

CRYPTAG[®]

READER MANUAL

IDENTEC READER TYPES RX1 and RX3

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WARNING NOTICE

This product uses radio frequency signals, and is therefore subject to possible interference. Any application should bear this in mind, and in particular it should not be possible for personal safety to be jeopardised by a failure to read.

This reader neither uses nor generates hazardous voltages. You should not connect any such voltage to it.



This product complies with the following European Community directives

Low Voltage Directive. (73/23/EEC)

EMC Directive. (89/336/EEC)

FCC Regulations

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) this device must not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC GRANT AUTHORISATION: JHD-EPW

CONTENTS

		Page
Chapter 1	Cryptag Readers RX1 and RX3	3
1.1	Introduction	3
1.2	Unpacking	3
1.3	Getting Started	3
Chapter 2	Reader Location	4
Chapter 3	Installation and Commissioning	4
3.1	Tools and materials for installation	4
3.2	Preparation	4
3.3	Connections	4
3.4	Mounting	5
3.5	Commissioning	5
3.6	Warning Labels	6
Chapter 4	Trouble-shooting	7
Chapter 5	Technical	9
5.1	Principles of operation	9
5.2	Reading Range	9
5.3	Dimensions	9
5.4	Environmental	10
5.5	Electrical	10
5.6	Cryptags	11
Figures		
Figure 1	Reader Block Diagram	13
Figure 2	Interfaces	14
Figure 3	Connections etc.	15
Appendix A	Output Formats and Data Connections	16
Appendix B	Power Supplies and Earthing	18
Appendix C	RX3 Look-up Table	21

1. CRYPTAG MULLION READERS RX1 and RX3

1.1 Introduction

Cryptag is a radio frequency tag identification system. Its multiple reading feature means that the reader can simultaneously identify and report one or more tags. RX1 and RX3 Mullion Readers consist of an Aerial Module (common to both types) and an Interrogation Unit.

This combined manual covers the following reader types

RX1 Wiegand Output	RX1 RS232 Output	RX1 Clock/Data Output
RX3 Wiegand Output	RX3 RS232 Output	RX3 Clock/Data Output

RX3 readers contain an internal look-up table which modifies the way in which the tag's identity is reported, whereas RX1 readers report a number which is derived directly from the tag's identity. See Appendix A for details of output formats.

The compact Aerial Module can be mounted on a door mullion. It contains the transmitter and receiver, both of which are controlled by the processor in the Interrogation Unit.

1.2 Unpacking

Check that the package contains

- Interrogation Unit (CM1 or CM3)
- Aerial Module (AM1 with cable attached)
- Magnet (if anti-tamper option fitted)
- Template/Installation Sheet
- Customising Aerial Label

Each pack of up to 5 readers will contain one manual.

1.3 Getting started

(If you are new to Cryptag readers, just follow these simple instructions.)

1. Connect the Aerial Module to the Interrogation Unit. The Aerial Module connections are made to the terminal block at the top of Figure 3.
Connect a 12V power supply to the reader.
The positive connection goes to 12V on the main terminal block (see Figure 3) and the negative connection goes to 0V.
2. Bring a tag near to the Aerial Module.
The reading range should be 22cm (9 inches) or more for a TM1 tag. Note how the range depends on the tag's orientation.
3. LED3 on the Interrogation Unit will blink regularly when a tag is being read. (LED3 is only visible when the cover is removed.)
When no tag is present LED3 may flicker if noise is present. Learn to recognise the difference when a tag is being read.
4. The reader reports a tag only once.
Although a tag is being read continuously, the reader will report it only once. To get another report the tag has to be removed completely first.

2. AERIAL MODULE LOCATION

There are no limitations on the location of the Interrogation Unit

Do not locate a Cryptag reader too close to another reader

If tags can pick up signals from two or more readers they respond to neither. The minimum separation is 1¼ times the combined reading range (i.e. 2½ times the range of two similar readers).

Keep the Aerial Module away from possible interference sources

Interference (also referred to as noise) can reduce the reading range and make reading slower although it is rare with RX1/RX3. Computer monitors can affect performance at up to 0.9m (3ft). Most monitors have less effect, but it does depend on the scan frequency.

When deciding where the reader is to be mounted, bear in mind where tags are to be worn. Think also of people in wheelchairs.

3. INSTALLATION AND COMMISSIONING

3.1 *Tools and materials for installation*

The normal cable is 6-core unscreened, unless another connection option has been selected. (See Appendix B). The Aerial Module is supplied with its cable fitted.

If the Interrogation Unit is to be mounted externally, silicone rubber sealant is required.

3.2 *Preparation*

Open the Interrogation Unit by removing the 4 front screws.
Loosen the terminal blocks

CAUTION

Take care not to move or damage internal components

3.3 *Connections*

3.3.1 Reader connections (see Figure 3)

For most installations using Wiegand format, the connections will be

0V	Power supply –ve (and data reference)
12V	Power supply +ve (10.8V to 14V, 130mA typical)
D0	Wiegand D0 line
D1	Wiegand D1 line
LED	LED control (high or floating for red, low for green)

The HOLD line can be used to buffer the output data, if there is a suitable signal available.

For details of other output formats refer to Appendix A. This includes the relay connections which are only provided on RS232 output readers.

The reader has the option of an isolated output section. For details of how to use this refer to Appendix B.

3.3.2 Aerial Module connections (see Figure 3)

0V	Black
+12V	Red
TX	Brown (or yellow)
RX	Green
LED	White (or blue)

3.4 *Mounting the Interrogation Unit*

3.4.1 Select a convenient position for the Interrogation Unit.

3.4.2 Using the template supplied drill the fixing holes and cable entry hole. The cable entry hole should be 13mm (½ inch) diameter. The holes for the fixings will depend on the surface to which the Unit is to be fixed.

3.4.3 If the Unit has the anti-tamper option fitted, the wall mounting magnet must also be fitted at the location shown on the template.

3.4.4 Run the cable. If there is any possibility of tension on the cable remove the PCB from the back-plate and fit a suitable clamp on the cable, before refitting the board.

3.4.5 Mount the Unit to the wall, bringing the cable through the hole in the Unit.

3.4.6 Connect the cable to the terminal block. The cable should not be accessible to the insecure side.

3.4.7 If the Unit is not to be commissioned immediately replace the cover.

3.5 *Mounting the Aerial Module*

3.5.1 Select a convenient position at a suitable height for the Aerial Module. Bear in mind how Cryptags will be presented.

3.5.2 Using the template supplied drill the fixing holes and cable entry hole. The holes for the fixings will depend on the surface to which the Module is to be mounted.

3.5.3 Run the cable.

3.5.4 Mount the Aerial Module to the wall.

3.5.5 Connect the cable to the Interrogation Unit, as shown on Figure 3.

3.6 **Commissioning**

If any problems are experienced during commissioning, refer to the Trouble-shooting Section (Section 4)

3.6.1 If necessary remove the cover of the Interrogation Unit. Check the following-

Wiring is correct and secure

Links are correctly positioned

LK1 must be in on the RX1/RX3. (Total isolation is not possible.)

If there is no wire to 5V(W) then LK2 should be in. There need be no wire to 0V(W), which is connected to 0V.

If there is a wire to 5V(W) then LK2 should be out.

Potentiometer is fully clockwise.

A range of suitable **Cryptags** is available.

If the anti-tamper option is being used it is best to short the terminals for the time being.

For **RX3** readers, ensure that the **look-up table** has been loaded. (Appendix C.)

3.6.2 Apply power to the system. The red indicator LED on the Aerial Module should come on. Green means that the LED input is being pulled low.

3.6.3 Ensure that there are no Cryptags close to the Aerial Module.

If the internal LED (LED3) is on at all, turn RV3 anticlockwise until LED 3 is permanently off. (If there are no Cryptags present LED 3 will only light if there is external interference. Reducing receiver sensitivity using RV3 will eliminate interference, but it may also affect the range.)

3.6.4 Bring a Cryptag towards the Aerial Module from the front with its face parallel to the Module. When LED 3 starts to blink the Cryptag is being read. This indicates the range of the reader.

3.6.5. Now carry out system checks with the equipment to which the Reader is connected. (In the Fault Finding this is referred to as the controller)

3.6.6 If the anti-tamper option is fitted, remove the shorting links. Check that the circuit is closed when the cover is placed on the Interrogation Unit.

3.6.7 Replace the cover on the Interrogation Unit and fit the 4 screws. If Security Screws are to be used, now is the time to fit them.

If the Interrogation Unit is mounted externally cover the screw heads with silicone rubber sealant. Also use silicone rubber sealant to seal the gap between the Interrogation Unit and the wall, but leave a small section unsealed on the bottom edge to allow for drainage. The Aerial Module is fully sealed and needs no extra protection.

3.6.8 Fit the label to the Aerial Module.

3.7 **Warning Labels**

Each Reader is supplied with a Warning Label which identifies a Cryptag Control Zone and advises against loitering. These labels are particularly recommended for situations where Active Cryptags might be left in the vicinity of a reader.

4. TROUBLE-SHOOTING

Refer to Figure 1 and Figure 3

The equipment to which the reader is connected is referred to here as the controller. The controller is expected to receive the output signal (Wiegand, RS232 or Clock/Data as applicable). It should also control the external LEDs.

The external LED indicators will either indicate red or green. If one goes out the other should come on. It may be possible for them both to appear to be lit, if an a.c. waveform is transmitted.

4.1 **No indicating LED on (both LED1 and LED2 off when power applied)**

Check: 0V is connected to 0V(W), i.e. is LK1 in.

Check: +12V with respect to 0V

If 12V is not present - Check wiring to Reader

If 12V is present – Check wiring between Aerial Module and Interrogation Unit.

Check Visibility of LEDs not affected by bright sunlight

4.2. **LED3 does not come on when Cryptag presented**

Check: RV3 is not fully anti-clockwise. (See commissioning section.)

Check: Wiring between Aerial Module and Interrogation Unit.

4.3 **LED3 permanently flickering**

Reduce the sensitivity by turning RV3 anti-clockwise. If this doesn't work it will be necessary to re-site the Aerial Module.

If LED3 is beating steadily, look for a tag within range of the Aerial Module.

4.4 **LED3 responds to tag but no response by Controller**

Check: Cryptags are valid for this Reader (refer to Appendix A for RX1 and Appendix C for RX3.)

Check: Wiring to Reader and correct if necessary.

Check: Is Hold line high? If it is low (<2.5V) the Reader will not transmit data .

NOTE: The presence of pulses could be tested with a Logic Probe or oscilloscope.

4.5 **Indicating Red/Green LEDs not operating** (always in the same state)

Check: Voltage on LED input (TB2 pin 6 with respect to TB2 pin 9)

If voltage is high (>3V) - red LED should be on

If voltage is low (<1V) - Green LED should be on.

The operation of the LEDs can be checked by removing the connection to the LED input. The red LED should be on. Now short the LED input to 0V(W). The green LED should come on (and the red LED go off).

If the LED is still not responding, check the wiring to the Aerial Module.

4.6 **Range insufficient**

Check: Is the Aerial Module mounted on metal?

If so then range can be improved by lifting the Aerial Module off the metal

Try connecting GND to the metal.

Check: Adjustment of RV3 (See Commissioning Section)

Check: Tag orientation is correct (including rotation in its own plane)

4.7 **Unreliable or Slow Reading**

Check: Adjustment of RV3 (See Commissioning Section)

Try connecting GND to metal.

Check: Tag orientation is correct (including rotation in its own plane)

4.8 **Anti-tamper circuit open circuit.**

Check: Micro-switch is operated when cover put on Reader

Check: Reed Switch is closed. Is the magnet correctly located on the wall behind the reed switch?

5. TECHNICAL

5.1 Principles of operation

The Aerial Module contains a transmitter and a receiver, both under the control of a processor in the Interrogation Unit.

The transmitter sends out signals that will be picked up by any Cryptag in its vicinity. Each Cryptag will respond and a dialogue takes place which identifies the Cryptag. The nature of the dialogue is well disciplined so that more than one Cryptag can be interrogated and correctly read without interaction.

After the interrogation dialogue the Reader communicates the identity of valid tags it has seen. Tag transmissions are buffered.

5.2 Reading Range

The reading range with an active Cryptag (TM1) is 220mm (9 inches). Range quoted is typical under optimum conditions and with the 12V supply at nominal. Normal variation is $\pm 10\%$.

The range at which a Cryptag will be identified is affected by -

Cryptag orientation - Figures quoted assume optimum orientation. Rotating through 45° reduces the range by about 15%. At exactly 90° tags will not be read at all. The optimum orientation varies around the reader.

Electrical interference - The transmission from Cryptag to Reader is at low power and may be affected by sources of electrical interference such as computer monitors.

5.3 Dimensions

	Interrogation Unit	Aerial Module
Height	232mm (9.1 inches)	116mm (4.6 inches)
Width	232mm (9.1 inches)	40mm (1.6 inches)
Depth	39mm (1.5 inches)	17mm (0.7 inches)
Weight	1.3kg (2.9lb)	180g (6.4 ounces)

5.4 Environmental

Temperature -20⁰ to + 60⁰C (-4⁰F to 140⁰F)

Housing Material Glass filled plastic (Flame Retardant) ABS – potted

Mounting Normally vertical on internal or external walls. When used externally the Interrogation Unit should be sealed using silicone rubber as described in the installation section.

5.5 *Electrical*

5.5.1 Power Input 12V nominal (10.5V to 14V)
130mA typical, 155mA maximum including 15mA interface
circuit current.
(Current measured at nominal supply voltage, maximum
transmitter power, no tags present and with the reader on a
non-metallic surface.)
If the reader is mounted on a metal surface, the current
consumption can rise to 160mA maximum.

5.5.2 Outputs (see Figure 2 for interface circuits)

Data Output DATA0 and DATA1 lines. Normally high (+5V), pulsing to
low 0.4V. Format - See Appendix A.
1k ohms pull-up to 5V(W).
In Wiegand and Clock/Data readers the data lines **cannot
handle more than 5mA maximum.**

LED Input impedance 100k ohms pull-up to + 5V(W)
High or floating for RED
Low for GREEN
Nominal switching level 2.5V.

HOLD Input impedance 100k ohms pull-up to 5V(W)
Input capacitance 1nF
High or floating for Data output
Low to freeze data output transmission
Nominal switching level 2.5V

(NOTE. If HOLD goes low during a transmission, that
transmission will continue to completion.)

Data Buffer Up to 10 tags can be stored. This limits the number of tags
that can be identified simultaneously.

Max Voltage The + 5V(W) input must never exceed 6.5V
Other data lines (DATA0, DATA1, LED, HOLD) must not
fall below - 0.3V or above 6.5V.

Protection circuits are incorporated to prevent damage from
transient spikes (above normal EMC limits).

Cable Length Wiegand and Clock/Data - 100m (300 ft) maximum.
(NOTE. Cable length may also be limited by the equipment
at the other end.)

RS232 - 20m (60 ft) maximum (9600 baud)

Output Timing When the Cryptag has been read its identity is stored. The
identity data is buffered to ensure that there is a minimum
inter-burst period between a pair of data transmissions. The

inter-burst time is configurable, and the standard value is 100ms.
(See Appendix A).

Interrogation Time	230ms maximum per Cryptag. This may increase in the presence of interfering signals.
Transmission Time	Nominally 1ms per bit, but can be altered on request. (See Appendix A.)
Pulse Width	Nominally 50 μ s.

5.5.3. Radio Transmissions

Reader to tag	132kHz carrier Magnetic field, <20db μ A/m at 10m
Tag to reader	66kHz (Phase locked to 132kHz) Magnetic field, <-10db μ A/m at 10m.

5.5.4 EMC

Emission	Exempt according to MPT1337 (Dept of Trade and Industry)
Susceptibility	Not affected by 4kV, 150ns pulses (such as defined by IEC Standard 801-4, 1988)

Screened cable is not normally required, but may be used. (Tested without screened cable.)

5.5.5 Anti-Tamper Option

The reader can be supplied with an anti-tamper loop containing a micro-switch to detect cover removal, and a reed switch to detect removal from wall. A magnet is supplied, for wall fixing, to operate the reed switch. Contacts are shorted in the secure state.

5.6 *Cryptags*

Current Cryptag types are:

- TM1 personnel tag
- TA1 article tag
- TK3 keyfob tag (replaceable battery)

All of these are active (battery powered) tags.

All Cryptags have a Public Identity (PID) of 16 bits and a Hidden Identity (HID) which is theoretically 16 bits, but in practice one bit cannot be identified and the useful size is

15 bits. The identity of the Cryptag is a total of 31 bits giving 2 billion possible identities.

Current production tags are programmed by Identec and can be supplied with sequential numbers. Once the identity has been programmed it cannot be altered, and tag identities are not duplicated.

Older (pre 1999) tags had a fixed identity. In order to obtain sequential numbering with older tags it is necessary to use an X3 reader with its look-up table, as described in Appendix C.

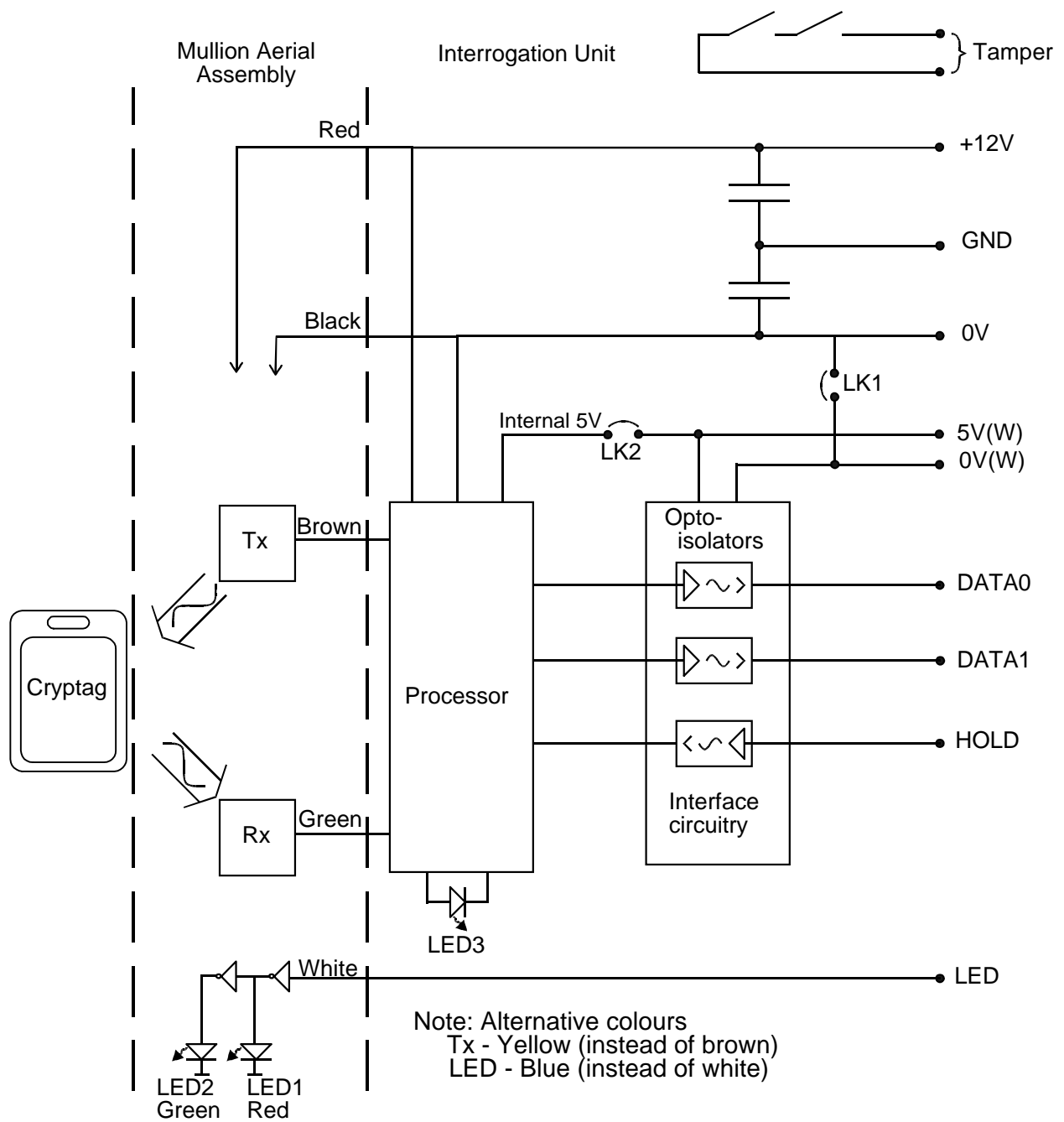
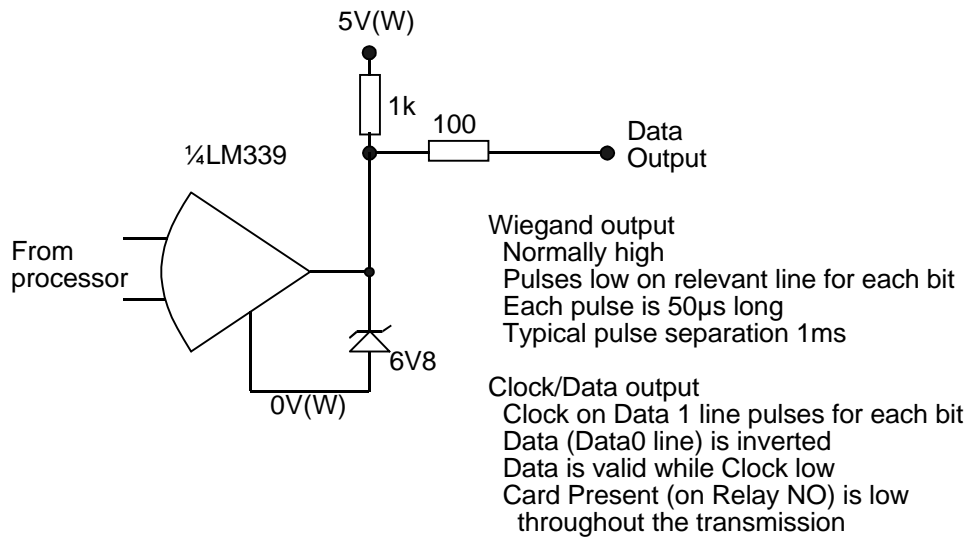


Figure 1: RX1 / RX3 Mullion Reader Block Diagram

Wiegand outputs (also Clock/Data, but not RS232)



LED and Hold inputs

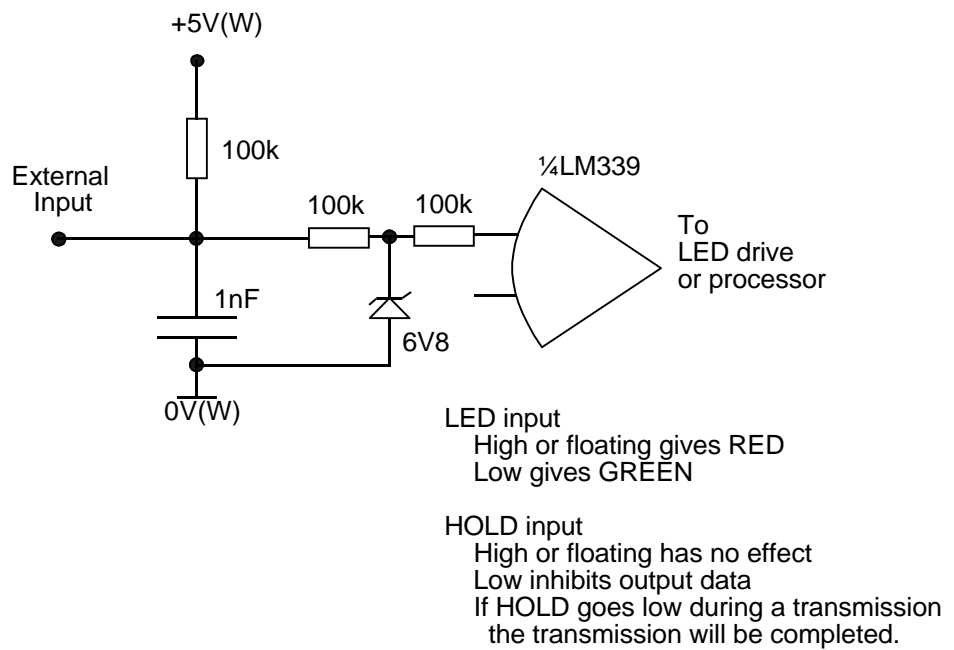


Fig 2: Interfaces

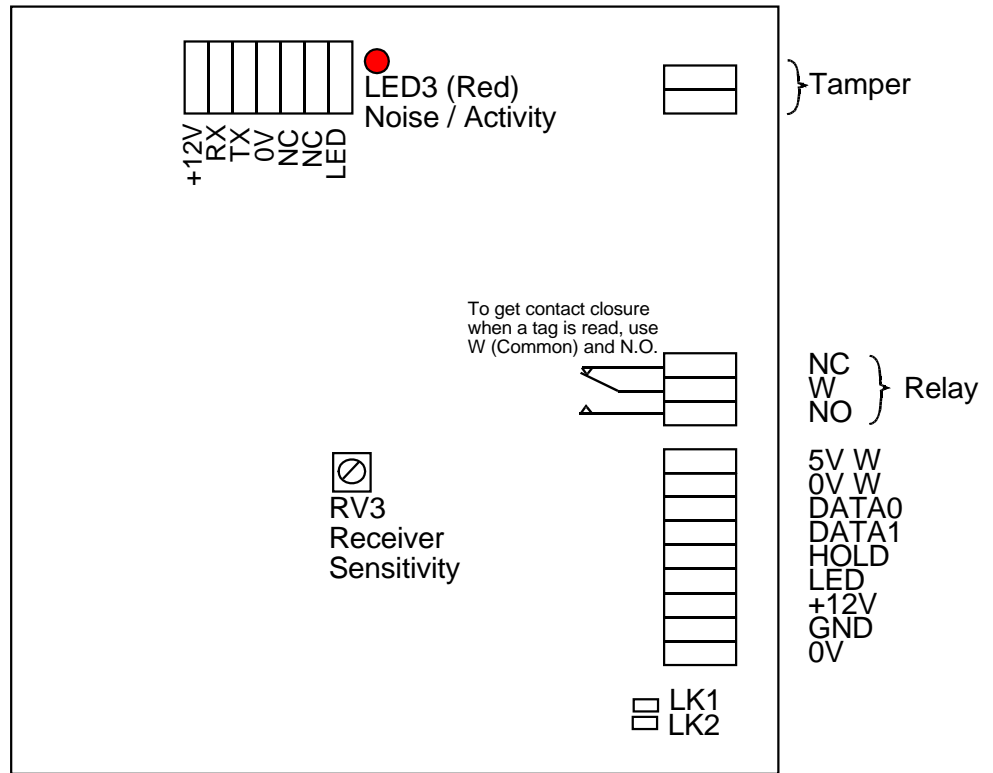
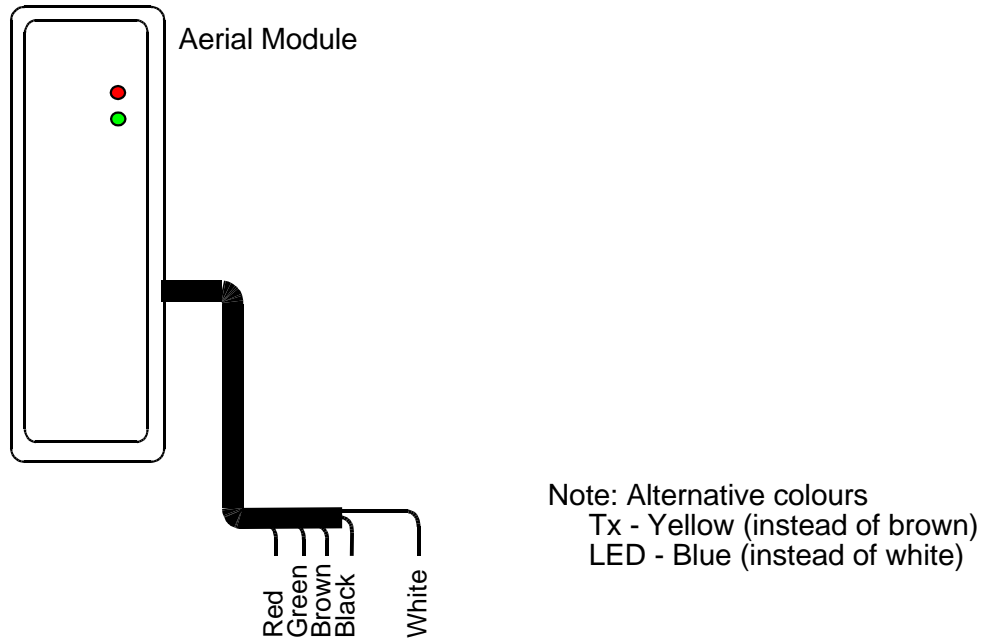


Figure 3: Interrogation Unit Connections etc.

APPENDIX A

Output Formats and Data connections

The output format of the reader is configurable. This appendix gives some typical formats and the terminal connections to use.

A.1 Wiegand output

The number of bits and their allocation is usually customer specific, but some RX1 readers are supplied with a standard 26 bit format.

Output bit	
1	Even parity on Bits 1-13
2-9	Hidden Identity (least significant byte)
10-25	Public Identity
26	Odd parity on Bits 14-26

The most significant part of the Hidden Identity (HID) is ignored. (On some RX1 readers, it will be checked so only tags with some HIDs will be reported.) Tags are reported when they are first seen, and then only if the tag has been out of the field for at least 2 seconds.

Timing 1 ms bit period
 50µs bit low pulse for each bit

Buffering The reader ensures a minimum period (100ms) between transmissions. This ensures that the controller does not confuse the two transmissions.

With current Cryptags the tag numbers are programmed to suit customer requirements. If older tags (pre 1999) are present on the site there is a possibility of numbering problems if the Access Control system is not sufficiently flexible. Two ways to avoid these are

- a) Use RX3 readers, as described in Appendix C.
- b) Make the user number as long as possible (ideally 31bits) and derive the tag number from the tag's identity

$$\text{Tag number} = \text{HID} * 65536 + \text{PID}$$

A.2 RS232 output

The standard output format is 9600 baud, 8 data bits, no parity and one stop bit. The data transmitted is

HID:HHHH PID:PPPPP<LF><CR>

Where HHHH is the Hidden Identity in hexadecimal, and P P P P P is the Public Identity in decimal, <LF> is line feed and <CR> is carriage return.

The RS232 output is on the D0 terminal. The D1 terminal is not used. RS232 readers have a single pole relay fitted, as shown in Figure 3. The HOLD input has no effect on RS232 readers.

A.3 *Clock/Data output*

This format emulates magnetic stripe card readers, and is supplied to conform to specific customer requirements. For details of the encoding format, contact Identec.

Terminals for Clock/Data output readers

D0	Data output (inverted data)
D1	Clock output (Data output is valid while Clock is low)
Relay NC	Card Present (low throughout data transmission)

APPENDIX B

Power Supplies and Earthing

This Appendix explains the options available, when they should be used, and how to implement them. Note that RX1/RX3 cannot be used with totally isolated outputs.

B.1 Circuitry

Refer to Figure 1 (Block Diagram).

The reader has two sets of Circuitry, which are electrically isolated using opto-isolators.

Reader Electronics -	Connected to 0V +12V
Output Interface -	Connected to 0V(W) +5V(W)

The ground connection (GND) is connected via 1nF capacitors to 0V and +12V.

The other connections (DATA 0, DATA 1, LED, and HOLD) are connected to the Interface Circuitry, and must be referenced to 0V(W)

The Reader electronics contain a 5V regulator. This can also be used to supply the Interface Circuitry

There are two links related to the power supplies -

LK1 connects 0V and 0V(W), and must be in on RX1/RX3.

LK2 connects 5V(W) to the Reader's own 5V

B.2 Normal Arrangement (Interface powered internally)

In this arrangement the external connections are -

0V	LK1 In
+12V	LK2 In
DATA 0	
DATA 1	
LED	
HOLD	

0V and 0V(W) are connected by LK1

5V and 5V(W) are connected by LK2

All outputs are referenced to 0V (and to 0V(W)).

This arrangement will be used when the Controller (the unit to which the Reader is connected) can provide a 12V supply with sufficient current.

The 12V supply must be capable of supplying 155mA. If the Reader is mounted on metal the current can rise to 160mA.

B.3. *Separate 12V supply (non-isolated, with interface powered externally)*

This arrangement is used when the controller cannot provide the required 12V power and an external supply is used. The 12V supply must not be grounded except through the Reader.

Connections are -

0V	LK1 In
+12V	LK2 Out
+5V (W)	
DATA 0	
DATA 1	
LED	
HOLD	

0V and 0V(W) are connected by LK1. It is best to use the 0V connection. 5V(W) is supplied separately by the controller so LK2 is out.

The outputs are referenced to 0V (and to 0V(W)).

The 12V supply must be capable of supplying 140mA. If the Reader is mounted on metal the current can rise to 145mA.

The 5V Interface Circuitry supply current (taken from the controller) will be 15mA.

B.4. *Ground*

The GND connection can be connected to local metal objects. This is unlikely to make much difference on RX1/RX3.

APPENDIX C

RX3 Look-up Table

This section applies to RX3 readers only. RX1 readers report the tag's identity number.

C.1 Introduction

Cryptags have a unique identity number. In current production Cryptags this is programmed into tags before they are shipped, but in earlier (pre 1999) Cryptags the number was put in at an earlier stage. This meant that it was not possible to supply tags with particular numbers. Many Access Control systems do not have the flexibility to handle what are effectively random numbers, and the RX3 reader was introduced to provide sufficient flexibility for those applications.

The RX3 reader contains a look-up table in non-volatile memory. This stores the identities of tags which are valid for that site, together with the number that is to be reported for that tag. The numbers are reported as a Site Code (fixed for the site) and a User Number which is normally sequential.

The look-up table can be programmed into the RX3 reader in two different ways.

1. using ENCODER STATION LE1
2. using MASTER TAG MT1

Normally readers are configured initially using an LE1 Encoder Station, and the MT1 is a portable "encoder" used for updating installed readers.

C.2 Operation of Encoder LE1 (for full instructions see LE1 Operational Manual)

The LE1 Encoder is used before a batch of tags and RX3 readers is shipped. The tags within the shipment are loaded into the encoder. Each tag is then given a small label which identifies its User Number.

The look-up table is downloaded into each of the readers for that shipment. Only readers that have the correct look-up table downloaded into them will report the tags correctly.

The look-up table can also be downloaded into an MT1 Master Tag. The look-up table can then be downloaded into existing readers on site.

C.3 Operation of Master Tag MT1

The MT1 Master Tag is most commonly used to upgrade an existing installation, for instance to add more tags. This will only work if the MT1 Master Tag is correctly programmed for that reader, so that a Master Tag is site specific. It is not necessary to remove the Interrogation Unit's cover before using the Master Tag..

Master Tag Operations during upload

	Master Tag indications	
	RED	GREEN
Initially	OFF	OFF
Present in field, power up and data integrity test	ON	ON
Test Passed	OFF	ON for 5 seconds maximum If this state persists the Site Code is incorrect. Contact Identec.
Loading	OFF	Flashing (on & off equal times)
Load Finished	OFF	Flashing (on 3 times more than off) (Continued for 10 seconds after leaving field)
Red Led – Error message	RED	GREEN
Power up test failed	ON	OFF
Battery Low	ON	Flashing (on & off equal times)
Loading (Bad Frames)	ON OFF (Alternating)	OFF ON
Load Failed	FLASHING (on 3 times longer than off)	OFF

Power Up Test Failed

Remove Master Tag from field and wait till no LEDs are on.
Reintroduce to field

If it fails again try a different Reader. Failure again means:-

- a) Wrong Master Tag
- b) Fault in Master Tag
- c) Very low battery
- d) Reader transmit power set close to minimum

Battery Low

OK for one reader upload but replace battery before next reader. Disconnecting the battery will not affect the stored data.

Bad Frame

This is OK but not recommended. Your master Tag will keep trying if it loads a bad frame. The more red light you see in general the harder it is finding it to upload so try a different position of the Master Tag relative to the Reader.

Load failed

Try again after removing the tag from the field.

Try a different Reader to see if the fault is in the Tag or the Reader

Report any difficulty to your supplier

C.4 Example of Look Up Table.

Tag number		User number
HID (Hexadecimal)	PID (Decimal)	(Decimal)
000D	00100	0001
0AAF	64436	0002
BDCE	37000	0003
000A	00010	0004
0A01	01952	0005
881F	26534	0006
6654	32212	0007
1010	11414	0008
		0009

Next Tag will be 0009