.10).

Example :

PC —> reader	01	03	00	40	00	01	85	DE
reader —> PC	01	03	02	00	7D	78	65	

6.4.2. Get modules status

This is a command of type **read n words**, code = 0041H. If the command parameter nb words is not equal to 1, the reader replies with the JBUS error 3 (Data incorrect).
The reader returns one word **status_m** (two bytes, MSbyte first).

status_m

bit	name	modular reader	compact reader
D15	DCH	Battery-charger fault	1
D14	DAC	Mains fault	1
D13	DDC	Battery backup fault	1
D12	DTE	External DC input voltage fault	1
D11	PSHF2	Microwave source module HF2 present	1
D10	PSHF1	Microwave source module HF1 present	0
D9	PCMR2	Module SAM2 present	1
D8	PCMR1	Module SAM1 present	0
D7	unused	1	1
D6	unused	1	1
D5	ERV2	Phase-lock error source HF 2	1
D4	ERV1	Phase-lock error source HF 1	1
D3	ERS2	Fault in module HF 2	1
D2	ERS1	Fault in module HF 1	1
D1	PEM2	Microwave power present on SAM2	1
D0	PEM1	Microwave power present on SAM1	

- NB : All bits are active low.

Example :

PC —> reader	01	03	00	41	00	01	D4	1E
reader —> PC	01	03	02	FA	FE	7B	64	

6.4.3. Get tag

This is a command of type **read n words**, code = 0042H. If the number of words to be read (see 6.4.1) is different from the number of words available (see command **get reader status**) , the reader replies with the JBUS error 8 (execution failure). This error is also produced if no tags are present.

The data field structure of the 'reply' frame is as follows :

1 byte	3 bytes	1 to 30 bytes
status_tag	distributor_code	user_code

The length of this field can vary from a minimum of 5 to a maximum of 34. The distributor code may not be present if distributor-code filtering is enabled.

Only two bits of **status_tag** are used :

D0 : tag battery (0 = OK, 1 = low)
D1 : Antenna number (0 = antenna 1 / SAM1, 1 = antenna 2 / SAM2) - for modular reader only
D4, D5 : 1
D6,D7 : 0

For modular readers :

- Antenna 1 is connected to the receiver module SAM1 (immediately to left of SPI in rack)
- Antenna 2 is connected to the receiver module SAM2 (leftmost SAM in a double rack).

The user-code can vary in length from 1 to 30 characters. It consists of any ASCII characters whose ASCII codes lie between 20H and 5FH.

Example :

PC —> reader	01	03	00	42	00	04	E4	1D					
reader —> PC	01	03	08	30	31	32	33	39	39	39	39	B8	C5

6.4.4. Turning reader ON / OFF

This command is only available for the modular reader.

This command turns the microwave emission on or off. This is a command of type **write one word**, code = 0043H. One word (two bytes) must be sent, the most significant byte first.

emis

D15							D8	D7							D0
NA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	VE

NA : N°. antenna (0 = antenna 1, 1 = antenna 2)
VE : Enable emission (0 = enable, 1 = disable)

If this command is successfully executed by the reader, then the UC bit in the status word **status_I** is set to 1.

Example :

PC —> reader	01	06	00	43	00	01	B9	DE
reader —> PC	01	06	00	43	00	01	B9	DE

6.4.5. Relay control

This is a command of type **write one bit**, code = 0044H. If the parameter byte contains 0 the relay is energised, if it contains FFH, the relay is de-energised.

If this command is successfully executed by the reader, then the UC bit in the status word **status_I** is set to 1.

Example :

PC —> reader	01	05	00	44	00	00	8D	DF	(energise relay)
reader —> PC	01	05	00	44	00	00	8D	DF	

6.4.6. Reset reader

This is a command of type **write one bit**, code = 0045H. If the parameter byte contains 0, an internal processor reset is generated. Any other value produces the JBUS error 3 (data incorrect).

This command resets all user configurable parameters to their default values and resets the UC bit in the status word **status_I** to 0 :

Parameter	Default value
Antenna light	green, slow blink
Anti reread time	1 second
Relay	de-energised
Microwave emission	ON

Example :

PC —> reader	01	05	00	45	00	00	DC	1F	(reset)
reader —> PC	01	05	00	45	00	00	DC	1F	

6.4.7. Tag Persistence

This is a command of type **write one word**, code = 0046H. One word (two bytes) must be sent, the most significant byte first.

This time is expressed as a multiple of 50ms and binary-coded using 11 bits, giving a range from 50ms to 100 seconds.

time

D15								D8	D7						D0
x	x	x	x	x	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1	T0

If a value of 0 is programmed, then the reader will send the tag-code at each detection. This is incompatible with several reader configurations and must be used with caution.

If this command is successfully executed by the reader, then the UC bit in the status word **status_I** is set to 1.

Example :

PC —> reader	01	06	00	46	00	28	68	01	(time = 2s)
reader —> PC	01	06	00	46	00	28	68	01	

6.4.8. Antenna LED control

This is a command of type **write one word**, code = 0047H. One word (two bytes) must be sent, the most significant byte first.

led

D15							D8	D7							D0
NA	RV	CF	AE	T3	T2	T1	T0	x	x	x	x	x	x	x	x

NA : N° antenna (0 = antenna 1, 1 = antenna 2) (=0 for compact reader)
RV : 0 = LED red, 1 = LED green
CF : 0 = blink, 1 = fixed
AE : 0 = on, 1 = off
T3 .. T0 : Blink period (on or off-time) as multiple of 50ms binary-coded using 4 bits. Thus :
0001 : 50ms / 50 ms
0010 : 100ms / 100 ms
0011 : 150ms / 150 ms
1111 : 750ms / 750 ms

If this command is successfully executed by the reader, then the UC bit in the status word **status_l** is set to 1.

Example :

PC —> reader	01	06	00	47	05	00	3A	8F	(led ant 1 blinks red 250/250ms)
reader —> PC	01	06	00	47	05	00	3A	8F	

6.4.9. Retransmit previous tag

This is a command of type **read n words**, code = 0048H. If the number of words to be read (chapter 6.4.1) is different from the number of words available, the reader replies with the JBUS error 8 (execution failure). This error is also produced if no tags are present.

This command makes the reader retransmit the previous tag code, providing no other transmission has occurred since. It is used in polling mode if the reader's reply contains errors and the host wishes a retransmission. In such a case, repeating the command **read tag** is of no use, this command must be used. The number of words to be read must be the same as that used in the previous **read tag** command.

Example :

PC —> reader	01 03 00 42 00 03 A5 DF	(read 3 words)
reader —> PC	01 03 06 01 02 03 04 05 16 9B B3	(CRC incorrect)
PC —> reader	01 03 00 48 00 03 85 DD	(retransmit 3 words)
reader —> PC	01 03 06 01 02 03 04 05 06 9B B3	(CRC OK)

6.4.10. Get Init Errors

This is a command of type **read n words**, code = 004FH. If the command parameter nb words is not equal to 1, the reader replies with the JBUS error 3 (Data incorrect).

The reader returns one word **status_e** (two bytes, MSbyte first).

After a manual reset, the reader performs an internal test of its major hardware elements. If an error is detected, the **MS** bit in the reader status word is set (see 6.4.1) and the reader resets itself after 4 seconds and continues to do so until the fault disappears. This command, if sent after the end of the test (the buzzer sounds while the test is in progress), will determine the nature of the fault. One word **status_e** is to be read:

Only the 5 bits D0 to D4 are used :

status_e

D15							D8	D7							D0
x	x	x	x	x	x	x	x	x	x	x	SCC	SCB	SCA	RAM	ROM

ROM : EPROM checksum is incorrect
RAM : RAM failure
SCA : SCC channel A failure
SCB : SCC channel B failure
SCC : SCC bus access failure

The bits are active at 1.
Example :

PC —> reader	01	03	00	4F	00	01	B5	DD	
reader —> PC	01	03	02	00	00	B8	44		(no errors)

6.4.11. Get EPROM version

This is a command of type **read n words**, code = 0049H. If the command parameter nb words is not equal to 1, the reader replies with the JBUS error 3 (Data incorrect).

The reader returns one word **version** (two bytes, MSbyte first).

version

identifier				major index				minor index				minor index			
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

For the modular reader, the identifier has a fixed value equal to 0. For the compact reader, this value is equal to 5.

Thus, version = 0401H indicates a modular reader with EPROM version 4.01.
Version = 5403H indicates a compact reader with EPROM version 4.03.

6.4.12. Get Config

This is a command of type **read n words**, code = 004AH. If the command parameter nb words is not equal to 1, the reader replies with the JBUS error 3 (Data incorrect).

The reader returns two bytes corresponding to the states of the two sets of switches. The first byte corresponds to the Address switches, the second to the Mode switches. Zeros correspond to switches in the ON position (see chapter 3 for description of switch positions).

6.4.13. Set channel number

This command is only available on compact readers.

This is a command of type **write one word**, code = 0050H. One word (two bytes) must be sent, the most significant byte first.

This command lets the user select one of 29 operating frequencies. For closely spaced readers using the same frequency, mutual interference can significantly degrade performance. These readers should use different frequencies.

channel

D15								D8	D7						D0
0	0	0	0	0	0	0	0	0	0	0	C4	C3	C2	C1	C0

Bits C4..C0 code the channel number. Channel 0 is not used. If this value, or a value greater than 29 is programmed, the reader replies with the JBUS error 3 (Data incorrect).

Channel	C4	C3	C2	C1	C0
0	not used				
1	0	0	0	0	1
2	0	0	0	1	0
29	1	1	1	0	1

The correspondance between channel number and microwave frequency is given in chapter 13.

6.5. Reader in Interrupt Mode

In this mode, as soon as a reader has a message to send to the host (i.e. a tag that has been detected), it sends it, rather than waiting for an invitation, as is the case in the polled mode. The host replies with an ACK or a NAK. The message sent has the following structure :

		1 byte	n bytes	
STX	04	nb characters	values	CRC 16

This structure is the same as that of a 'reply' frame to the command **read n words**. The first field, the reader number, is fixed at 2 and the second field, the code function, is fixed at 4.

Example :

			11 bytes	
02	04	0B	30 41 42 43 33 34 35 36 37 38 39	CRC 16

Here, the badge status = '0', the code read is 'ABC3456789'

The data field contains 11 bytes.

See chapter 6.4.3 for details of the structure of the data field.

The same message is retransmitted up to three times in case an ACK is not received. If a NAK is received the message is sent again immediately, if no reply is received the message is sent after a 100ms timeout. After three failed attempts, transmission for that message is abandoned.

This protocol is enabled using reader configuration (See chapter 3.2.3.).

NB :
In this mode of operation, the host can send all of the normal commands using the JBUS protocol (as defined in chapter 6.4 above), except for the one command **read tag** which would make no sense. The reader sends a reply just as if it were in polled mode. However, the reader cannot send a reply straight away if it has just detected a tag and has started to send this message, and vice versa. The host must decide if and when it can safely interrogate the reader.

7. EXTERNAL CONNECTIONS

7.1. 5-pin Connector - link to Host

pin	Name	I/O
O1	O1	I/O
O2	O2	I/O
O3	O3	I/O
O4	O4	I
O5	GND	

Pins O1 to O4 are associated with different signals, depending on the type of link used (Board configuration : see chapter 3.8).

Name	RS-232	RS-422	RS-485	ISO2	WIEGAND
O1	TX	TX+	+ V	STROBE	DATA "1"
O2	—	TX-	- V	MDATA	DATA "0"
O3	—	RX+	—	PRES_BADGE	—
O4	RX	RX-	—	—	—
O5	GND	GND	GND	GND	GND

Signals on front panel 5-pin connector

Connector reference :

Brand :	PHOENIX	WAGO
5 pin	MSTB 2,5/5-ST-5,08	231-305/026-000

7.2. 3-pin Connector - relayed circuit

pin	Name	I/O
1	Make	O
2	Common	I
3	Break	O

Signals on front panel 3-pin connector

This connection allows a signal to be switched using the on-board relay. When the relay is not energized, pins 2 and 3 are connected together, when it is, pins 1 and 2 are connected together.

Connector reference :

Brand :	PHOENIX	WAGO
3 pin	MSTB 2,5/3-ST-5,08	231-303/026-000

7.3. Installation and connection procedures for the asynchronous links

7.3.1. Electrical specifications

- **Interface RS-232** :

Input (RX)	Input voltage range VIL threshold VIH threshold	- 30V min, + 30V max 1,2V typ 1,7V typ
Output (TX)	Output voltage	± 5V min, ± 9V typ

- **Interface RS-422** :

Input (RX)	Common-mode voltage Différential-mode voltage V_{IH} threshold V_{IL} threshold	± 7V max ± 12V max 2V min 0,8V max
Output (TX)	$V_{OH}(I_{OL} = -20mA)$ $V_{OH}(I_O = 0)$ V_{OL} (I_{OL} = 48mA) V_{OL} (I_O = 0) Differential voltage V_{OD1} (I_O = 0) Differential voltage (R_L = 100½) Common-mode voltage (R_L = 100½)	2,5V min 5V 0,5V max 0V 2V min, 5V max $0,5V_{OD1}$ (2V min) ±3V max

- **Interface RS-485** : Identical to RS-422

7.3.2. Cables for RS-422 and RS-485

- Clean environments - twisted pairs, without screen.
- Noisy environments - twisted pairs, individual screen for each pair

Each cable is characterised by :
- its characteristic impedance (Z_0 in ohms)
- its distributed capacity (C_L in pF/m).
- its distributed resistance (R_L in ohms/m)

For short cable lengths, normal cables are satisfactory.
For cable lengths greater than 1000 metres, high quality cables (low C_L and R_L) should be used for all baud rates.

7.3.3. Line Termination

For a simplex link, the termination (if present) should be placed at the receiving end of the line.

For a duplex link, the termination (if present) should be placed at the each end of the line.

For baud rates less than 1200 bauds, no termination is necessary. For baud rates greater than 9600 bauds and line lengths greater than 1000 metres, a resistor equal to the line impedance (120 ohms) is usually necessary. For cases in-between, there is no clear-cut rule and depends on individual installations (combination of baud-rate, line-length, cable quality, emitter/receiver characteristics).

7.3.4. Electrical connections

For an RS-232 link , wiring up is straightforward, the TX and RX lines of both equipments are connected together.

For a differential link (RS-422 or RS-485), the polarities are not always clearly defined. Normally the "+" line is at a high level at rest and is active low. For the "-" line, the opposite is true. This is the case for the differential interface for the HYPERX readers. However if the differential signals are generated by a converter acting on RS-232 signals, then the "+" line can be at a low level at rest and active high. In this case, the "+" line of one equipment must be connected to the "-" line of the other equipment.

Connection of 0V

Whether this is necessary or not, depends on the installation. If host and reader are distant with different local ground potentials, then an RS-232 link may not work if the 0V references are not connected. However connecting them will cause ground currents to circulate. In general, for large link lengths, a differential link should be used. This also tolerates a large common-mode voltage difference.

7.3.5. Networking

7.3.5.1. Topologies

The preferred topology is the bus.

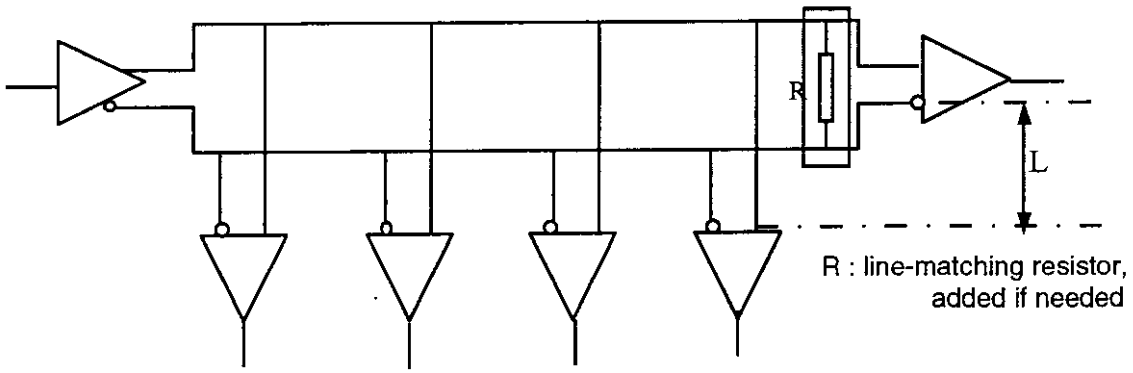


Figure 7-1 : Simplex link

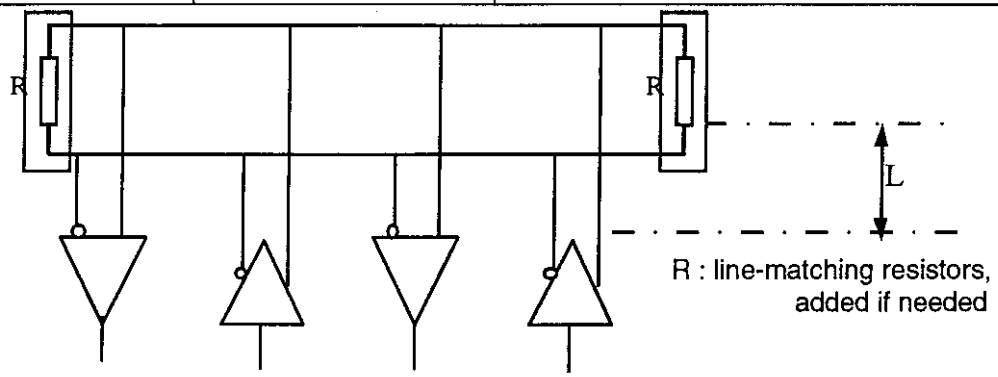


Figure 7-2 : Half duplex link

The length of the derivation should be as short as possible (< 30 cm).
The maximum length allowed can be calculated from the cable characteristics using the equation below.

$L < 1300 / (Z_0 \times C_L)$ L in metres, Z_O in ohms and C_L in pF/m

7.3.5.2. Line biasing

For RS-422 and RS-485, line biasing may prove necessary and must be done externally and only at one point on the line.

The line "+" is connected to +5V via a 4K7 resistor.
The line "-" is connected to 0V via a 4K7 resistor.

7.4. Output circuit for Open-collector interface

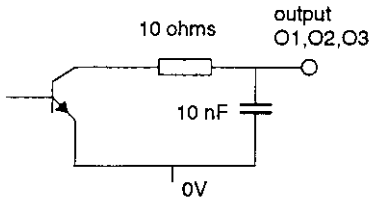
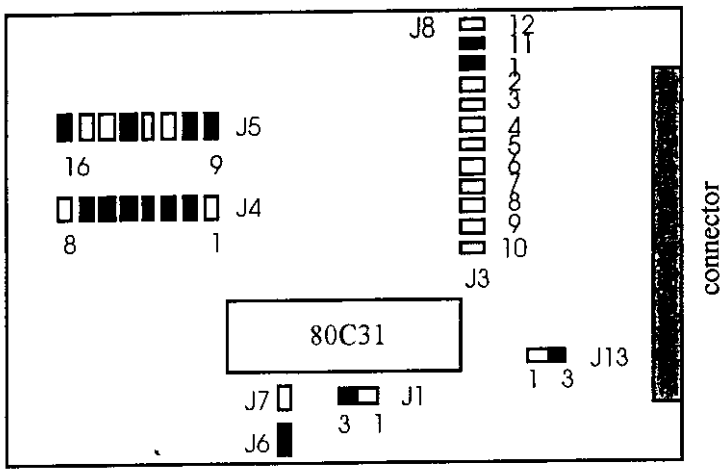


Figure 7-3 : Open-collector interface output circuit

8. APPENDIX A : JUMPER SETTINGS FOR MODULAR READER OLD VERSION

Asynchronous serial interface



Fixed jumpers :

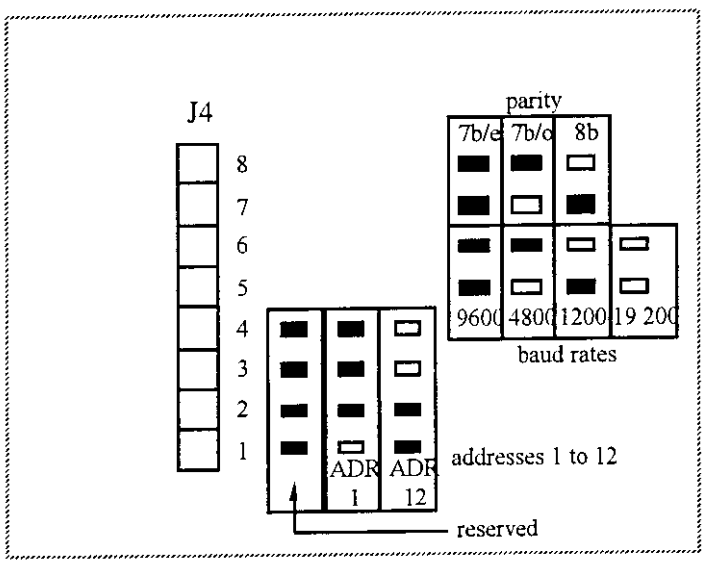
J1 - position 2-3
J6 - present
J13 - position 2-3
J7 - absent

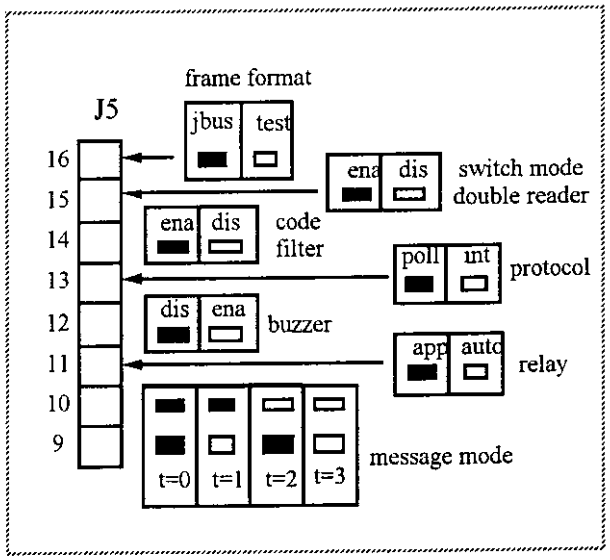
Configuration shown :

RS-232, polling
9600 bauds, 8 bits
address = 1
relay = auto
buzzer = active
serial mode = 0

Configuring the operating mode :

Connectors J4 (8 positions) and J5 (8 positions)



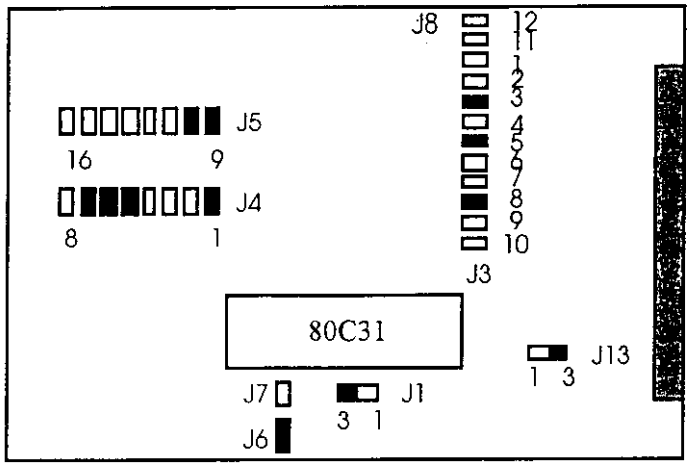


Configuring the electrical interface :

Jumpers for connectors J3 (10 positions, 1 to 10) and J8 (2 positions, 11 and 12) must be positioned as indicated below :

interface	positions J3	positions J8
RS-232	1	11
RS-422	2, 4, 9, 10	12
RS-485	2, 4, 6, 7	12

Modular reader old version - ISO2 and WIEGAND interfaces



Fixed jumpers :

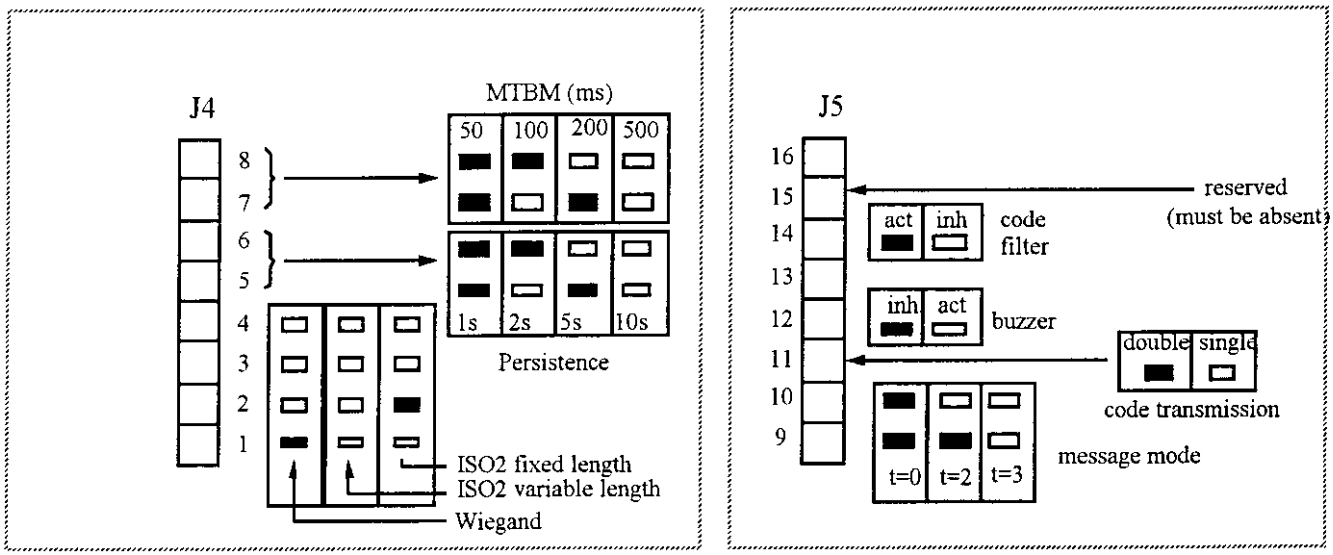
J1 - position 2-3
J6 - present
J13 - position 2-3
J7 - absent

Configuration shown :

Wiegand
Persistence = 1s
MTBM = 0.2s
buzzer = active

Configuring the operating mode :

Connectors J4 (8 positions) and J5 (8 positions)

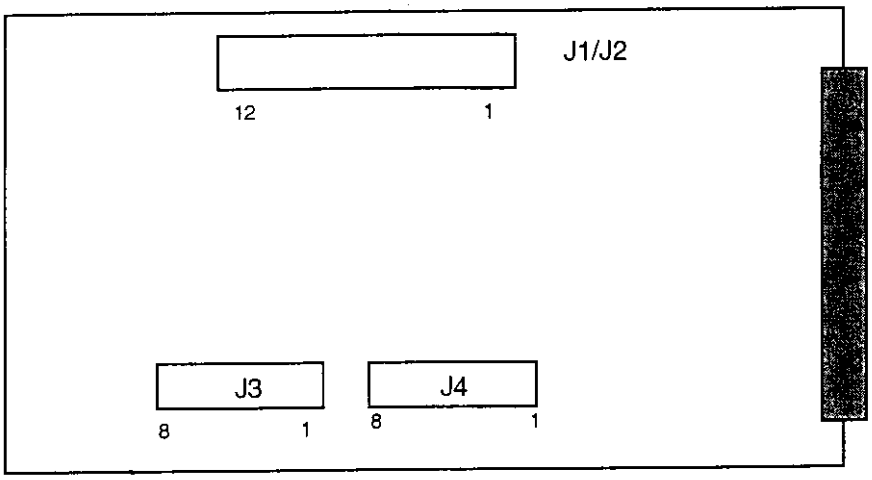


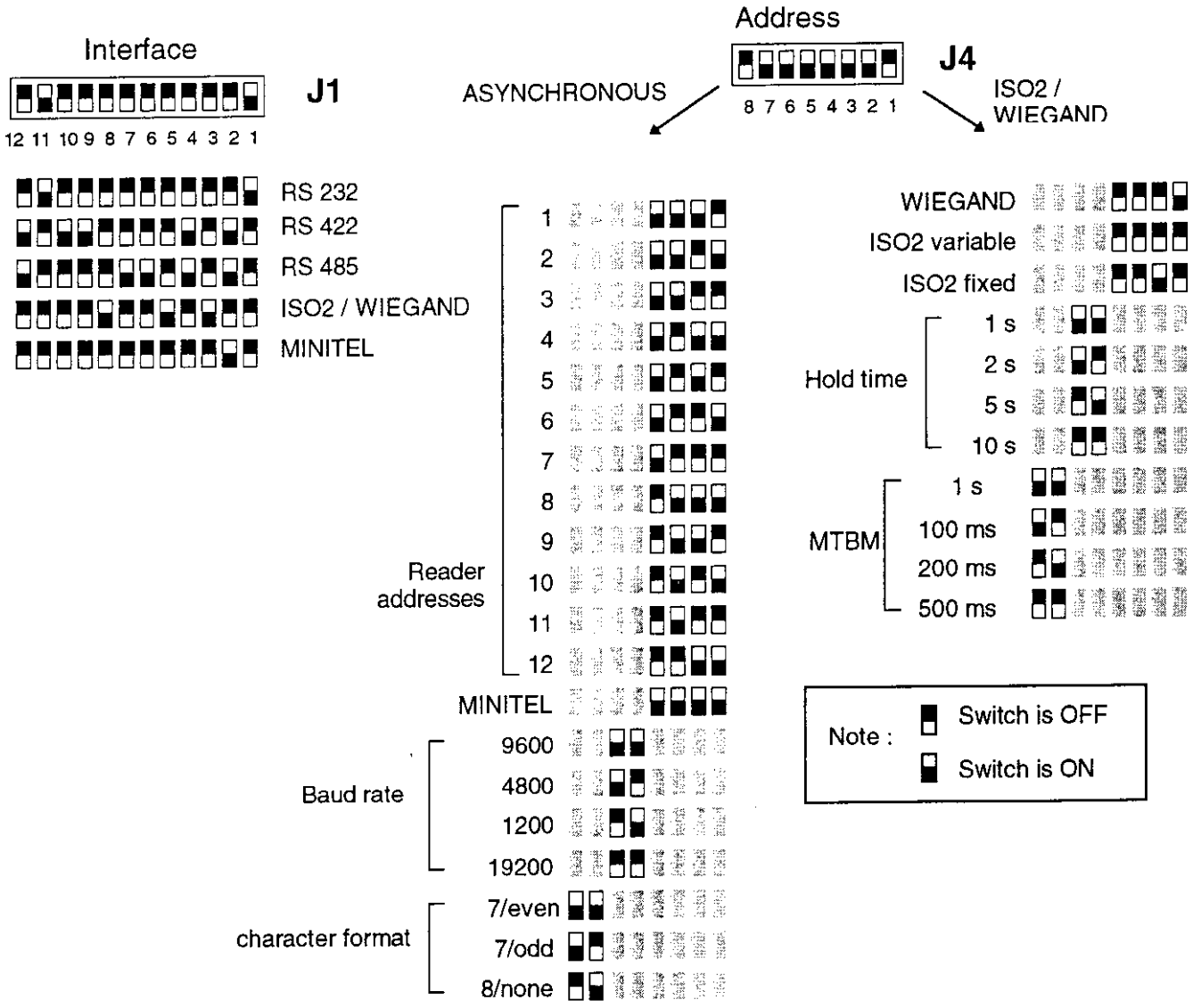
Configuring the electrical interface :

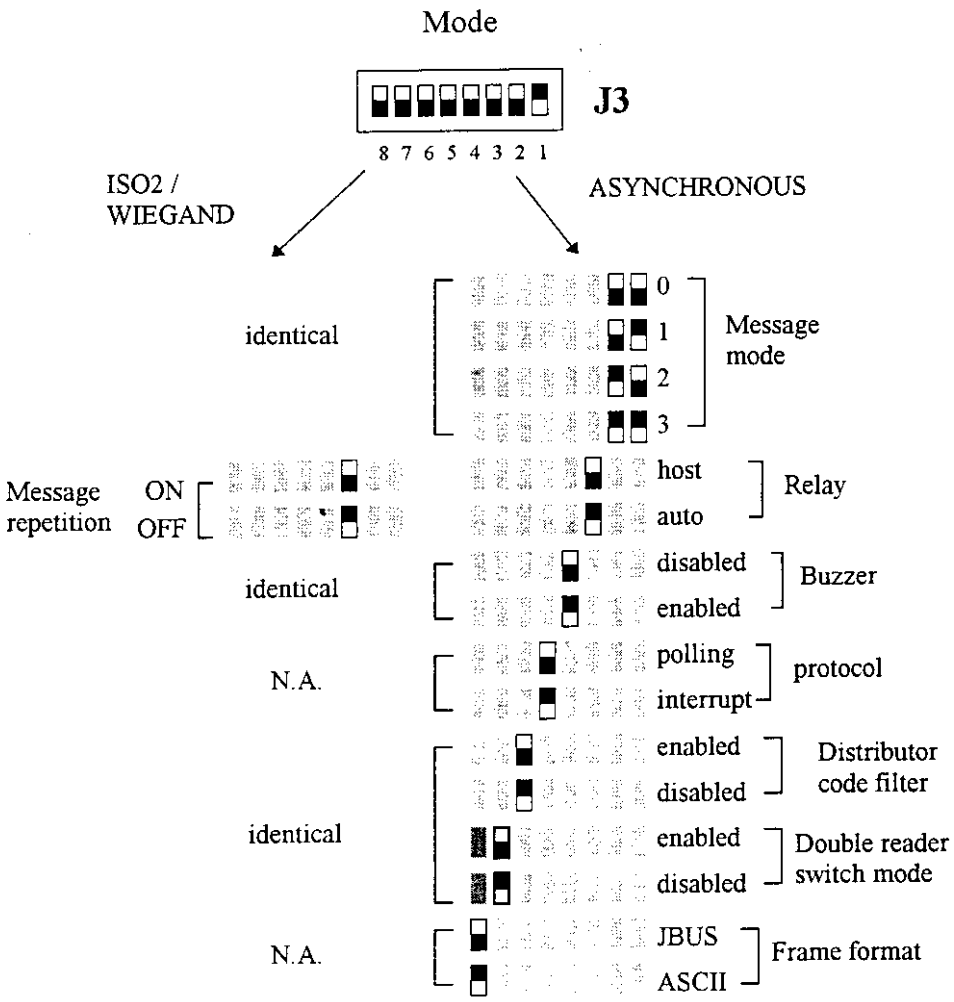
Jumpers for connectors J3 (10 positions, 1 to 10) and J8 (2 positions, 11 and 12 !) must be positioned as indicated below :

interface	positions J3	positions J8
ISO2/WIEG	3, 5, 8	—

9. APPENDIX B : SWITCH SETTINGS FOR MODULAR READER NEW VERSION



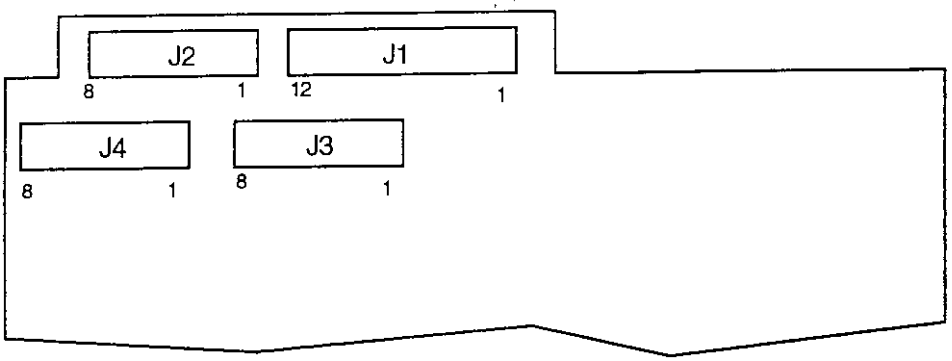




Note :
Switch is OFF
Switch is ON

CLASSIFICATION SOCIETE/ CLEARANCE LEVEL	REFERENCES DU DOCUMENT / DOCUMENT REFERENCES						PAGE
NON	Code Fabricant / Manufact. Code	Numéro / Number	Code Doc / Doc. Code	Tome / Volume	Indice / Revision Index	Langue Language	

10. APPENDIX C : SWITCH SETTINGS FOR COMPACT READER



Interface

J1

12 11 10 9 8 7 6 5 4 3 2 1

Address

J2

8 7 6 5 4 3 2 1

ASYNCHRONOUS

ISO2 / WIEGAND

RS 232
RS 422
RS 485
ISO2 / WIEGAND
MINITEL

Reader addresses
1
2
3
4
5
6
7
8
9
10
11
12

MINITEL

Baud rate
9600
4800
1200
19200

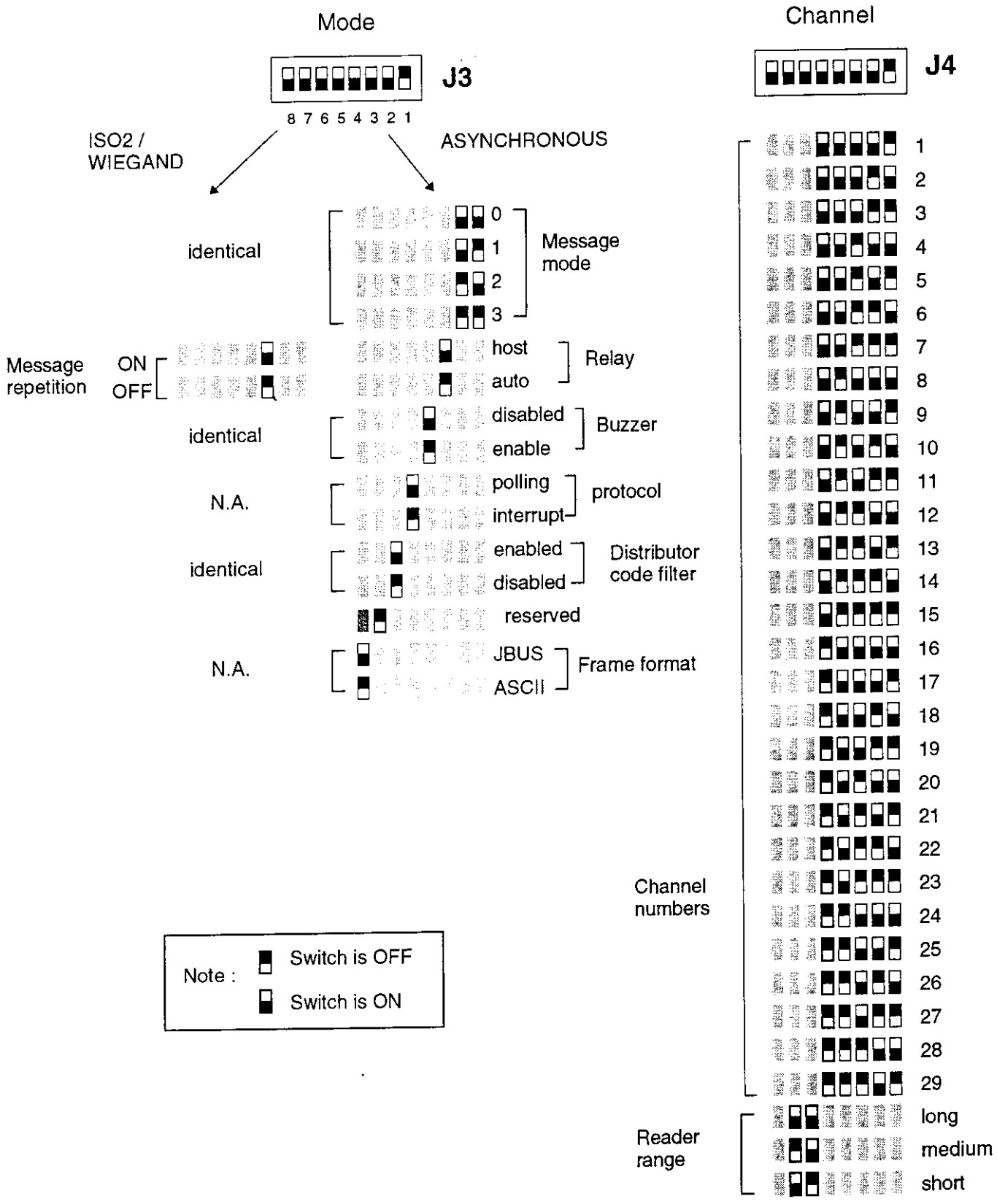
character format
7/even
7/odd
8/none

WIEGAND
ISO2 variable
ISO2 fixed

Hold time
1 s
2 s
5 s
10 s

MTBM
1 s
100 ms
200 ms
500 ms

Note : Switch is OFF
Switch is ON



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	Code Fabricant / Manufact. Code	Numéro / Number	Code Doc / Doc. Code	Tome / Volume	Indice / Revision index	Langue Language	
NON PROTEGE	F0057	46 322 790	104		B	E	49

11. APPENDIX D : DESCRIPTION OF TEST MODE

The information transmitted from the reader to the host normally uses a JBUS frame format.. During system installation, the host computer may not yet be connected or available. For this reason , an ASCII transmission mode exists, allowing the connection of a dumb terminal in order to visualize the messages sent and thus to verify correct system operation. This is called **test** mode and is enabled using a board jumper configuration

This mode has the following characteristics :

- interrupt mode is used (the tag-code is sent immediately)
- tag persistence = 1 second
- frame structure = 24H / status tag / 20H / code / 0DH / 0AH
- transmission characteristics (baud rate and character format) must be configured

Example:

During system installation, the reader is put into test mode. A terminal is connected to the reader via an RS-232 link. Transmission characteristics of reader and terminal are matched, and tags are held in front of antenna. The terminal will display messages of the type :

$0 001ABCDEF-100
$2 XYZHYPER X.007

The messages have the following structure :

$ <status badge>(space) <distributor code> <user code>

where status badge : 0 = antenna 1, tag battery good
1 = antenna 1, tag battery low
2 = antenna 2, tag battery good
3 = antenna 2, tag battery low

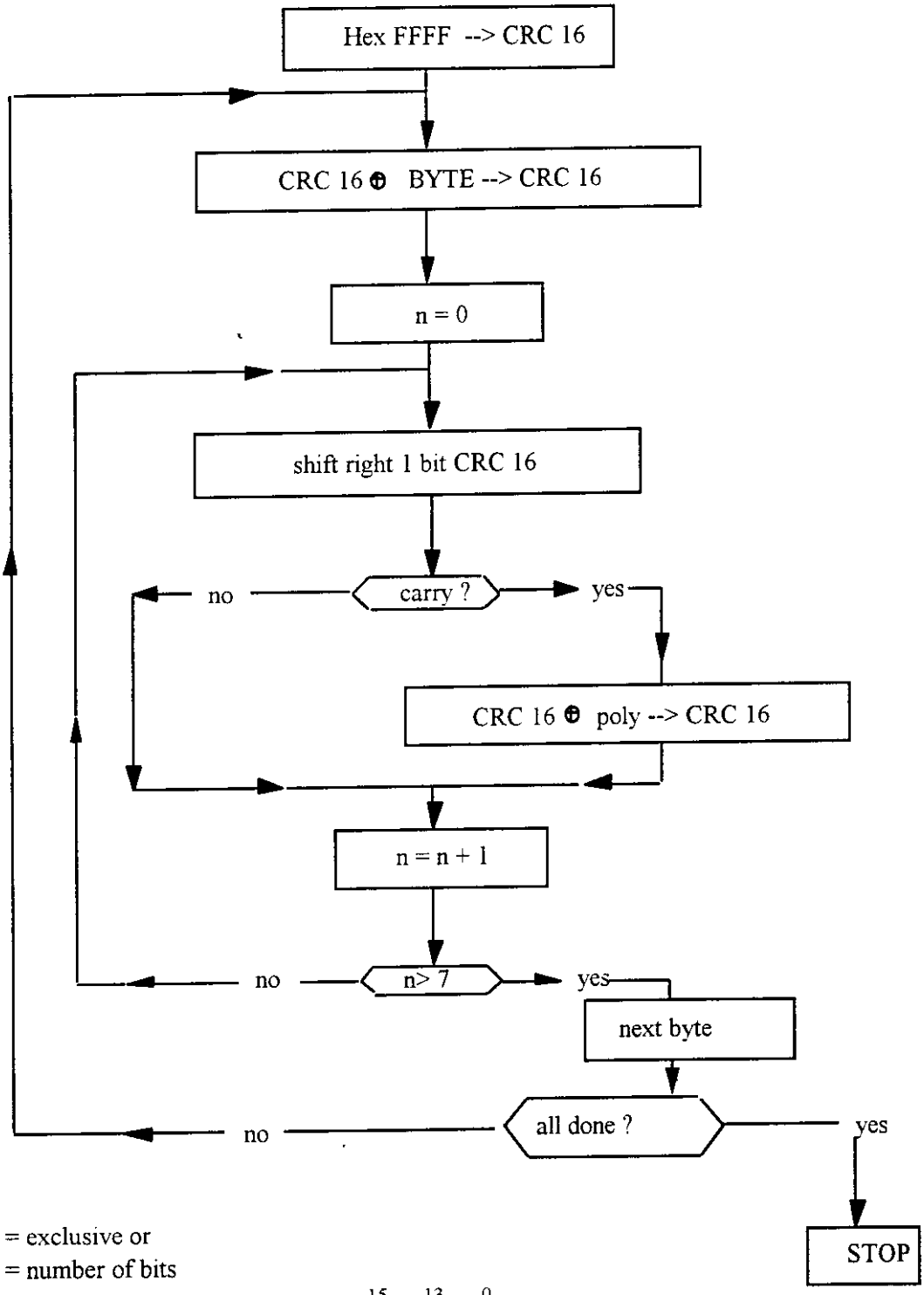
distributor code : nnn where n is a digit (0 à 9)

user code : from 1 to 30 characters, see chapter 6.4.3.

message	antenna	battery	distr. code	user code
0 001ABCDEF-100	1	good	001	ABCDEF-100
2 XYZHYPER X.007	2	good	XYZ	HYPER X.007

12. APPENDIX E : ALGORITHM FOR CALCULATING THE CRC16

It is a 16 bit field. The calculation is performed on all bytes preceding the field.



⊕ = exclusive or

n = number of bits

POLY = polynomial for CRC 16 = $2^{15} + 2^{13} + 2^{0}$

For the 16-bit CRC16, the lsb is transmitted first

13. APPENDIX F : CHANNEL FREQUENCIES FOR COMPACT READER

Channel N°	Frequency (MHz)
1	2448.00
2	2448.25
3	2448.50
4	2448.75
5	2449.00
6	2449.25
7	2449.50
8	2449.75
9	2450.00
10	2450.25
11	2450.50
12	2450.75
13	2451.00
14	2451.25
15	2451.50
16	2451.75
17	2452.00
18	2452.25
19	2452.50
20	2452.75
21	2453.00
22	2453.25
23	2453.50
24	2446.50
25	2446.75
26	2447.00
27	2447.25
28	2447.50
29	2447.75