# 5270/5280/5288/5311/5312
# Reader Handbook

## HB02/62 Iss 3C

**Applicability**

This handbook applies to the 5270 Loop Reader,
the 5280 and 5280-C5 Hands Free Readers,
the 5288 Reader and PINpad,
the 5311 and 5311-C5 Reader Interfaces
and the 5312 Reader Interface PCB.

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**NOTE: This equipment has been tested and found to comply with the limits for a Class B 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 this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment 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.**
- **Increase the separation between the equipment and the 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/TV technician for help.**

## Safety

This equipment must be powered by a supply which is suitably insulated from the mains. The supply should be classed as SELV under the terms of IEC950.

The power supply must be connected to safety earth. A mains isolation switch should be provided by the installer. Any third party equipment connected must also be suitably insulated from the mains supply.

Any fuses which are replaced must be of the recommended rating and type.

Wiring connected by the installer must be adequate. The use of inadequate wiring may present a fire hazard.

Except where specified the equipment is not suitable for outside use.

Except where specified this equipment is not for use in safety critical applications.

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**Chapter 3 Setting up**



**Chapter 4 Data interfaces**

Chapter 1

# Introduction

These Readers and Reader Interfaces are designed to read the codes contained in Cotag coded cards and tags and to pass these codes, if valid, to a host system. They are primarily for use by OEMs to provide hands free reading for their own proprietary access control systems.

## Models

There are five different models available specified by the following model numbers:

- 5280 Hands Free Reader
- 5288 Reader and PINpad
- 5270 Loop Reader
- 5311 Reader Interface
- 5312 Reader Interface Board

The **5280 Hands Free Reader** consists of a printed circuit assembly mounted inside a 280 Reading Head which reads a card or tag. Its advantages over a separate Reader Interface and Reading Head are reduced cost, less cabling and easier installation. It requires a power supply near the door, but can usually share the same supply as the door lock. (Also available as 5280-C5 with 24V power supply adapter board fitted.)

The **5288 Reader and PINpad** is a 5280 Hands Free Reader with a PINpad mounted on the face of the reading head. Each time a key on the PINpad is pressed, the Reader sends data to the host system.

The **5270 Loop Reader** consists of two printed circuit assemblies mounted in a plastic case, one of which is a Reader Interface and the other the circuit board from a Loop Coupler. It needs only to be connected to the loop antenna which reads a card or tag. Its advantages over a separate Reader Interface and Loop Coupler are reduced cost, less cabling and easier installation. It requires a power supply near the door, but can usually share the same supply as the door lock. It must be installed within 10 metres of the loop antenna, and, unlike the Loop Coupler, it cannot be mounted outside.

The **5311 Reader Interface** consists of a printed circuit assembly mounted in a plastic case. It drives a reading head or loop antenna which detects the presence of a card or tag. (Also available as 5311-C5 with 24V power supply adapter board fitted.)

The **5312** is the **printed circuit board** from the 5311 and can be used by OEMs who want to incorporate the hands free reading technology in their own enclosures.

# Data output

All five models provide Wiegand or Magnetic Stripe or ASCII format data output, but PINpad data is not transmitted if the Reader is configured to use a Magnetic Stripe data output. The ASCII output is provided at TTL voltage levels: 0 and +5V, but can be converted using the 5810 RS232 Converter to true RS232 voltage levels.

For some OEM systems, the data lines from two Readers can be connected in parallel, the host polling each Reader in turn using the Data Hold input. When this input is held low, the Reader buffers the data from one transaction for 5 seconds. The host must release the Data Hold line and read the message before the next card is read, or else the message is discarded by the Reader.

# Interrogation of cards and tags

Readers and Reader Interfaces have “noise sensitive” interrogation which switches from “standard” to “vehicle” interrogation automatically when the conditions become too noisy to read cards and tags successfully. Standard interrogation reads the card code just once and outputs the data in a little under half a second. Vehicle interrogation is designed to cope with the high levels of electrical noise often found in vehicle applications. It reads the card code at least twice (possibly more in noisy conditions) and therefore takes longer to output the data.

The interrogation routine checks both the Distributor Code and the Secondary Code of a card or tag and sends data to the host system only if both are valid.

# Setting up the Reader

There are no rotary switches or jumpers on the Reader's circuit board. Instead, you put the Reader into a "configuration mode" and then teach it by presenting one, or sometimes two, coded cards to the antenna.

One card teaches the Reader its Distributor and Secondary Codes. The second configures the type of data interface, and various other features* when anything other than the factory settings are needed. **It is most important that you read and understand chapter 3 of this handbook before you attempt to install a Reader**.

*All the features which can be set using the configuration card are listed on the first page of chapter 3.

# Testing the Reader

If you install a Reader and it does not work correctly, you can put it into a "test mode" which enables you to check the wiring, the data output drivers, data hold input, and the reading range. If you use a 922 Test Card you can see if there is a problem with transmit or receive range, see the end of chapter 2.

Chapter 2

# Installing and connecting

## Earthing

Note: this section applies to all Readers. You must read this section and make a decision on how to earth the equipment based on the advice given below and the regulations which apply in your country.

| Reader | Function |
|---|---|
| E | Earth connection (link to 0V terminal) |

We recommend that you always connect the earth terminal labelled E to the 0V terminal using a short piece of wire of minimum cross sectional area 0.38mm$^2$ (22 AWG). We do not recommend that this terminal is connected to a local earth due to the possibility of varying earth potential causing damage by flowing through the signal and power supply wires. The power supplies used with the Reader should either be earthed at the host or should be double insulated. The installer needs to be aware of the wiring regulations which vary by country and application, and which may insist on local earthing. Do not remove link LK1 from the board.

Cotag guarantees that its designs are safe; however the safety of the installation is the responsibility of the installer. Cabling and protection devices should be provided as required to ensure that the current carrying capacity is adequate, there is no danger of shock to personnel, and where required there is protection against the effect of a lightning strike.

## Installing the different Reader types

The 5280 Hands Free Reader and 5288 Reader and PINpad consist of a printed circuit assembly mounted inside a 280 Reading Head. Their installation is identical to that of a 280 Reading Head, but they need different connections: 12V DC power supply (24V DC on 5280-C5) and data lines to host.

- If you are installing a 5280 or 5288 then see the section entitled “Installing the 5280 and 5288 Readers” below.

The 5270 Loop Reader consists of two printed circuit assemblies mounted inside a plastic box. It must be connected to a loop antenna, a 12V DC power supply and data lines to host. The Reader must be

tuned to match the characteristics of the loop antenna using switches on the upper circuit board.

- If you are installing a 5270 then turn to the section entitled “Installing the 5270 Loop Reader”.

The 5311 Reader Interface consists of a 5312 printed circuit board mounted inside a plastic box. It must be connected to an antenna (a 280 or 090 Reading Head, or a loop via a 270 Loop Coupler), a 12V DC power supply (24V DC on 5311-C5) and data lines to host.

- If you are installing a 5311 (or 5312) then turn to the section entitled “Installing the 5311 Reader Interface”.

# Installing the 5280 and 5288 Readers

## Removing the cover

The 5280 and 5288 Readers are supplied with the cover separate. The cover of the 5288 Reader contains the PINpad and is attached to the Reader by a short ribbon cable - be careful not to break it. If the cover has been fitted for any reason, remove it by holding the Reader in your hand and pushing two of the lugs from the back using the end of a Cover Removal Tool (part number D02/445) or a suitable screwdriver. The lugs can be found in the four rectangular cut-outs around the edge of the back of the 5280 Reader. They are coloured light grey in contrast to the dark grey of the rear case. When two lugs are free, prise off the other side of the cover using your fingers under its edge.

(The bent end of the Cover Removal Tool enables removal of the cover when the Reader is fixed to a wall. Place the end between the wall and the fixing lug, and lever out the lug. To avoid damage to delicate wall surfaces use a piece of card between the tool and the wall.)

## Mounting and connecting

1. Choose a suitable position to mount the 5280/5288 Reader near the door.

   If people wear their cards at the hip, mount the Reader at a height of 90cm from the floor to the centre of the Reader.

   If people wear their cards at the lapel or breast pocket, mount it at a height of 120cm from the floor to the centre of the Reader.

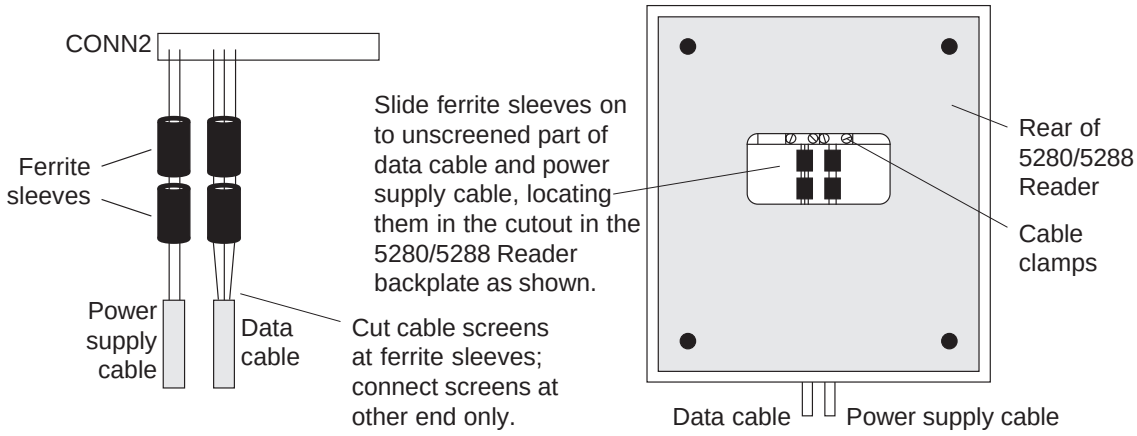
   If people do not wear their cards in a consistent place then mounting the Reader at a height of 110cm is a good compromise.

2. The Reader should be mounted with the LEDs at the top. Mark out and drill the four mounting holes. Don't fix the Reader to the wall yet. The holes accept 4mm machine screws or No 10 wood screws.

3. The connections required for the 5280/5288 Reader are power supply connections (0V and VIN +12V DC on 5280/5288, GND and IN +24V DC on 5280-C5), data output connections for Wiegand or Magnetic Stripe or ASCII, and a connection from the host to the Data Hold input if data lines from two Readers are to be connected in parallel.

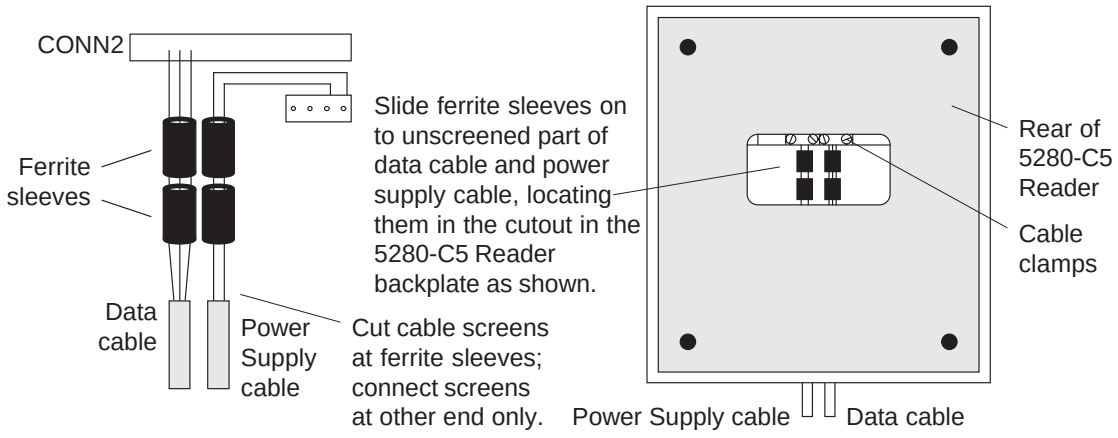
   Note: to comply with European EMC and American FCC regulations, the four ferrite sleeves (Q124) supplied with the 5280/5288 Reader must be fitted around both the power supply and the data cables as shown in the following diagram.

**Figure 2-1a Fitting ferrite sleeves to 5280 and 5288**




The 5280-C5 Reader has a separate 24V power supply adapter board fitted. The four ferrite sleeves (Q124) supplied with the 5280-C5 Reader must be fitted around both the power supply and the data cables as shown in the following diagram.

**Figure 2-1b Fitting ferrite sleeves to 5280-C5**



Route the cables into the Reader through the holes provided in the bottom or rear. There are also two knock-out panels in the moulding if you prefer to route the cables in through the side.

4. Pass the cables through the ferrite sleeves and the cable clamps in the Reader and make the connections to CONN2 on the circuit board shown in the following table. (See second table below for power supply connections to 5280-C5 Reader.)

| Reader | Function |
|---|---|
| 0V | Power supply 0V (-ve),<br>(also ground reference for data output) |
| VIN | Power supply +12V unregulated<br>(max 15.6V, min 10.7V, 0.5A max) |
| E | Earth - read the section on “Earthing” at the beginning of this chapter |
| D0 | “Data Zero” for Wiegand<br>“Data” for Mag Stripe<br>“TXD” for ASCII |
| D1 | “Data One” for Wiegand<br>“Strobe” for Mag Stripe |
| DA | “Data Available” for Wiegand<br>“Present” for Mag Stripe<br>“RTS” for ASCII |
| $\overline{H}$ | “Data Hold” for Wiegand and Mag Stripe<br>“CTS” for ASCII |

If you connect the power the wrong way round, the circuit is protected by a self-resetting fuse (which will be hot to touch!).

On the 5280-C5 Reader, make the power supply connections to the connector on the power supply adapter board as shown in the following table. (All other connections are to CONN2 on the Reader circuit board as shown in the table above.)

| Power Supply Adapter Board | Function |
|---|---|
| IN | Power supply +24V unregulated (input to power supply adapter board)<br>(max 35.0V, min 10.7V, 7W max) |
| GND | Power supply 0V (-ve) |
| GND | Should be linked to 0V on CONN2 on the Reader circuit board |
| OUT | 12V out from power supply adapter board<br>- should be linked to VIN on CONN2 on the Reader circuit board |

For details of connections to the host system (Wiegand, Magnetic Stripe or ASCII), see chapter 4, “Interfaces”.

The red and green LEDs are either driven internally by the Reader or they can be driven externally by pulling the R and G terminals of CONN2 down to 0V to light the corresponding LED (red or green). A single wire control to operate both red

and green LEDs is also available, either at 0V/+10V levels or at logic levels (0V/+5V) using the Data Hold input. See chapter 3, “Setting up” for details of how to configure the LED drives.

5. Screw the Reader in position on the wall, taking care not to damage the antenna coils. **Do <u>not</u> fit the front cover to the Reader until you have configured it and tested it**.

## Configuring

The Reader must be in configuration mode (switch 1 up/ON and switch 2 down on the DIL switch in the middle of the board) - the horn bleeps and the green MODE LED flashes at one second intervals.

- To teach the Reader its Distributor and Secondary Codes, present any of the normal programmed cards which will be used with the system. The horn bleeps and the MODE LED lights for two seconds when the card is read successfully.

- If you need to change the factory settings for data interface, or tag type, or interrogation mode, or LED control, or hold-off time, or repeat data delay, present the programmed configuration card. The horn bleeps and the MODE LED lights for two seconds when the card is read successfully. For details of how to program a configuration card, see chapter 3, “Setting up”.

- When you have configured the Reader, return switch 1 on the DIL switch labelled CONF down/OFF.

## Testing

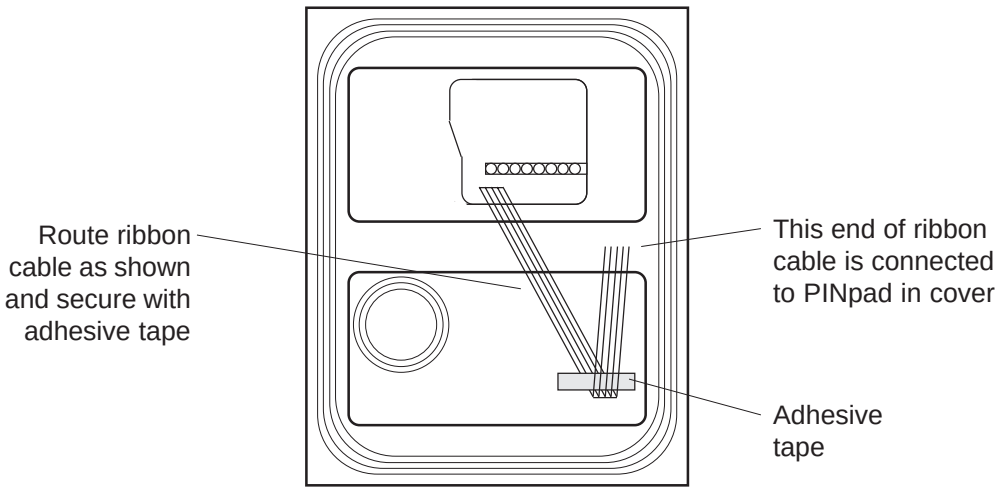
There is a test mode on the Reader (switches 1 and 2 on the DIL switch both up/ON) which makes the horn bleep and the MODE LED light when it reads any card.

If your 5280 or 5288 Reader is not working correctly, you can test it as described in the section entitled “Testing the Reader” at the end of this chapter.

## Fitting the front cover

After you have configured and tested the Reader you can fit the front cover by pressing it until it snaps into place. On the 5288 Reader you need to route the ribbon cable so that it is not pinched between the cover and the Reader. It is best to lay it flat as shown in the diagram below and fix it with adhesive tape so that it doesn’t move while you are fitting the cover.

**Figure 2-2 Routing the ribbon cable when fitting cover to 5288 Reader & PINpad**




# Installing the 5270 Loop Reader

## Removing the cover

If the cover is fitted to the 5270 Loop Reader, you can remove it by holding the sides and pulling it off.

## Mounting

The 5270 Loop Reader has four mounting holes in the rear of the case. The Reader must not be mounted in direct sunlight. You can mount the Reader in any orientation to suit the direction you want the cables to enter the case. The lid can be fitted either way up. Avoid mounting Readers side by side if you intend to configure them by holding a card over each circuit board.

Mark out and drill four mounting holes for the base and screw it in position on the wall, checking that the cable entry point is accessible. External connections are made to the 5270 Loop Reader via cables which can enter through two cable glands on the case.

## Connecting

Connections to the loop antenna are made to TB1 (labelled TX Loop) on the uppermost circuit board. Connections to power supply, host and indicator LEDs are made to CONN2 on the lower circuit board.

## Loop antenna

Connect a combined transmit and receive loop antenna between the connections labelled TB1-B and TB1-R.

If you are installing separate transmit and receive loops, set switches 4 and 5 of DIL switch SWA on the upper circuit board to OFF and connect the transmit loop antenna between the connections labelled TB1-B and TB1-R and connect the receive loop antenna between the connections labelled TB2-B and TB2-R.

The cable can be any single core multi-strand cable with 18AWG (32/0.2mm) conductor or bigger.

For full details of installing and testing loop antennas, see chapter 6.

## Indicator LEDs

Unlike reading heads, loop antennas have no LED indicators to show the cardholder when the door is unlocked. The 272 Remote Indicator provides red, amber and green LEDs for use with loop antennas. It should be mounted where it can be seen by people as they walk up to the loop antenna. Connect CONN2 on the lower circuit board to the 272 Remote Indicator as follows:

| Reader | 272RI | Function |
|---|---|---|
| R | terminal 2 | red LED (-) |
| G | terminal 4 | green LED (-) |
| A | terminal 3 | amber LED (-) |
| VA | terminal 1 | LEDs common anode (+) |

The red and green LEDs are either driven internally by the Reader or they can be driven externally by pulling the R and G terminals of CONN2 down to 0V to light the corresponding LED (red or green). A single wire control to operate both red and green LEDs is also available, either at 0V/+10V levels or at logic levels (0V/+5V) using the Data Hold input. See chapter 3, “Setting up” for details of how to configure the LED drives.

## Power supply

The power supply connections to the 5270 Loop Reader are made to CONN2 on the lower circuit board as follows:

| Reader | Function |
|---|---|
| 0V | Power supply 0V (-ve) |
| VIN | Power supply +12V unregulated<br>(max 15.6V, min 10.7V, 0.5A max) |

The power supply you use must be able to provide 500mA DC continuous at 12V (+25% -10%). It is recommended that you use a

linear power supply (as opposed to a switch-mode power supply) to cut down on noise which might otherwise reduce the reading range. The power supply can be unregulated but must be smoothed. The voltage must be within the range 10.7V to 15.6V at all times under all load conditions.

If you connect the power the wrong way round, the circuit is protected by a self-resetting fuse (which will be hot to touch!).

## Earthing

Read the section on "Earthing" at the beginning of this chapter and make the correct earth connections for your installation and your country's regulations.

## Host system

Connect the data interface to CONN2 on the lower circuit board as follows:

### Wiegand

| | |
|---|---|
| D0 | Data zero |
| D1 | Data one |
| 0V | Signal ground |

### Magnetic Stripe

| | |
|---|---|
| D0 | Data |
| D1 | Strobe |
| DA | Present |
| 0V | Signal ground |

**ASCII TTL** (0V/+5V levels)

| | |
|---|---|
| D0 | TXD |
| DA | RTS |
| $\overline{H}$ | CTS |
| 0V | Signal ground |

(For ASCII output at RS232 levels, use the 5810 RS232 Converter.)

## Configuring

The Reader must be in configuration mode (switch 1 up/ON, switch 2 down on the DIL switch labelled CONF on the lower circuit board) - the green MODE LED flashes at one second intervals.

- To teach the Reader its Distributor and Secondary Codes, present any of the normal programmed cards which will be used with the system. The MODE LED lights for two seconds when the card is read successfully. (You may be able to get the card to read by holding it over the circuit board.)

- If you need to change the factory settings for data interface, or tag type, or interrogation mode, or LED control, or hold-off time, or repeat data delay, present the programmed configuration card. The MODE LED lights for two seconds when the card is read successfully. For details of how to program a configuration card, see chapter 3.

- When you have configured the Reader, return switch 1 on the DIL switch labelled CONF down/OFF.

## Testing

There is a test mode on the Reader (switches 1 and 2 on the DIL switch labelled CONF both up/ON) which makes the MODE LED light when it reads any card.

If your 5270 Loop Reader is not working correctly, you can test it as described in the section entitled “Testing the Reader” at the end of this chapter.

For full details of installing and testing loop antennas, see chapter 6.

# Installing the 5311 Reader Interface

## Removing the cover

If the cover is fitted to the 5311 Reader Interface, you can remove it by squeezing the sides and pulling it off.

## Mounting

1. The 5311 Reader Interface has two keyhole mounting points in the rear of the case and also has four mounting holes, one in each corner. These mountings are all blanked off. Choose the

ones you want to use and cut away the thin plastic to open them up.

2. Choose a wall which is **inside** the area protected by the system, that is, you have to pass through the secure door to gain access to the Reader Interface. You should also ensure that the area containing the Reader Interface is accessible by a door with a normal lock and key in the event of system failure. The Reader Interface must not be mounted in direct sunlight. You can mount the Reader Interface in any orientation to suit the direction you want the cables to enter the case. The lid fits either way up.

3. Mark out and drill the mounting holes for the base and screw it in position on the wall, checking that the cable entry point is accessible. Cables enter the 5311 Reader Interface through two glands on one face of the case.

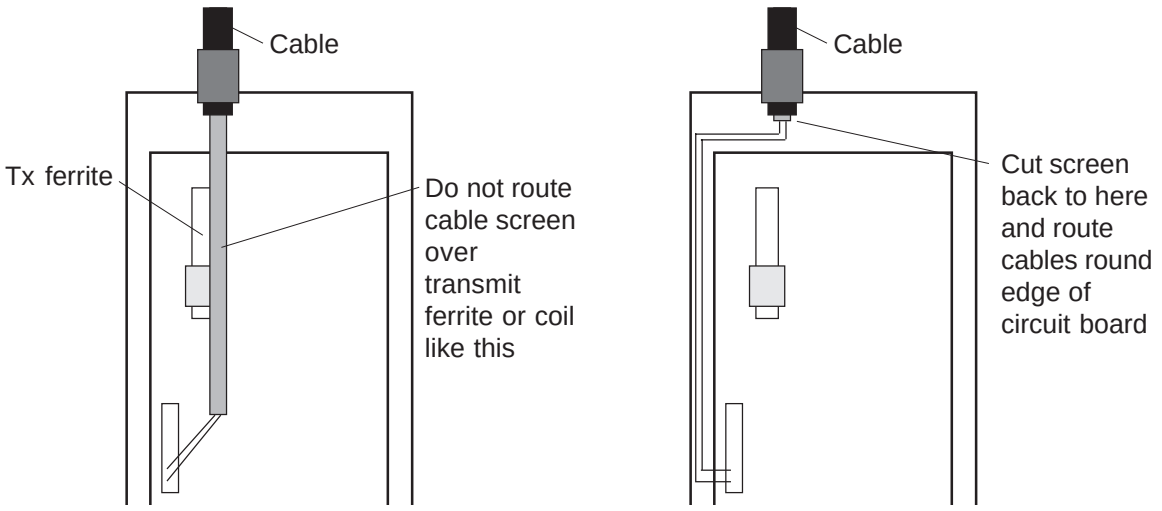
## Connecting

Connections to antennas (reading head or loop coupler) are made to CONN1. Connections to power supply, mains earth, host and reading head LEDs are made to CONN2.

### Cable routing

You must not route screened (shielded) cable over the transmit ferrite or coil on the circuit board as shown in the left diagram below. Cut the screen back to the cable clamp and route the conductors around the edge of the circuit board as shown in the diagram on the right.

**Figure 2-3 Routing the cable away from the Tx ferrite**



## 280 Reading Head

The table below lists connections to the 280 Reading Head. It shows the pins on CONN1 and CONN2 (the connectors on the 5311 Reader Interface circuit board) which should be connected to the pins on TB1 (the connector on the 280 Reading Head).

| 5311 | 280RH | Function |
|---|---|---|
| $\overline{\text{RX}}$ | TB1-6 | Receive line |
| RX | TB1-7 | Receive line |
| SCR | - | Rx cable screen - connect to 5311 only |
| SCR | - | Tx cable screen - connect to 5311 only |
| $\overline{\text{TX}}$ | TB1-8 | Transmit line |
| TX | TB1-9 | Transmit line |
| R | TB1-3 | Red LED cathode (-ve) |
| G | TB1-5 | Green LED cathode (-ve) |
| A | TB1-4 | Amber LED cathode (-ve) |
|  | TB1-1 | Horn (-ve) |
| VA | TB1 - 2 | LEDs common anode, horn (+ve) |

Note: the polarity of the two transmit lines and the two receive lines does not matter.

The Tx and Rx lines must be connected using individually screened twisted pair cables. For distances up to 200 metres you can use 812 Cable, or cable with 0.38mm$^2$ (22AWG) conductors (for example Belden 8723 or equivalent for twin twisted pair). For distances between 200 and 300 metres you must either use 812 Cable, or cable with 0.5mm$^2$ (20AWG, 16/0.2) conductors (for example Belden 9402 or equivalent for twin twisted pair). The maximum distance between the Reader Interface and the reading head is 300 metres using either 812 Cable or 20AWG screened twisted pairs. Any suitable 5-core cable can be used for the LEDs and horn.

## 090 Reading Head

The table below lists connections from the 5311 Reader Interface to the 090 Reading Head.

| 5311 | 090RH | Function |
|---|---|---|
| $\overline{\text{RX}}$ | terminal 6 | Receive line |
| RX | terminal 7 | Receive line |
| SCR | - | Rx cable screen - connect to 5311 only |
| SCR | - | Tx cable screen - connect to 5311 only |
| $\overline{\text{TX}}$ | terminal 1 | Transmit line |
| TX | terminal 2 | Transmit line |
| R | terminal 4 | red LED cathode (-ve) |
| G | terminal 5 | green LED cathode (-ve) |
| VA | terminal 3 | LEDs common anode (+ve) |

Note: the polarity of the two transmit lines and the two receive lines does not matter.

The Tx and Rx cable specification is the same as for the 280 given above. Any suitable 3-core cable can be used for the LEDs.

## Loop antenna

The table below lists connections from the 5311 Reader Interface to the 270 Loop Coupler.

| 5311 | 270LC | Function |
|---|---|---|
| $\overline{RX}$ | TB3-B | Receive line |
| RX | TB3-R | Receive line |
| SCR | - | Rx cable screen - connect to 5311 only |
| SCR | - | Tx cable screen - connect to 5311 only |
| $\overline{TX}$ | TB4-B | Transmit line |
| TX | TB4-R | Transmit line |

Note: the polarity of the two transmit lines and the two receive lines does not matter. The Tx and Rx cable specification is the same as for the 280 given above.

Unlike reading heads, loop antennas have no LED indicators to show the cardholder when the door is unlocked. The 272 Remote Indicator provides red, amber and green LEDs for use with loop antennas (or hidden 280 Reading Heads). It should be mounted where it can be seen by people as they walk up to the loop antenna.

The connections to the 272 Remote Indicator are as follows:

| Reader | 272RI | Function |
|---|---|---|
| R | terminal 2 | red LED (-) |
| G | terminal 4 | green LED (-) |
| A | terminal 3 | amber LED (-) |
| VA | terminal 1 | LEDs common anode (+) |

For full details of installing and testing loop antennas, see chapter 6.

## Power supply

The power supply connections to the 5311 Reader Interface are as follows (these are <u>not</u> the connections for a 5311-C5 - see later):

| 5311 | Function |
|---|---|
| 0V | Power supply 0V (-ve) |
| VIN | Power supply +12V unregulated<br>(max 15.6V, min 10.7V, 0.5A max) |

The power supply you use must be able to provide 500mA DC continuous at 12V (+25% -10%). It is recommended that you use a linear power supply (as opposed to a switch-mode power supply) to cut down on noise which might otherwise reduce the reading range.

The power supply can be unregulated but must be smoothed. The voltage must be within the range 10.7V to 15.6V at all times under all load conditions.

If you connect the power the wrong way round, the circuit is protected by a self-resetting fuse (which will be hot to touch!).

The power supply connections to the 5311-C5 Reader Interface are made to the connector on the power supply adapter board as shown in the following table:

| Power Supply Adapter Board | Function |
|---|---|
| IN | Power supply +24V unregulated (input to power supply adapter board) (max 35.0V, min 10.7V, 7W max) |
| GND | Power supply 0V (-ve) |
| GND | Should be linked to 0V on CONN2 on the Reader circuit board |
| OUT | 12V out from power supply adapter board - should be linked to VIN on CONN2 on the Reader circuit board |

The power supply can be unregulated but must be smoothed. The voltage must be within the range 10.7V to 35.0V at all times under all load conditions.

## Earthing

Read the section on “Earthing” at the beginning of this chapter and make the correct earth connections for your installation and your country’s regulations.

## Host system

Connect the data interface as follows:

### Wiegand

| | |
|---|---|
| D0 | Data zero |
| D1 | Data one |
| 0V | Signal ground |

### Magnetic Stripe

| | |
|---|---|
| D0 | Data |
| D1 | Strobe |
| DA | Present |
| 0V | Signal ground |

**ASCII TTL** (0V/+5V levels)

| | |
|---|---|
| D0 | TXD |
| DA | RTS |
| $\overline{H}$ | CTS |
| 0V | Signal ground |

(For ASCII output at RS232 levels, use the 5810 RS232 Converter.)

## Configuring

The Reader Interface must be in configuration mode (switch 1 up/ON and switch 2 down on the DIL switch labelled CONF) - the green MODE LED flashes at one second intervals.

- To teach the Reader Interface its Distributor and Secondary Codes, present any of the normal programmed cards which will be used with the system. The MODE LED lights for two seconds when the card is read successfully. (You may be able to get the card to read by holding it over the circuit board.)

- If you need to change the factory settings for data interface, or tag type, or interrogation mode, or LED control, or hold-off time, or repeat data delay, present the programmed configuration card. The MODE LED lights for two seconds when the card is read successfully. For details of how to program a configuration card, see chapter 3.

- When you have configured the Reader, return switch 1 on the DIL switch labelled CONF down/OFF.

# Testing the Reader

If your Reader / Reader Interface is not working correctly, you can test it as described below.

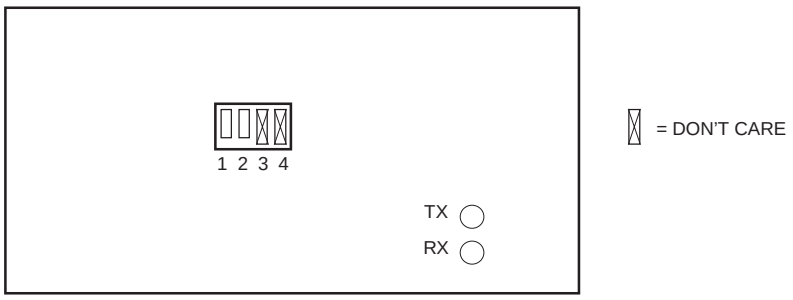
## Selecting test mode

Before selecting test mode, disconnect the LED connections to the host (R, G, A and VA) and also the data hold connection ($\overline{H}$).

The mode is selected using a 4-way DIL switch labelled CONF.

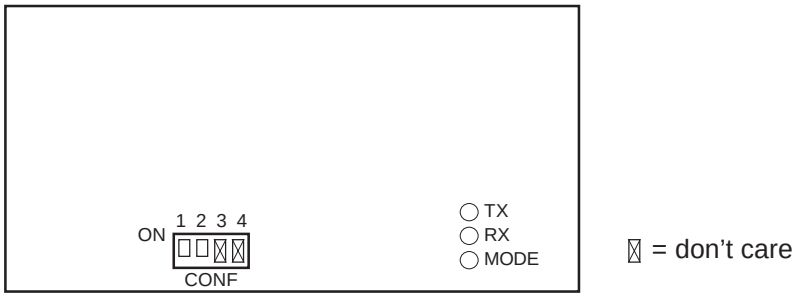
On the 5280 and 5288 Readers the DIL switch is in the middle of the circuit board, as shown in the diagram below.

**Figure 2-4 Test mode switch settings on 5280 and 5288**




On the 5270 Loop Reader and 5311 Reader Interface, the DIL switch is nearer the edge of the board, as shown in the diagram below.

**Figure 2-5 Test mode switch settings on 5270 and 5311**




To put the Reader into test mode, switches 1 and 2 must both be up (ON). You can do this either with or without the power connected. (If you change the switch settings while the Reader is on, the new mode does not come into effect until the switches have been set for 1 second. This prevents the Reader going into unwanted modes by accident when you are changing settings.)

When the Reader goes into test mode, on the 5280 Reader all three LEDs (red, green and amber) light for three seconds, on the 5270 Reader and the 5311 Reader Interface the MODE LED on the circuit board lights for three seconds.

## Testing the wiring between the host, the data outputs (D0, D1, DA) and the data hold input ($\overline{H}$)

From the host end, connect each of the data outputs in turn to the data hold input. If the data lines are working correctly, each connection will give the following output on the horn (5280 Reader) or MODE LED (5270 Reader, 5311 Reader Interface):

D0 connected to $\overline{H}$: Horn/LED 2s on 2s off

| | |
|---|---|
| D1 connected to $\overline{H}$: | Horn/LED 1s on 1s off |
| DA connected to $\overline{H}$: | Horn/LED 0.5s on 0.5s off |

## Testing card reading

Present any card to the reading head or loop antenna. The horn / MODE LED pulses when the card is read. If the pulses are short (0.1s on 0.5s off) then the card is invalid (wrong Distributor Code or Secondary Code). If the pulses are long (0.5s on 1s off) then the card is valid for the current configuration of the Reader.

If the horn/LED does not pulse at all, or not until the card is very close to the antenna, there is a problem. Check the connections to the antenna - a common cause of low reading range is the Tx and Rx connections being swapped. On loop antennas, other common causes of low range are electrical noise or poor tuning of the 270 Loop Coupler, see chapter 6. Present a 922 Test Card to the antenna and look at the LED in the card. When the LED flashes quickly it is within the transmit field of the antenna - this is the transmit range. When the LED pulses slowly, the card is being read - this is the receive range. If the receive range is very low, the problem is almost certainly electrical noise - see chapter 6 on loop antennas for details of how to overcome this.

## Testing the LEDs and horn

Note: on a 5270 Loop Reader, the LEDs are in a remote indicator; on a 5311 Reader Interface, the LEDs are in a reading head or remote indicator.

On the CONN2 connector, connect each of the R, G, A and horn terminals in turn to 0V. The corresponding LED should light and the horn should sound.

## After testing

After testing, return the switches to “normal mode” (switches 1 and 2 down/OFF). If you removed them, re-connect the LED connections to the host.

Chapter 3

# Setting up

You must set the following functions on a Reader before it will operate correctly:

- Distributor Code
- Secondary Code

You will probably need to set the following:

- Data interface option

You may need to set the following:

- Horn disable
- Internal/external/single-wire control of LEDs
- Tag type (AD and ND or ND only)
- Interrogation mode (auto-select, standard or vehicle)
- Data integrity parity check
- Hold-off time and repeat data delay
- Data output lines active-high or active-low
- Data Hold input line active-low or active-high
- Leading parity calculation for Wiegand data output
- Protocol and baud rate for ASCII data output
- Passive tag reading routines
- Transmit range on 5280/5288 Readers (you can reduce the transmit range by turning the variable resistor marked TX on the circuit board)

## Configuring the Reader

You configure the Reader by putting it into “configuration mode” and then presenting one, or sometimes two, coded cards to its antenna.

The first card (any of the ordinary Distributor Coded cards which will be used with the system) teaches the Reader its Distributor and Secondary Codes.

The second card (the configuration card) defines the type of data interface, and most of the features listed in the third group listed above.

# The DC/SC card

To teach the Reader its Distributor and Secondary Codes you use any of the normal cards which will be used with the system (any of the cards which are issued to cardholders). We shall call this the “DC/SC card”.

# The configuration card

If you need to change the data interface or any of the other settings, you need to use a configuration card programmed in 63 bit display format on the 633-2 Programmer. Data fields in the configuration card set up various options described below.

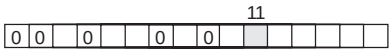
The configuration code is a 64-bit binary number which determines how the Reader operates. Here is the complete 64-bit configuration code, with each bit represented by a letter or number. The fields in the code represented by the letters and numbers are defined in the next section “Programming the configuration card”.

**0xxx xxxx ttmm xxxx dfss mbff xxxx pxxh xxxx hhhh pa10 harg rrrr rrrr iiii iiii**

The code is written down as sixteen 4-bit groups. Each 4-bit group can be represented by a single hexadecimal digit which can be typed directly into the 633-2 Programmer in 63-bit display format.

An **x** means that this bit of the code is not used.

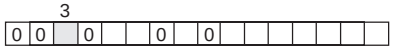
The next section “Programming the configuration card” defines each of the fields in the configuration code. You should type each field into the 633-2 Programmer in the order in which they are described. We have shown a diagram with each entry, showing the position of the hex character in the configuration code. For example, the hex character determining the polarities of the data outputs is the eleventh character:




Because the first two characters, the fourth, the seventh and the ninth characters are unused, they are set to zero, and we have shown this in the diagram. The leading zeros can be left out when typing the configuration code into the 633-2 Programmer.

# Programming the configuration card

## ttmm (tag type and interrogation mode)




The tag type and interrogation mode each use 2-bits of a 4-bit field. To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | Tag type | Interrogation mode |
|---|---|---|
| 0 | AD and ND | Auto-select |
| 1 | AD and ND | Standard |
| 2 | AD and ND | Vehicle |
| 4 | ND only | Auto-select |
| 5 | ND only | Standard |
| 6 | ND only | Vehicle |

### Tag type

**AD**
The Reader will read AD and ND cards and tags.

**ND**
The Reader will read ND cards and tags only.

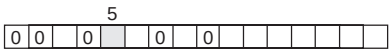
### Interrogation mode

**Auto-select**
The Reader regularly samples the noise in the reading area. If the noise is low then it uses standard interrogation. If the noise is high then the Reader uses vehicle interrogation which is at least twice as slow as standard interrogation but is more reliable in noisy conditions.

**Standard**
The Reader reads a tag in one go, taking around 400ms to read the whole tag code. If the reading area has a lot of electrical noise present, the Reader can fail to read the tag code.

**Vehicle**
The Reader reads the tag code at least twice, taking a minimum of around 800ms to read the whold tag code. If it fails to read the tag correctly, it keeps trying until it has built up the complete tag code. Vehicle interrogation mode is designed for maximum reliability in conditions of strong electrical noise.

## dfss (data integrity parity check and card status message output from Reader via ASCII/TTL interface)




If the **d** bit is set to 1, the Reader will only send out data when it reads a valid card or tag which has been programmed with the "data integrity parity check" code.

If the **d** bit is 0, the Reader will send out data when it reads any valid card or tag, whether it has been programmed with the "data integrity parity check" code or not.

Note that in the 633 Programmer Handbook and on the 633 Programmer display, this feature is referred to simply as "PARITY".

The three bits **fss** of this field determine whether the Reader sends status messages on the ASCII/TTL data interface, and what types of message it sends. To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | Types of message | Flags |
|---|---|---|
| 0 (or 8 with dipc) | No messages sent | Leading digit/ battery flag |
| 1 (or 9 with dipc) | Cotags and Noise | Leading digit/ battery flag |
| 2 (or A with dipc) | Invalid cards, Cotags and noise | Leading digit/ battery flag |
| 3 (or B with dipc) | No Cotag, Invalid cards, Cotags and noise | Leading digit/ battery flag |
| 4 (or C with dipc) | No messages sent | Extra flags (see) |
| 5 (or D with dipc) | Cotags and Noise | Extra flags (next) |
| 6 (or E with dipc) | Invalid cards, Cotags and noise | Extra flags (page) |
| 7 (or F with dipc) | No Cotag, Invalid cards, Cotags and noise | Extra flags |

Note that none of these settings suppress door normal, door open, door forced and door jammed messages.

Note that the numbers from 8 to F (hex) in the above table enable the "data integrity parity check" feature. The numbers from 1 to 7 (hex) do not.

## ASCII/TTL interface

The messages provided from the ASCII/TTL interface are as follows:

| | |
|---|---|
| ***STAT00#** | No Cotag (ND Read) |
| ***STAT01#** | No Cotag (AD Read) |
| ***STAT10#** | Cotags (ND Read) |
| ***STAT11#** | Cotags (AD Read) |
| ***STAT20#** | Invalid Cotag (ND Read) |
| ***STAT21#** | Invalid Cotag (AD Read) |
| ***STAT80#** | Noise |

The extra flags can be output in place of the leading digit and battery flag in ASCII/TTL interface numbers hex 61 and hex 65 only. The card data with leading digit and battery flag (**f**=0) is as follows:

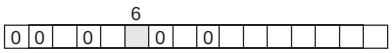
| | |
|---|---|
| ***NNNNNNNNLB#** | **NNNNNNNN** = card number<br>**L** = leading digit<br>**B** = battery flag |

The card data with extra flags (**f**=1) is as follows:

| | |
|---|---|
| ***NNNNNNNNFF#** | **NNNNNNNN** = card number<br>**FF** = ASCII code for two hex digits which represent eight flags as follows: |

| Data bit | Flag |
|---|---|
| 7 | Battery flag |
| 6 | Leading digit |
| 5 | Loiter flag (card present in reading area for longer than 40 times the hold-off time) |
| 4 | Same card read more than once in succession |
| 3 | Not used |
| 2 | Not used |
| 1 | Not used |
| 0 | Not used |

## mbff (ASCII interface protocol and baud rate, and modulo 4 passive tag reading routine)

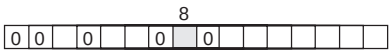



The 3 bits **bff** determine the protocol and baud rate of the ASCII/TTL interface. To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | ASCII protocol and baud rate |
|---|---|
| 0 | 7 data bits, even parity, 1 stop bit, 1200 baud |
| 1 | 7 data bits, odd parity, 1 stop bit, 1200 baud |
| 2 | 7 data bits, no parity, 1 stop bit, 1200 baud |
| 3 | 8 data bits, no parity, 1 stop bit, 1200 baud |
| 4 | 7 data bits, even parity, 1 stop bit, 9600 baud |
| 5 | 7 data bits, odd parity, 1 stop bit, 9600 baud |
| 6 | 7 data bits, no parity, 1 stop bit, 9600 baud |
| 7 | 8 data bits, no parity, 1 stop bit, 9600 baud |

The **m** bit selects a “modulo 4 reading routine” which is designed to check that the correct code has been read from passive cards and tags. If you are using passive cards and tags, it is a good idea to enable this check by adding 8 hex to the value you have chosen for the ASCII interface protocol and baud rate. For example, if you chose 6 for the ASCII interface, you would enter E into the configuration code to enable the passive tag reading routine.

## pxxh (passive tag reading routine and Data Hold input signal polarity)




The most significant bit (the **p** bit) of this 4-bit field determines whether the Reader uses the passive tag reading routine in which it keeps reading the first 16 bits of tag code until the same number is read twice. If you are using passive cards and tags, it is essential to enable this routine.

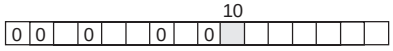
The least significant bit (the **h** bit) determines the polarity (active-low or active-high) of the Data Hold input. (This also applies when it is used as a single-wire control of the green and red LEDs.)

**Note**: if you are using the ASCII data output you must set Data Hold to be active-high - the **h** bit must be set to 1.

To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | Passive reading | Data Hold polarity |
|---|---|---|
| 0 | Disabled | Active-low |
| 1 | Disabled | Active-high |
| 8 | Enabled | Active-low |
| 9 | Enabled | Active-high |

## hhhh (hold-off time)

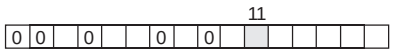



When the Reader reads a valid card, it does not poll again until the hold-off time has elapsed. During the hold-off time the Reader maintains the state of the green and red LED indicators.

To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | Hold-off time | Hex number | Hold-off time |
|---|---|---|---|
| 0 | 1s | 8 | 10s |
| 1 | 1s | 9 | 15s |
| 2 | 2s | A | 20s |
| 3 | 3s | B | 30s |
| 4 | 4s | C | 40s |
| 5 | 5s | D | 50s |
| 6 | 6s | E | 60s |
| 7 | 8s | F | 0s |

## pa10 (calculation of leading parity bit for 26-bit Wiegand interfaces, polarity of data lines - DA, D1, D0 active-low or active-high)




Leading parity bit (**p**):

**0** the Reader does not calculate a leading parity bit.

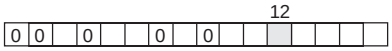
**1** the Reader calculates an even leading parity bit based on the first 13 bits of a 26-bit Wiegand interface (for example, interface number 12 in the Reader). This saves you from having to program the leading parity bit into the cards. The trailing odd parity bit is still calculated as normal.

Each of the 3 bits **a10** determines the polarity of each of the data lines: DA, D1 and D0 respectively. 0 gives an active-low data line, 1 gives an active-high data line.

The leading parity and data line polarity are entered as one hexadecimal digit. The table below shows what you would enter for common configurations: To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | Function |
|---|---|
| 0 | No leading parity and active-low data lines (0000) |
| 7 | No leading parity and active-high data lines (0111) |
| 8 | Leading parity bit and active-low data lines (1000) |
| F | Leading parity bit and active-high data lines (1111) |

## harg (internal/external/single-wire control of red and green LEDs)




To work out the hex number you need to type into the Programmer, refer to the following table:

| Hex number | LED control |
|---|---|
| 0 | External control of red and green LEDs |
| 1 | Internal control of red and green LEDs |
| 2 | Single-wire control of red and green LEDs at 0V/+10V levels (green LED driven externally, red LED lights inverse of green) |
| A | Single-wire control of red and green LEDs at 0V/+5V levels via Data Hold input |

(With the above settings, the amber LED is driven internally by the Reader. If you want to control the amber LED externally, add hex 4 to the above settings.)

Use the **0** setting when the drive for both the red and green LEDs is supplied only by the host controller. (When you drive LEDs externally, you have to pull down the corresponding terminal labelled R or G on the board from +10V to 0V.)

Use the **1** setting if you want the Reader to control both the red and green LEDs. The Reader lights the green LED after a valid card read and keeps it lit all the while the card is in range of the antenna. The red LED is the inverse of green.

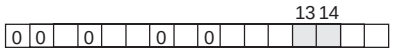
Use the **2** setting when you want to drive both the red and green LEDs with just one wire from the host. With this setting, the host should drive the green LED, while the Reader automatically drives the red LED as the inverse of the green. So, when the host lights the green LED to show that the door is unlocked, the reader switches off the red LED. (When you drive the green LED externally, you have to pull down the G terminal on the board from +10V to 0V.)

Use the **A** setting if you want to drive both the red and green LEDs with just one wire from the host to a logic input on the Reader (+5V instead of +10V). Doing this gives single wire control of red and green LEDs using the $\overline{H}$ (data hold) input to the Reader.

The drives for the LEDs are open collector, so the same LED can be driven both internally by the Reader and externally by the host controller without conflict. This enables you to do the following:

When the Reader reads a card, there can be a delay while the host system verifies the card number and then unlocks the door. To provide more information to the cardholder while this is happening, it is possible to use setting **1** and to drive the red LED from the host controller as well as internally from the Reader. In operation, the cardholder sees the green LED come on when the card is read, but the red LED (driven by the host) stays lit. When the door is unlocked, the host switches off the red LED and the cardholder knows that the door is now open. Note that when used in this way, the hold-off time of the Reader should be set to the same value as the door relay time used by the host controller - otherwise the Reader will switch the red LED back on while the door is still unlocked.

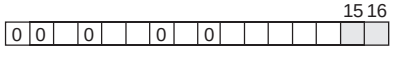
## rrrrrrrr (repeat data delay - RDD)




This field sets the repeat data delay time or RDD (two hexadecimal digits). If this field is set to 00, the RDD used is the one specified in the interface setting. For an RDD of 0, set this field to FF. If this field is set to any number from 1 to 254 (01 to FE in hex), the RDD is set to this number of seconds. You must convert the decimal number into hexadecimal before typing it into the Programmer; for example, 10 is $A_H$, 20 is $14_H$, etc.

**What is the Repeat Data Delay?** When the Reader reads data from a card, it sends card data to the host. After it has done this, it will not send the same card data to the host again until the RDD time has elapsed. This prevents the system becoming overloaded with lots of data from one card being read over and over again.

## iiiiiiii (interface number)




This field sets the data interface number (two hexadecimal digits). See the chapter on data interfaces and, if necessary, contact your supplier to find out what setting you should be using. The interface number given to you by your supplier is a two digit hexadecimal number and therefore can be entered directly into the 633-2 Programmer without conversion.

# Programming the DC/SC card

The card you use to teach the Reader the Distributor and Secondary Codes can be any normal Distributor Coded card programmed with the correct Secondary Code (any of the cards which are issued to cardholders).

Set your 633-2 Programmer to any of the Distributor Coded display formats (usually Dec/Dec, but could be Hex/Dec or Hex/Hex or Hex/BCD), enter the correct Secondary Code in the SITE or SECONDARY field and program the card (the card number does not matter).

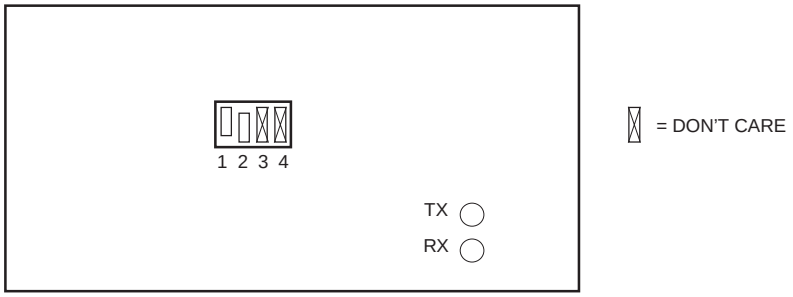
# Configuring the Reader

## Selecting the configuration mode

The mode is selected using a 4-way DIL switch labelled CONF.

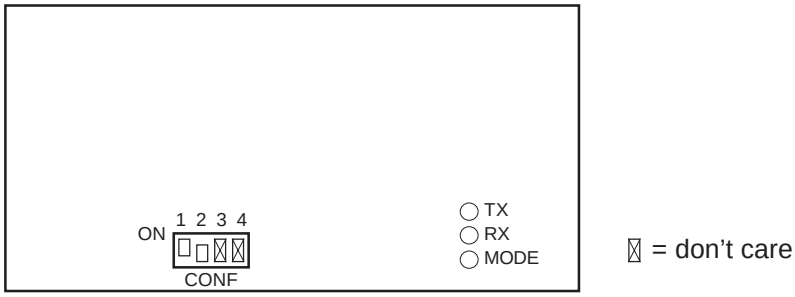
On the 5280 and 5288 Readers the DIL switch is in the middle of the circuit board, as shown in the diagram below.

**Figure 3-1 Configuration mode switch settings on 5280 and 5288**




On the 5270 Loop Reader and 5311/5312 Reader Interface, the DIL switch is nearer the edge of the board, as shown in the diagram below.

**Figure 3-2 Configuration mode switch settings on 5270 and 5311/5312**




To put the Reader into configuration mode so that it is ready to read the configuration data from the coded cards, switch 1 must be up (ON) and switch 2 must be down (OFF). You can do this either with or without the power connected. (If you change the switch settings while the Reader is on, the new mode does not come into effect until the switches have been set for 1 second. This prevents the Reader going into unwanted modes by accident when you are changing settings.)

In configuration mode, the horn / MODE LED output pulses for 0.1s at 1s intervals (the horn output and MODE LED are connected in parallel on the Reader circuit board).

On the 5280 and 5288 Readers the horn is fitted, so you can hear the pulses.

On the 5270 Reader and 5311 Reader Interface, you have to look at the MODE LED flashing. The position of the MODE LED is shown on the diagrams above.

When you present either of the configuration cards, the Reader reads it twice then sounds the horn / lights the MODE LED for 2s to indicate a successful read.

## Presenting configuration cards to the Reader

### 5280/5288 Reader

The Reader must be in configuration mode (switch 1 up, switch 2 down) - the horn bleeps at one second intervals.

- To teach the Reader its Distributor and Secondary Codes, present any of the normal programmed cards which will be used with the system. The Reader bleeps for 2 seconds when the card is read successfully.

- If you need to change the factory settings for data interface, LED control, etc, present the 63-bit configuration card. The Reader bleeps for 2 seconds when the card is read successfully.

### 5270/5311/5312 Reader / Reader Interface

The Reader must be in configuration mode (switch 1 up, switch 2 down) - the green MODE LED flashes at one second intervals.

- To teach the Reader / Reader Interface its Distributor and Secondary Codes, present any of the normal programmed cards which will be used with the system. The MODE LED lights for two seconds when the card is read successfully. (You may be able to get the card to read by holding it over the circuit board.)

- If you need to change the factory settings for data interface, LED control, etc, present the 63-bit configuration card. The MODE LED lights for two seconds when the card is read successfully.

# Changing the Secondary Code

If, after setting the Distributor and Secondary Code, you need to change the Secondary Code, put the Reader into configuration mode and present a Distributor Coded card programmed with the new Secondary Code. The Reader bleeps/flashes for 2 seconds when the card is read successfully.

# After configuring the Reader

After configuring, return the switches to “normal mode” (switches 1 and 2 down/OFF).

# Default configuration

If the Reader / Reader Interface has not been configured by your supplier, it will have the following default settings:

- Distributor Code: 1234 (1234 is not a valid Distributor Code - it is used for demonstration purposes).
- Secondary Code: 5678
- Interface number: 12 hex (26-bit Wiegand)
- AD and ND tag type
- Auto-select interrogation
- Repeat Data Delay: 00 hex - as specified by interface (2 seconds for interface 12)
- LED control: 0 hex (red and green external)
- Data output polarity: 000 binary (all active-low)
- Wiegand parity: 0 binary (not calculated)
- Hold-off time: 0 (1s)
- Passive card interrogation not selected
- Gives data output after reading a valid card which has been programmed with or without the “data integrity parity check”

These settings remain in force until they are changed by the configuration card and the DC/SC card.

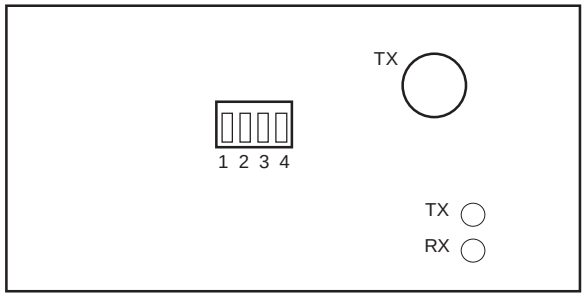
# Horn bleep on reading valid card

The Reader can activate the horn output briefly (100ms) when it reads a valid card or tag. To enable this feature, move switch 4 of the DIL switch labelled CONF on the circuit board up (to the ON position).

# Reducing the transmit range on the 5280 and 5288 Readers

You can adjust the transmit range on the 5280 and 5288 by turning the variable resistor marked TX on the circuit board (using a small screwdriver).

**Figure 3-3 Position of transmit range variable resistor (TX) on 5280/5288 circuit board**




The Tx range is normally set to maximum (fully clockwise). If you want to reduce it, turn the variable resistor counter-clockwise until you get the desired transmit range which you can measure with a 922 Test Card or 851 Field Meter. There is no adjustment on the 5311 or 5312.

# Reducing the transmit range on the 5270 Loop Reader

You can adjust the transmit range on the 5270 Loop Reader by turning the variable resistor marked “TX range adjust RV1” on the upper circuit board (using a small screwdriver).

The Tx range is normally set to maximum (fully clockwise). If you want to reduce it, turn the variable resistor counter-clockwise until you get the desired transmit range which you can measure with a 922 Test Card or 851 Field Meter. There is no adjustment on the 5311 or 5312.

# Examples of working out what to program into the configuration card in 63-bit mode on the Programmer

When you refer to the earlier section entitled “Programming the configuration card”, you can look up the hexadecimal numbers you need in the tables and write them down as you go. You then enter the hexadecimal numbers into the Programmer in 63-bit display format.

If you ever need to convert decimal and binary numbers to hexadecimal digits, here is a table giving the decimal (top row), binary (middle row) and hexadecimal (bottom row) equivalents for all possible 4-bit numbers:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |

## Example 1

- First two digits always zero (00 in hex)
- Tag type: AD and ND; interrogation mode: auto-select (look up in table - 0 in hex)
- Next digit always zero (0 in hex)
- Accept cards and tags with or without the “data integrity parity check” programmed into them, ASCII interface settings not required, no passive tag routine (look up in tables - two digits - 00 in hex)
- Next digit always zero (0 in hex)
- Data Hold input active-low, no passive tag routine (look up in table - 0 in hex)
- Next digit always zero (0 in hex)
- Hold-off time: 2 seconds (look up in table - 2 in hex)
- Wiegand leading parity enabled, data outputs active-low (look up in table - 8 in hex)
- Single-wire control of red and green LEDs via Data Hold logic input (look up in table - A in hex)
- RDD: 5 seconds decimal (05 in hex)
- Wiegand data output (interface number 12 in hex)

Write down the hex digits in order: 00000000028A0512

The Programmer doesn't need the leading zeros, so the number you enter in 63-bit display format is: 28A0512 (hexadecimal).

## Example 2

- First two digits always zero (00 in hex)
- Tag type: AD and ND; interrogation mode: vehicle (look up in table - 2 in hex)
- Next digit always zero (0 in hex)
- Accept only cards and tags programmed with the "data integrity parity check", ASCII interface settings: no card status messages (look ASCII settings up in table (0 in hex) then add 8 hex for the "data integrity parity check" - 0+8 = 8 in hex)
- ASCII interface settings: 7 data bits, no parity, 1 stop bit, 9600 baud, no passive tag routine (look up in table - 6 in hex)
- Next digit always zero (0 in hex)
- Data Hold input active-low, no passive tag routine (look up in table - 0 in hex)
- Next digit always zero (0 in hex)
- Hold-off time: 30 seconds (look up in table - B in hex)
- Wiegand leading parity disabled, data outputs active-high (look up in table - 7 in hex)
- Internal control of red and green LEDs (look up in table - 1 in hex)
- RDD: 60 seconds decimal (3C in hex)
- ASCII data output (interface number 64 in hex)

Write down the hex digits in order: 002086000B713C64

The Programmer doesn't need the leading zeros, so the number you enter in 63-bit display format is: 2086000B713C64 (hexadecimal).

# Displaying the configuration data

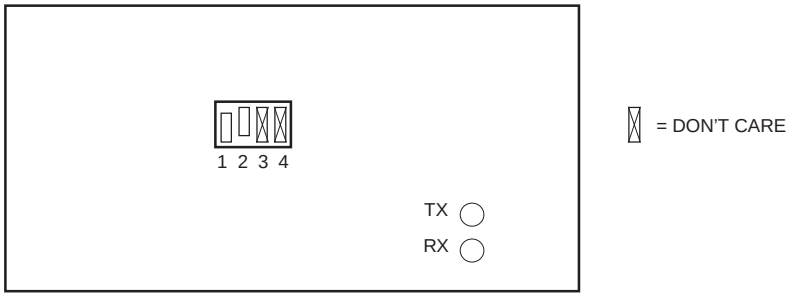
If you need to find out the configuration of a 5311/5312 Reader Interface or 5280 Reader, you can put it into “display the configuration mode” which outputs the fields in the configuration as a series of bleeps and LED flashes. On the 5280 you can count bleeps from the horn. On the 5311/5312 you can either connect a horn or count flashes on the green LED labelled MODE in the bottom right corner of the circuit board.

## Selecting “display the configuration” mode

The mode is selected using a 4-way DIL switch labelled CONF.

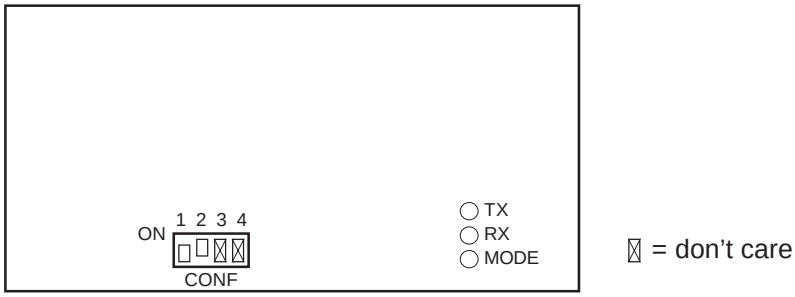
On the 5280 and 5288 Readers the DIL switch is in the middle of the circuit board, as shown in the diagram below.

**Figure 3-4 Display the configuration mode switch settings on 5280 and 5288**




On the 5270 Loop Reader and 5311/5312 Reader Interface, the DIL switch is nearer the edge of the board, as shown in the diagram below.

**Figure 3-5 Display the configuration mode switch settings on 5270 and 5311/5312, and position of MODE LED on circuit board**




To put the Reader into display the configuration mode, switch 1 must be down (OFF) and switch 2 must be up (ON). You can do this either with or without the power connected. (If you change the switch settings while the Reader is on, the new mode does not come into effect until the switches have been set for 1 second. This prevents the

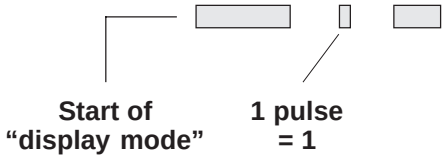
Reader going into unwanted modes by accident when you are changing settings.)

## Reading the configuration

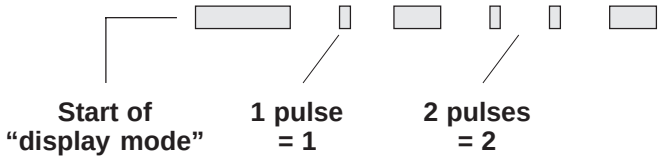
In “display the configuration mode”, the horn and the LED operate together, so whichever one you are using, the sequence of data output is the same.

When you select “display the configuration mode”, the horn sounds / LED lights for 2 seconds. This is then followed by a sequence of 36 hexadecimal numbers, each number being between 0 and 15 bleeps/flashes (0 to F). Each hexadecimal digit consists of 0.2s bleeps/flashes separated by 1s intervals. Each hexadecimal digit is terminated by a 1s bleep/flash.

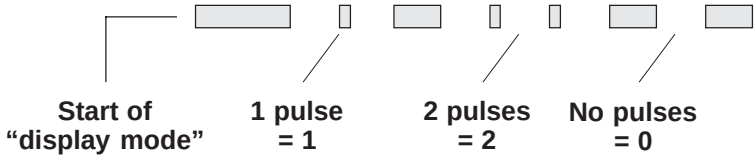
For example, if the first digit on entering “display the configuration mode” is 1, you would get a 2s bleep/flash, 1s interval, 0.2s bleep/flash, 1s interval, 1s bleep/flash, followed by a 1s interval and the start of the next digit.



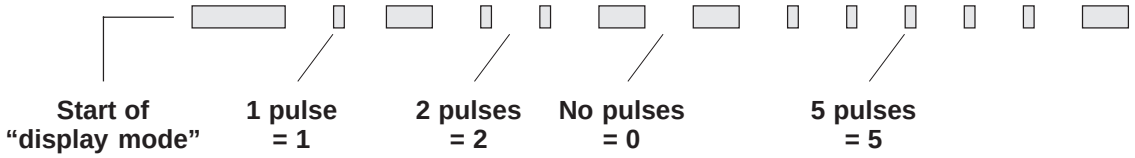

If the next digit is 2, you would get a 0.2s bleep/flash, 1s interval, 0.2s bleep/flash, 1s interval, 1s bleep/flash, followed by a 1s interval and the start of the next digit.




If the next digit is 0 then you would get no short bleeps/flashes, just another 1s bleep/flash.



Each pair of digits forms an 8-bit field, output most significant digit first. For example, if the interface number is 12 (hex) and the RDD is 5 seconds (05 hex), the data is output as shown below.




The "1" is the most significant digit of the interface number, the "2" is the least significant.

The "0" is the most significant digit of the RDD, the "5" is the least significant.

The data is output in its entirety as follows:

| Hex character | Configuration data |
|---|---|
| 1 and 2 | Interface number (most significant digit first) |
| 3 and 4 | Repeat data delay (most significant digit first) |
| 5 | Data output polarity and leading parity bit |
| 6 | LED control |
| 7 | Should be zero |
| 8 | Hold-off time |
| 9 | Should be zero |
| 10 | Passive read mode and Data Hold polarity |
| 11 | Data integrity parity check,<br>ASCII interface messages and flags |
| 12 | Modulo-4 check and ASCII interface protocol |
| 13 | Tag type and interrogation mode |
| 14 | Should be zero |
| 15 | Should be zero |
| 16 | Should be zero |
| 17 to 20 | Secondary Code<br>(most significant digit first) |
| 21 to 36 | Cotag internal use only |

Chapter 4

# Data interfaces

The 5280, 5288, 5270, 5311 and 5312 Readers offer a choice of Wiegand or Magnetic Stripe interface to communicate with a host system. An ASCII data output is also available at TTL voltage levels (0V/+5V), which can be converted to an RS232 data output using the optional 5810 RS232 Converter. You select the interface you require by programming a 63-bit configuration card and presenting it to the Reader, see chapter 3.

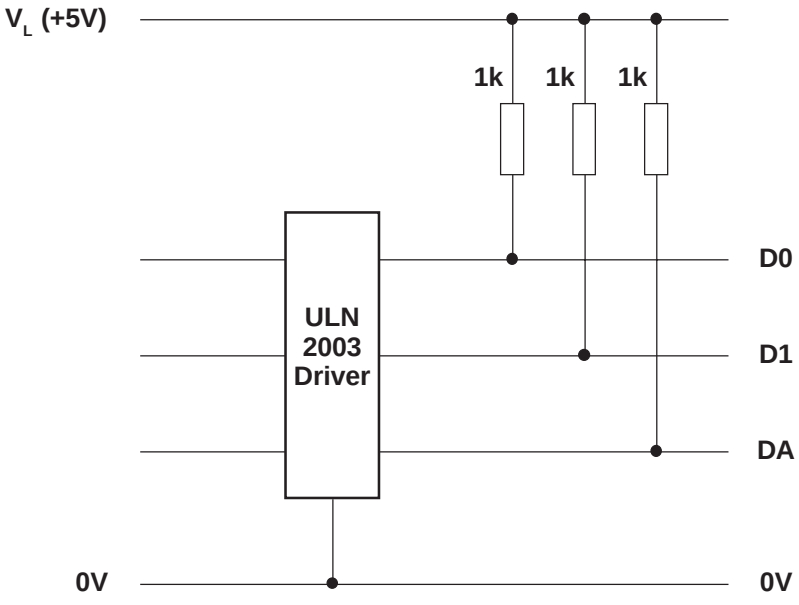
## Electrical characteristics of outputs from the Reader

The Wiegand and Magnetic Stripe interfaces use the data lines D0, D1 and DA.

All outputs are driven by open drain drivers which can each sink up to 500mA. When a driver is off, its output is pulled up to +5V (the regulated logic voltage on the board) by a 1k resistor (and also by whatever is connected at the host end).

The polarities of the three data outputs (D0, D1 and DA) are individually selectable (active-high or active-low) by setting bits in the configuration code (see chapter 3).

The diagram below shows the logical implementation of the outputs used for Wiegand and Magnetic Stripe interfaces.



# Data Hold input

The Data Hold input ($\overline{H}$) can be used by the host to buffer one data message in the Reader until the host is ready to read it. This enables the data lines from two Readers to be connected in parallel, the host polling each in turn by releasing its Data Hold input, reading the data, then asserting the Data Hold input again. The Reader will store the message for 5 seconds, or until the next card is read, whichever occurs sooner. The ASCII data interface uses the Data Hold input as its CTS input.

**Note**: the Data Hold input can be used by a host system to control the red and green LED outputs from the Reader. This feature is set using a bit in the configuration code and disables the Data Hold function.

# Wiegand

## Connections

The pin connections for the Wiegand interface are as follows:

0V (ground)
D0 (logic 0)
D1 (logic 1)
DA (data available)

## Electrical characteristics

The interface provides three outputs: logic zero data (D0), logic one data (D1) and data available (DA).

Data transfer is performed by pulsing the D0 line to indicate a logic zero and by pulsing the D1 line to indicate a logic one. The pulses can be set to be either active-high or active-low using bits in the configuration card (see chapter 3). The voltage of the data lines is +5V or 0V.

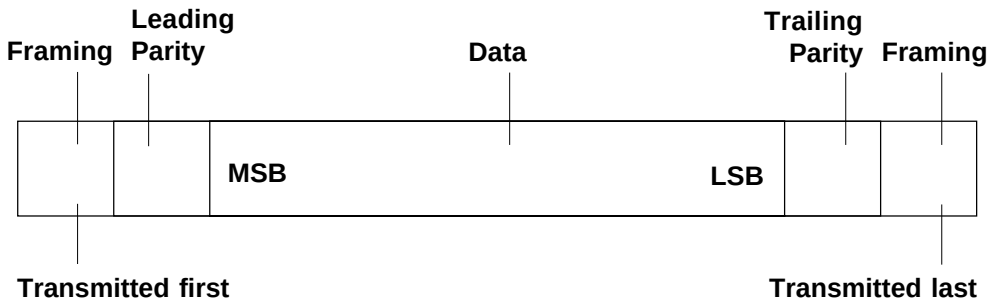
The Data Available output (DA) is provided to tell the host system it must read a data message from the Reader. If the Data Hold input (see above) is not active, DA becomes active 1ms before data is sent and is released 1ms after the data has been sent. If the Data Hold input is active, DA becomes active but data is not sent until Data Hold is released, DA remaining active until 1ms after the data has been sent. When used in association with the Data Hold input (see above), DA enables the data lines from two Readers to be connected in parallel. The polarity of the DA output, active-high or active-low, can be set using a bit in the configuration code, see chapter 3.

## Data format

There are three aspects to the format of the data message, all of which can be varied, depending on the interface number you use:

- Framing bits at the start and finish of the message.
- Any parity bits which may be used.
- The data from the card.

The following diagram shows a typical message structure.




Framing bits are usually either not used or confined to start and stop bits which have a fixed state. Some applications require a more complicated sequence of framing bits, usually at the start of the message.

Parity bits are used to check the integrity of the data message. Parity may be odd or even and it may be calculated from the data only or from the data and some framing bits. The Reader can calculate the leading parity bit based on the first 13 bits of 26-bit Wiegand format if you require - see chapter 3).

### Card data

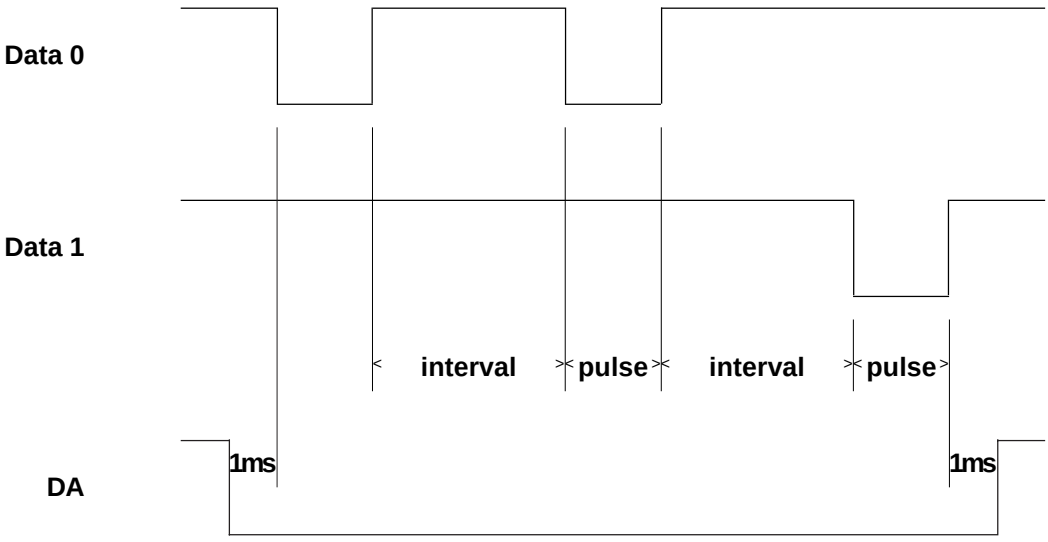
Data from the card can be any number of bits up to a maximum of 48. This includes any parity check bits which may be stored in the card code. The interface selected also determines whether the data is sent most significant bit first or least significant bit first.

### PINpad data

Data from a PINpad is sent whenever a key is pressed, providing the Reader is not already sending a card data message, in which case it sends the PINpad data afterwards. PINpad data has 8 data bits. The first four bits are the inverse of the PINpad key, the second four bits are the PINpad key. For example, if the data is 1010 0101, the key pressed was 5. If the data is 0100 1011, the key pressed was B, which is the hex code for the # key. (0 to 9 corresponds to keys 0 to 9, A is * and B is #.)

## Interface settings

All other options to do with the Wiegand interface such as variation of pulse width and interval are selected using the interface number programmed into the configuration card (see chapter 3). The following diagram shows some typical timings for a Wiegand interface. The data outputs in this example are all active low (the most common setting:)




Some "standard" settings are available and are shown in the following table.

| Interface Number | Function |
|---|---|
| 00 | 1 start bit, 32 bits of data, 1 stop bit, 50µs pulse, 100µs space, 2s Repeat Data Delay |
| 01 | Same as 00 but with a 33rd bit indicating the battery flag |
| 02 | 32 bits of data plus 1 parity bit, 100µs pulse, 400µs space, 2s Repeat Data Delay |
| 12 | 25 bits of data, 50µs pulse, 3ms space, 2s Repeat Data Delay (use for "standard" 26-bit Wiegand) |
| 2A | 3400 interface - transmits secondary code as site code |
| 59 | 4101/4010 Controller AVI interface - use when connecting to 4410/4420 swipe module or 4010 swipe Controller for AVI |

Contact your supplier for any special requirements. If the interface you require has already been implemented then your supplier will tell you which interface number you should use. If not, your supplier can provide you with a demonstration unit to try. When you have formally approved it, your own interface number will then be incorporated in all subsequent production units.

# Magnetic Stripe

A Magnetic Stripe interface is provided which simulates the output of a magnetic card reader. (Note that the Magnetic Stripe interface does not provide PINpad data output.)

## Connections

The pin connections for the Magnetic Stripe interface are as follows:

0V (ground)
D0 (data)
D1 (strobe)
DA (present)

## Electrical characteristics

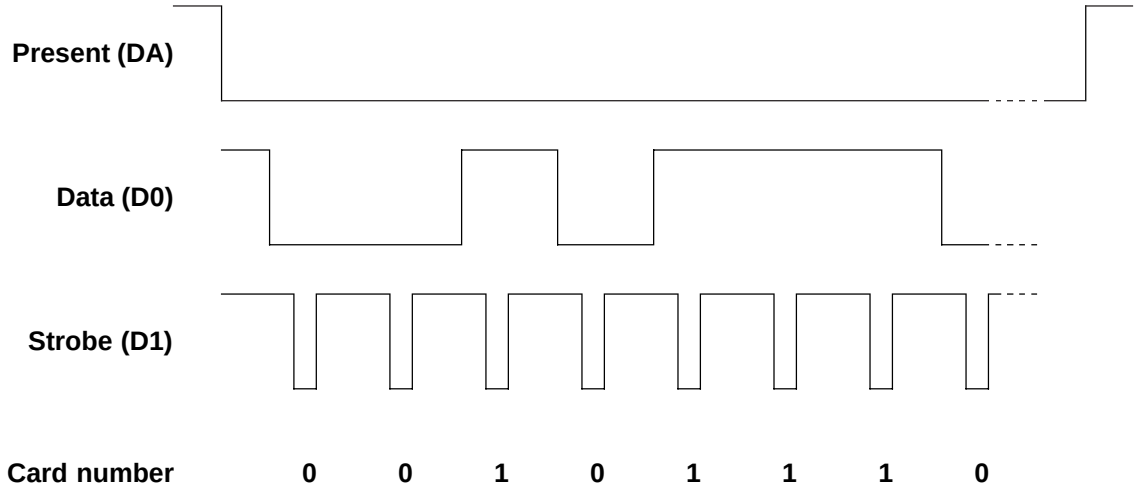
The interface provides three outputs: Present, Data and Strobe.

**Present** is a signal given by a magnetic card reader indicating that a card has been inserted in the slot. On the Readers, this signal becomes active just before data is sent and is released after the data has been sent. The polarity of the signal, active-high or active-low, can be set using a bit in the configuration card, see chapter 3.

**Data** is a signal whose level reflects the value of the bit in the code. The polarity of the signal, normal logic or inverse logic, can be set using a bit in the configuration card, see chapter 3. Normal logic is where a high signal (+5V) indicates a one and a low signal indicates a zero. Inverse logic is where a high signal indicates a zero and a low signal indicates a one.

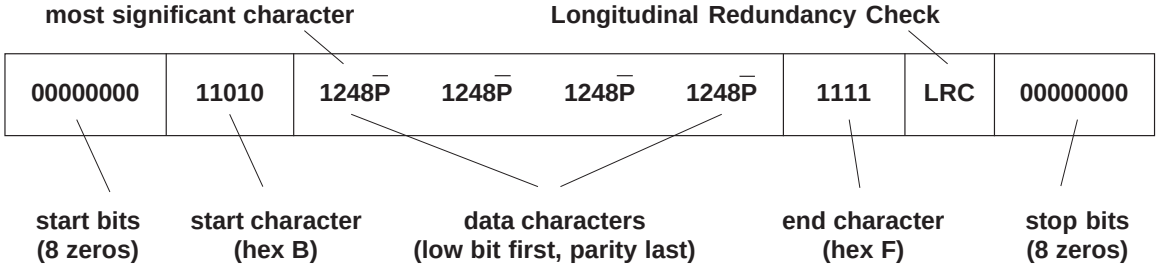
**Strobe** is a series of clock pulses. The polarity of the signal, active-high or active-low, can be set using a bit in the configuration card, see chapter 3. Data can be sampled on either the rising edge or the falling edge of the Strobe signal, whatever its polarity.

The following diagram should make clear the action of all three signals in a data transfer. In this example, the Data line (D0) is high for a one and low for a zero (normal logic):




## Interface settings

As an example, configuring the Reader with interface 41 hex (4 data characters, 0 Secondary Code characters) gives the following Magnetic Stripe output:




Interface settings which output Secondary Code data send the Secondary Code first followed by the card number, each number being sent most significant character first.

The following interfaces are the most commonly used:

| Interface Number | Function |
|---|---|
| 43 | 0 Secondary Code characters, 8 data characters, 1.5ms bit period, 500µs strobe, 2s RDD |
| 47 | 5 Secondary Code characters, 5 data characters, 1.5ms bit period, 500µs strobe, 2s RDD |

With interface 43, cards must be programmed using Hex/Hex display format on the 633-2 Programmer, so all eight characters of card

number can be programmed. The card number must be programmed in binary coded decimal (BCD), that is, each digit must be between 0 and 9. If the card number contains any of the hexadecimal digits A to F, the card will not work with the Magnetic Stripe interface.

With interface 47, Secondary Codes from 0 to 65535 and card numbers from 0 to 65535 are each output as five decimal characters, ten characters in all, Secondary Code first. It is best to use the 633-2 Programmer in Dec/Dec display format to program the cards, but even if it is set up in Hex/Hex and the Secondary Code or card number contain hexadecimal digits A to F, the card will still work with the magnetic stripe interface.

Contact your supplier for any special requirements. If the interface you require has already been implemented then your supplier will tell you which interface number you should use. If not, your supplier can provide you with a demonstration unit to try. When you have formally approved it, your own interface number will then be incorporated in all subsequent production units.

# ASCII data output - TTL voltage levels

## Connections

The pin connections for the ASCII/TTL interface are as follows:

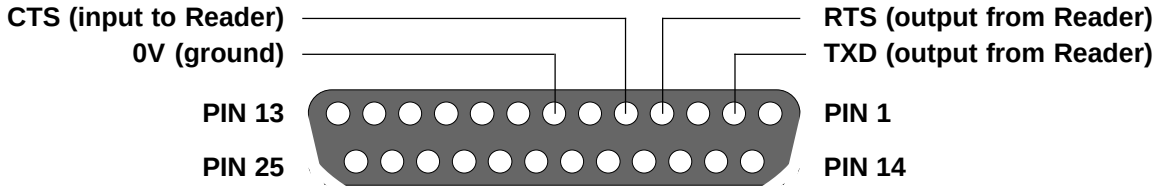
0V (ground)
D0 (TXD)
DA (RTS)
H (CTS)

**Note**: you must set the Data Hold input to be active-high - the bit in the configuration code which selects the Data Hold polarity must be set to 1 (the **h** bit in the **pxxh** field).

The protocol (number of data bits, parity and baud rate) is also defined in the configuration code, see chapter 3.

## Electrical characteristics

This output is at TTL voltage levels (0V/+5V). It can be converted to RS232 voltage levels using the 5810 RS232 Converter. This consists of a cable attached to a D-type connector shroud containing the converter. The pin connections to the 25-way D-type connector on the 5810 RS232 Converter are as follows:




**25-way D-type female connector (viewed from mating side)**

## Data format

The commonly used interface settings which send output to the ASCII interface are as follows:

| Interface Number | Card data output |
|---|---|
| 60 | ***hhhhhhhh#** |
| 61 | ***hhhhhhhhLB#** |
| 64 | ***hhhhhhhh#<c/r><l/f>** |
| 65 | ***hhhhhhhhLB#<c/r><l/f>** |

The ouput consists totally of ASCII characters:

***** is the ASCII asterisk character. It is used to indicate the start of data.

**hhhhhhhhh** is a sequence of ASCII characters representing the eight hex digits of the 32-bit card number.

**#** is the ASCII hash character. It is used to indicate the end of data.

**L** indicates that the leading bit of the tag code is 1. If the leading bit is 0 then the "**-**" character is output in this position instead.

**B** indicates the battery flag in the tag is set. If the battery flag is not set then the "**-**" character is output in this position instead.

**<c/r>** is the ASCII code for "carriage return" (hex D).

**<l/f>** is the ASCII code for "line feed" (hex A).

### PINpad data

Data from a PINpad is sent whenever a key is pressed, providing the Reader is not already sending a card data message, in which case it sends the PINpad data afterwards. PINpad data has the following format:

***Ph#**

***** is the ASCII asterisk character. It is used to indicate the start of data.

**P** indicates that this is a PINpad data message.

**h** is the ASCII code for a single hex character, from 0 to B.
(0 to 9 corresponds to keys 0 to 9, A is * and B is #.)

**#** is the ASCII hash character. It is used to indicate the end of data.

### ASCII interface messages and flags

The ASCII interface can be configured to output the following messages (as specified in the table in the section on "Programming the 63-bit configuration card" in chapter 3).

| | |
|---|---|
| ***STAT00#** | No Cotag (ND Read) |
| ***STAT01#** | No Cotag (AD Read) |
| ***STAT10#** | Cotags (ND Read) |
| ***STAT11#** | Cotags (AD Read) |
| ***STAT20#** | Invalid Cotag (ND Read) |
| ***STAT21#** | Invalid Cotag (AD Read) |
| ***STAT80#** | Noise |

In ASCII interface numbers hex 61 and hex 65 only, extra flags can be output in place of the leading digit and battery flag.

The card data with extra flags is as follows:

***hhhhhhhhFF#**

**hhhhhhhhhh** is a sequence of ASCII characters representing the eight hex digits of the 32-bit card number

**FF** is two ASCII characters representing two hex digits which represent a byte containing 8 flags as follows:

| Data bit | Flag |
|---|---|
| 7 | Battery flag |
| 6 | Leading digit |
| 5 | Loiter flag (card present in reading area for longer than 40 times the hold-off time) |
| 4 | Same card read more than once in succession |
| 3 | Not used |
| 2 | Not used |
| 1 | Not used |
| 0 | Not used |

### Protocol

The baud rate, start/data/stop bits and parity can be selected by setting bits in the configuration code, see chapter 3.

## 4101/4010 Controller interface

The Reader can be connected to a 4410 or 4420 swipe card module installed in a 4101 or 4010 Controller, or directly to a 4010 swipe Controller, the pin connections being as follows:

| Reader | 4410/4420 swipe module or 4010 swipe Controller |
|---|---|
| D0 | D0 |
| D1 | D1 |
| 0V | 0V |

| Interface Number | Function |
|---|---|
| 59 | Wiegand output to 4410/4420 swipe module or 4010 swipe Controller |

Chapter 5

# Operation

Once you have set up all the options described in chapter 3, “Setting up”, normal operation simply consists of presenting your card or tag to the reading head or loop antenna and awaiting the response. The Readers and Reader Interfaces are always used in conjunction with a host system which controls the door lock mechanism and takes decisions about when to activate it.

## LEDs

### Green and red LEDs on 5280/5288 Reader, 280 Reading Head, 090 Reading Head and 272 Remote Indicator

The 5280/5288 Reader, 280 Reading Head, 090 Reading Head and 272 Remote Indicator have green and red LEDs visible through the cover.

The 5280/5288/5270 Reader and 5311/5312 Reader Interface can provide the green and red LED indications if configured to do so (see chapter 3), or the LED indications can be driven externally by the host.

Under internal control (LEDs driven by 5280/5288/5270 or 5311/5312), the green LED is driven when the Reader detects the presence of a valid card and stays on for as long as a card is within range of the antenna. The red LED output is always the inverse of the green LED output, unless either or both is driven externally.

### Amber LED on 5280/5288 Reader, 280 Reading Head and 272 Remote Indicator

If the amber LED output on the 5280/5288/ 5270 Reader and 5311/5312 Reader Interface is configured so that it is driven internally by the Reader, it is lit in the following circumstances:

- If an invalid card is presented.
- If there is excessive electrical noise being picked up by the Reader’s receive circuitry.
- If there is more than one card in the reading area of the antenna then the amber LED output pulses, making the amber LED flash.

### TX and RX LEDs on the Reader circuit board

At the bottom of the circuit board are two amber LEDs labelled TX and RX.

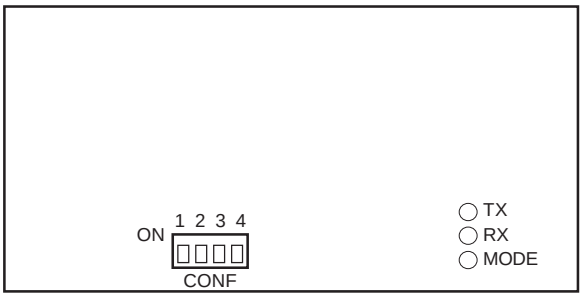
With no card within range of the antenna the TX LED glows gently. Bringing a valid card into range causes both RX and TX LEDs to glow brightly for about half a second and then flash quickly for about one second. If the card remains in range, the LEDs reflect the hold-off time and the anti-loiter routine - see later in this chapter. An invalid card within range of the antenna is read over and over again - the LEDs lighting for half a second then off for 1 second, repeated all the time the card stays in range.

Under normal noise conditions the RX LED flashes very dimly. Bringing a card into range causes the RX LED to flash in time with the TX LED. High levels of ambient noise cause the RX LED to glow more brightly without a card being present.

### MODE LED on the 5270/5311/5312 circuit board

At the bottom right of the circuit board is a green LED labelled MODE. This is used in “configuration mode” and also in “display the configuration mode”, see chapter 3, “Setting up”.

**Figure 5-1 Position of TX, RX and MODE LEDs on 5270/5311/5312 circuit board**




# Card interrogation

## Standard interrogation routine

When the Reader detects a card at the reading head or loop, it reads all 64-bits of code in one burst. The security codes are checked against those stored in the unit (which were read from the Distributor Coded configuration card, see chapter 3). If they are valid then a data message is transmitted via the selected interface.

Note: if the “data integrity parity check” feature is enabled (see chapter 3), the Reader will only transmit a data message if it reads a

valid card which has been programmed on a 633 Programmer with PARITY on.

After the card code has been read successfully, polling of the reading head or loop antenna can be suppressed altogether for a period called the “hold-off time”. This time is specified in the non-Distributor Coded (63-bit) configuration card (see chapter 3). The minimum hold-off time is 1 second.

If the card remains in range of the reading head or loop after the hold-off time, so is read more than once, no further data messages are transmitted until a period of time has elapsed called the “repeat data delay” (RDD). The value of this time is set either according to the interface specification, or to a value specified in the non-Distributor Coded (63-bit) configuration card (see chapter 3).

The length of time between the card being detected by the antenna and the data being transmitted to the host is normally 0.4 seconds. Sometimes, if the host system takes a considerable time to respond, it is helpful for the cardholder to see that the card has been read correctly, even if the door has not unlocked yet. This can be achieved by driving the green LED on the reading head internally from the Reader, and driving the red LED externally from the host so it is switched off when the door is unlocked.

The sequence of events will then be:

- Cardholder presents card.
- 0.4s delay until card is read and green LED, driven by Reader, lights. Cardholder can see that card has been read, but the red LED is still on showing that the door is still locked.
- Another delay until host verifies card number, unlocks door and turns off the red LED so cardholder knows door is unlocked.

## AVI routine (vehicle)

The AVI (automatic vehicle identification) routine is used by the Reader to interrogate coded tags fitted to vehicles via a loop antenna buried in the roadway. Vehicles produce a lot of radio frequency interference to which a loop antenna is especially sensitive. The AVI routine is designed to read the code from a vehicle tag even with large amounts of noise present. Because of the extra interrogations required, the fastest that a tag can be read in AVI mode is 800ms. If there is a great deal of noise present then this time increases accordingly. If the tag has still not been read after 10 seconds then the routine resets and starts again.

### Noise sensitive interrogation (auto-select)

When configured for auto-select interrogation, the Readers automatically select standard or vehicle interrogation depending on the RF noise present, thereby combining the advantages of both methods (speed of standard interrogation, noise rejection of AVI interrogation). The Reader takes a noise sample from the antenna before each poll. If the level of noise is above a certain threshold then it switches to vehicle interrogation.

After the Reader has switched to vehicle interrogation, it must receive fifteen noise-free samples before automatically switching back to standard interrogation. This will happen very quickly after the noise has stopped, fifteen samples taking approximately 300ms.

### Reading routine when a card stays in the reading area (anti-loiter)

When a valid card is read, the Reader sends card data to the host, and then stops polling the antenna for the hold-off time. After the hold-off time has elapsed, the Reader polls the antenna to check for the presence of a card. There are then three possibilities:

- There is no card in range of the Reader. In this case the Reader continues polling at 25ms intervals.
- There is a different card in range of the Reader. In this case, the Reader reads 64 bits of card code.
- The same card remains in range of the Reader. In this case the anti-loiter routine is activated to preserve the life of the battery in an active card.

In anti-loiter mode, operation returns to normal immediately if the card is removed or a different card is detected.

The typical life of a card left continuously in range of the reading head or loop will exceed one year.

## Using cards

### Wearing a card

You will find the system easiest to use if you wear your card at the same height as the reading heads installed in your building.

Clip the card to a pocket, belt, shirt, blouse or anywhere else that is convenient. A card works whether it is concealed by clothing or not,

so you can wear it either outside or inside. It will also work in a briefcase, handbag or wallet, but it is recommended that you always wear your card to get full benefit from the system.

Accessories are available to help you wear your card. Your system supplier can provide you with clips, neck-chains, pouches etc. Note: neck-chains must not be passed directly through the slot in the card because the chain will wear out the slot.

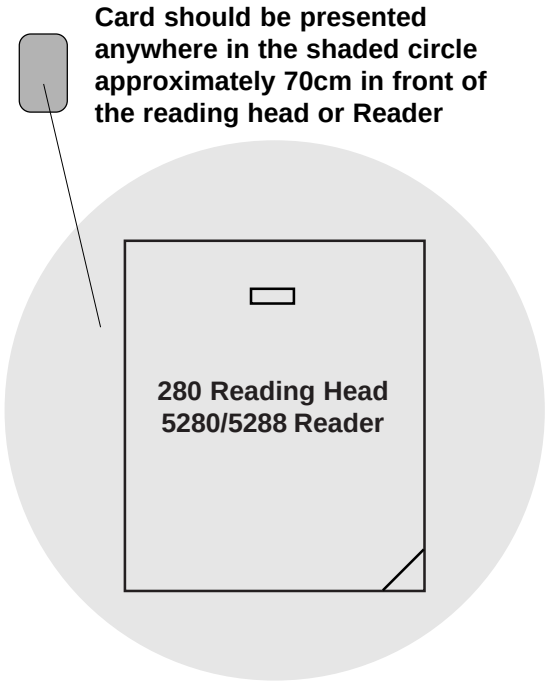
## Using a card with the 280 Reading Head, 5280 Reader or 5288 Reader

A 280 Reading Head or 5280/5288 Reader has a range of up to 90cm with a 928 Card. When your card comes within this range the card is read and the host access control system unlocks the door.

Move your body towards the reading head and wait for the green light to come on. You do not need to hold the card in your hand.

The best place for your card is with the face towards the reading head approximately 70cm in front of it. For the 280 Reading Head or 5280/5288 Reader, the card should work anywhere in the shaded region shown in the diagram below.

**Figure 5-2 Presenting a card to the 5280/5288 Reader or 280 Reading Head**



## Using a card with the 090 Reading Head

Because the 090 Reading Head is very small, it is designed for use with a hand-held card. Present the face of the card about 20cm away from the reading head and wait for the green light to come on.

## Using a card with a loop antenna

A loop antenna is a piece of wire surrounding the door, so you won't be able to see it. It has a long range and the door should unlock as you walk up to the threshold. Because of the long range it is very easy for two cards to be in range at the same time which will prevent them from being read. Make sure that only one person at a time walks up to the door.

## Looking after a card

- To get the best results from the system, wear your card at all times.
- Don't let the card get too hot - for example if left in a car on a sunny day. The operating temperature range for the card is -20 to +50°C.
- Don't let the card get wet and especially not submerged. Don't send your card to the laundry!
- Don't deliberately bend the card and take care not to sit on it in your pocket.
- Do not dispose of the card in a fire.
- To clean the card, use a damp cloth. Don't use any solvents and don't immerse it in anything.
- Use clips with the cards, not chains.

## Typical reading ranges for cards and tags in the correct orientation

| | **928 Card** | **911 Keyring** |
|---|---|---|
| **280** | 90cm | 75cm |
| **090** | 30cm | 25cm |

Chapter 6

# Loop antennas

## How to use this chapter

This chapter describes all three types of loop antenna which can be driven by the 5270 Loop Reader or 5311/5312 Reader Interface, how to install them, connect them and operate them.

The chapter is divided into four sections. You must read the **General** section (section **1**) and then the relevant section (**2 - Side loops**, **3 - AVI loops** or **4 - Door loops**) for the type of loop you are installing.

### Summary of section 1 - General

Important information contained in this section:

- What to do when there is electrical **noise** affecting the loop antenna, including **how to connect the attenuator circuit in the Loop Coupler**.
- Using the 922 Test Card. **You must have a 922 Test Card** before attempting to install any loop antenna system.
- Installing and **connecting the Loop Coupler**, including which type of cable you should use.
- Setting up, including **tuning the Loop Coupler**.
- **Connecting the 272 Remote Indicator** to let the cardholder know when the door is unlocked.

The information above is not repeated in any of the other sections describing each type of loop. You must refer to the **General** section for all connection information.

### Summary of section 2 - Side loop

A side loop behaves like a large 280 Reading Head which can be customised for various situations. There are few problems with the installation and operation of a side loop.

## Summary of section 3 - AVI loop (for automatic vehicle identification)

An AVI loop reads Vehicle Tags attached to the underside of vehicles. There are few problems with the installation and operation of an AVI loop.

## Summary of section 4 - Door loop

A door loop reads personnel tags (usually the 928 Card) as the cardholder approaches the door. Door loops can be tricky to get working, especially in electrically noisy sites. Important information contained in this section:

- **Doing a site survey**. This is **essential** - in some noisy situations a door loop can **never** be made to work.
- What **shape** door loop to choose.
- What to do about door loops around **metal doors** and/or doorframes.
- **Noise cancelling** using pairs of discrete receive antennas .

# Section 1 - General

By using the 5270 Loop Reader, or a 5311 Reader Interface driving a 270 Loop Coupler, you can make your own loop antenna using ordinary single core wire.

The simple **door loop** is a single loop of wire which combines both the transmit and receive functions. It can give a wider and deeper reading area than a standard 280 Reading Head providing the site in which it is installed does not have too much background RF noise and the doors/doorframes are not made of metal. For these reasons it is essential to carry out a site survey before specifying door loops - in a particularly noisy site they may not work at all!

The **side loop** can be a few turns of a single wire, or can have separate transmit and receive antennas, acting like a much larger 280 Reading Head. It is less susceptible to noise than the simple door loop, but is still more susceptible than the 280 Reading Head.

The **AVI loop** is a special configuration designed for use with vehicles and the 970 Vehicle Tag.

In reasonably noise-free conditions, a loop antenna should give a reliable reading range of at least 1.2 metres, and can give much more.

## Advantages

- Wide and deep reading area.
- Long range (1 metre plus).
- Can be easily hidden around door frame or corridor, or can be buried in a wall.

## Disadvantages

- Lower noise immunity than Reading Heads.
- More difficult than Reading Heads to install and set up.
- If you need to install a door loop around metal frame doors then a different method of installation is needed. Even then, the range will be reduced.
- Extra range can give unwanted reads.
- Reading nulls and variations in range from card to card may be more noticeable.

## Noise

All loop antenna systems are more susceptible to noise than Reading Heads and you must do a site survey using an 855 Installation Alignment Meter (IAM) before installing a loop. Noise reduces the receive range of the system, in some cases to zero. The best solution is to remove the source of the noise, or move the loop away from the source. If the noise cannot be removed, an improvement can usually be obtained by connecting the attenuator circuit which is built into the Loop Coupler. If this doesn't work then you can try noise cancelling using one or two pairs of discrete receive antennas, see section 4 on Door Loops.

### Connecting the Loop Coupler's attenuator circuit

The attenuator circuit on the Loop Coupler circuit board is shorted out by switches 2 and 3 of SWA. To connect the attenuator, open switches 2 and 3 on SWA (move them to the OFF position). Test the system to see if the receive range is improved. If further attenuation is required, close switch 1 on SWA (leaving 2 and 3 OFF). Note that with the 5270 Loop Reader, the Loop Coupler circuit board is inside the Reader's case.

## Using the 922 Test Card

When setting up a loop antenna system, you should always use a 922 Test Card. (**If you don't have Cotag test equipment**, **the 922 Test Card is essential**.) The 922 Test Card is the same as a normal 928 Card, except that it has an LED connected across the output coil. The LED therefore lights whenever the card is switched on. The 922 Test Card is made from clear plastic so you can see the LED.

### Checking the transmit range of an antenna using the 922 Test Card

Bring the 922 Test Card towards the antenna. At a certain distance from the antenna the card is switched on and the LED flickers. This is the transmit range of the antenna.

### Checking the receive range of an antenna using the 922 Test Card

Bring the 922 Test Card towards the antenna. If the LED flickers, the card is inside the transmit field but is not being read. Bring it closer to the antenna until the LED in the Test Card lights brightly in long pulses. This distance is the receive range. Note that if the transmit range is less than the receive range, the 922 Test Card will only display the transmit range.

## 270 Loop Coupler

Loop antennas use the 270 Loop Coupler between the Reader Interface and the loop antenna itself. In the 5270 Loop Reader, the Loop Coupler circuit board is enclosed within the Reader's case and so does not have to be mounted as described below. The Loop Coupler provides impedance matching, filtering and tuning to enable the wire loop to read cards.

### Installing

Mount the Loop Coupler in any convenient position **within 10m of the loop antenna**. Make sure there is access for cables and for setting up.

The Loop Coupler can be installed outside if required providing the following conditions are met:

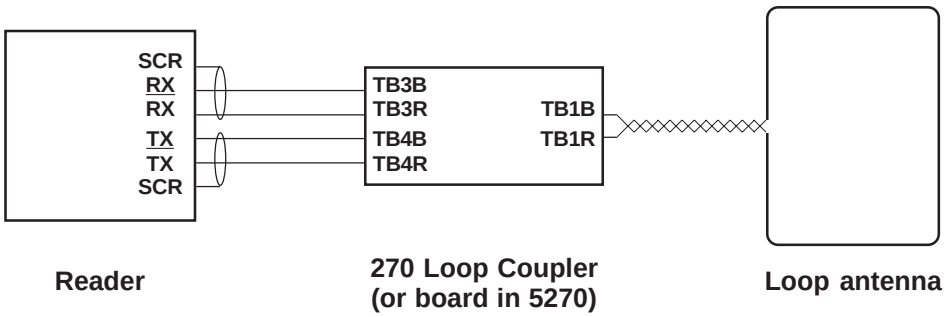
- It should be fixed to a vertical surface with the long axis horizontal.
- The cable glands must face downwards.
- Cables should be looped up to the box to avoid moisture running down them and through the glands.
- The gland should be tightened onto the cable.
- The Loop Coupler must not be buried or subjected to the risk of immersion in water.

## Cable

**5311 Reader Interface to 270**: use 812 Cable, or cable with 0.38mm$^2$ (22AWG) conductors (for example Belden 8723 or equivalent for twin twisted pair). For distances between 200 and 300 metres you must either use 812 Cable, or cable with 0.5mm$^2$ (20AWG, 16/0.2) conductors.

**Loop**: single core 20AWG minimum, 16AWG or 18AWG recommended, eg BELDEN 9916 or 9918. Cable for the AVI loop must be suitable for direct burial, eg BELDEN 9438.

## Connecting the Reader Interface, Loop Coupler and loop antenna (combined transmit and receive)

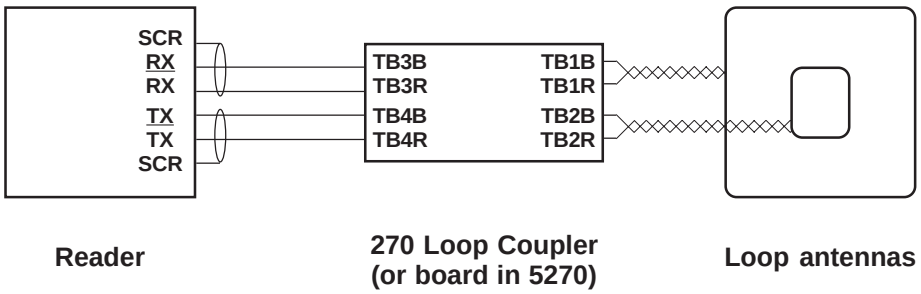



**Maximum cable lengths:**
**5311 to 270: 300m with 20AWG or 812 Cable**
**270 or 5270 to loop: 10m, must be twisted**

Notes:

- Leadouts from loop antenna to Loop Coupler or Loop Reader must be twisted and be less than 10 metres in length.
- Cable screens should be connected at the Reader Interface only. At the Loop Coupler they should be cut back and insulated.

## Connecting the Reader Interface, Loop Coupler and loop antenna (separate transmit and receive antennas)




**Maximum cable lengths:**
**5311 to 270: 300m with 20AWG or 812 Cable**
**270 or 5270 to loops: 10m, must be twisted**

Notes: as above plus

- Move switches 4 and 5 of DIL switch SWA on Loop Coupler circuit board to the OFF position to separate Tx and Rx (but do not do this for a loop with combined transmit and receive).

# Setting up

## Tuning the Loop Coupler

(Note: if you are using a 5270 Loop Reader, the Loop Coupler circuit board is inside the Reader's case.)

Make sure RV1 on the Loop Coupler circuit board is turned fully clockwise (for maximum transmit). Set a multimeter to a range capable of handling 20V DC and connect the negative probe to the 0V pin and the positive to the MON pin on the Loop Coupler circuit board. Power up the Reader. Adjust the capacitance value using switches SWB 1 to 8 on the Loop Coupler circuit board until the voltage is maximum. It may be necessary to choose a lower voltage range on the multimeter in some installations. Capacitors are in circuit when the switch is in its ON position. The approximate capacitance values are marked on the board (in nanofarads) beside each switch. If an analogue meter is used, the voltage change associated with the smallest capacitors will be hard to see, but it is important to get the highest possible voltage.

To find the capacitor setting for maximum field, take the following steps:

1. Find the largest single value by trial and error leaving all other switches OFF. This will be either a little too great or a little too small.

2. Leaving this switch ON, find the next largest value which increases the voltage. If all other values decrease the voltage then the first value was a little too great. Switch it OFF and switch ON the next lower value.

3. Repeat the last step until the highest voltage is achieved.

4. Select the best setting of switches 6, 7 and 8 on SWA. **Note**: only one of the switches 6, 7 and 8 must be closed (ON) at one time - try each switch in the closed position with the other two open and again check for the highest voltage. If a different switch is selected, slight retuning may be required.

## Setting the transmit range

Measure the transmit range around the loop antenna using an 851 Field Meter or 922 Test Card. If you wish to reduce the transmit range of the loop, turn RV1 on the Loop Coupler circuit board counter-clockwise until the Field Meter or Test Card shows that a Card will be read reliably at the range you require. Points to consider when setting the range are:

- The field extends both sides of the loop.

If the door is on the side of a corridor and the range is long, cards moving past the loop may get read unintentionally, possibly opening the door.

- Are there stationary cards close to the loop?

  People may hang jackets or handbags containing cards close to the door. This may include shelves, racks and desks in the office next door or on the floors above and below. Ensure that the range of the loop is not so large as to activate other cards, or keep cards further away.

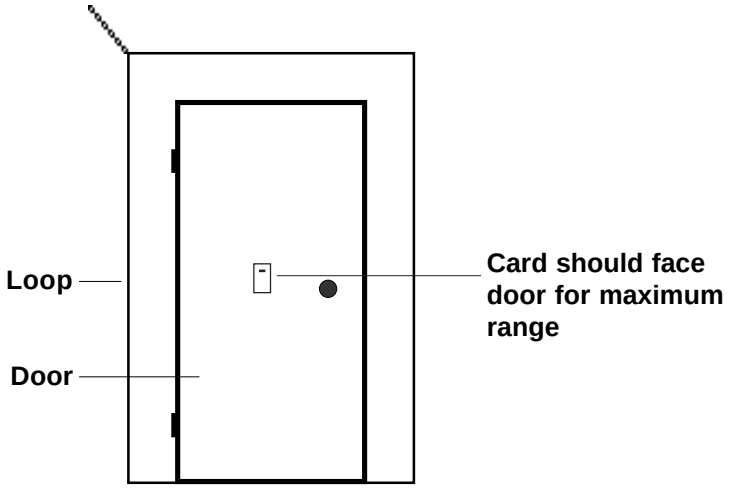
- What is the usage of the door?

  For doors where people approach quickly, a large Tx range will mean that the card will start being read earlier so there will be less of a delay before the door opens. However, if two people approach the door then both cards may be activated and the door will not open until one card is much closer to the loop.

The best range setting will be found by trial and error.

Typical ranges for a card worn on the hip or round the neck are 1.0 to 1.5 metres.

In use, card orientation is important. For best results the card must be presented parallel to the loop.




For a door loop, this means that leaving the card in a jacket side pocket or hanging from the side of the hip will give reduced performance unless the cardholder approaches the door sideways!

## 272 Remote Indicator

Unlike Reading Heads, loop antennas have no LED indicators to show the cardholder when the door is unlocked. The 272 Remote Indicator provides red, amber and green LEDs for use with loop antennas (or hidden 280 Reading Heads). It should be mounted where it can be seen by people as they walk up to the loop antenna. (Make sure they don't think it is an 090 Reading Head.)

The connections to the 272 Remote Indicator are as follows:

| 5311 | 272 | Function |
|---|---|---|
| R | terminal 2 | red LED (-) |
| G | terminal 4 | green LED (-) |
| A | terminal 3 | amber LED (-) |
| VA | terminal 1 | LEDs common anode (+) |

# Section 2 - Side loop

A side loop can, in suitable sites, provide greater range than a 280 Reading Head.

## Advantages

- Gives greater reading range than a 280 Reading Head.
- Much more tolerant of noise than a door loop.
- Easily concealed, either behind the wall or buried beneath the plaster.
- Can be mounted inside a free-standing enclosure.

## Disadvantages

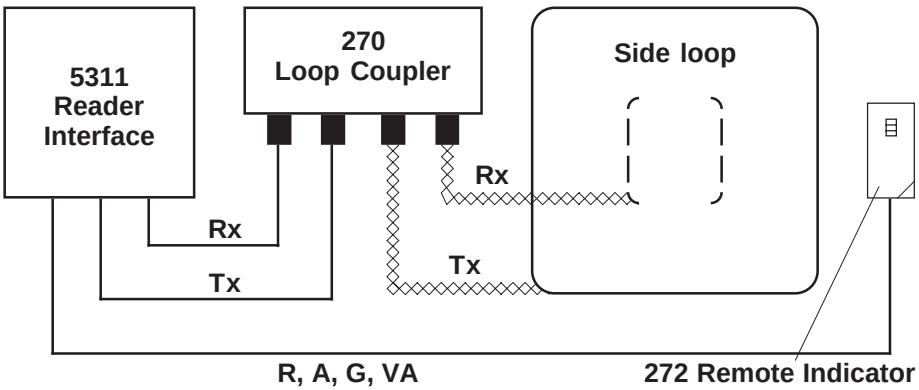
- More expensive and time consuming to install than a Reading Head. You may have to bury the loop in the wall.
- Lower noise immunity than a 280 Reading Head, but much better than a door loop.
- No LED indicators, so a 272 Remote Indicator must be used.

## Applications

Side loops are particularly suitable in the following situations.

- Near metal doors where a door loop will not give sufficient range.
- Long range reading of drivers' cards inside vehicles.

The following diagram shows how a side loop system can be implemented.

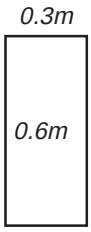



Normally, a side loop system uses a combined transmit and receive loop. The separate receive loop (shown as a dashed line in the above diagram) is only required if the the receive range of the single loop system is being reduced by noise.

See the next section for details of different side loop configurations and dimensions.

## Dimensions of side loops

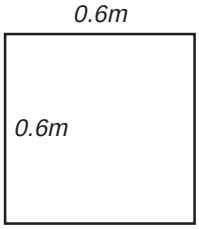
Good results have been obtained with the following configurations:




**Combined transmit and receive side loop**
**300mm x 600mm (1'x2')**

| | |
|---|---|
| Loop dimensions: | 300mm x 600mm |
| Recommended turns: | 4 |
| Wire size: | 1.0mm², 18AWG, 32/0.2 |
| Normal range at centre: | 1.2m (4') |

Note: separate Rx antenna not usually necessary.

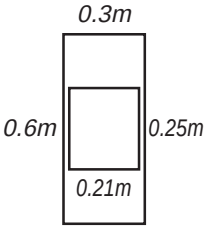



**Combined transmit and receive side loop**
**600mm x 600mm (2'x2')**

| | |
|---|---|
| Loop dimensions: | 600mm x 600mm |
| Recommended turns: | 3 |
| Wire size: | 1.0mm², 18AWG, 32/0.2 |
| Normal range at centre: | 1.5m (5') |

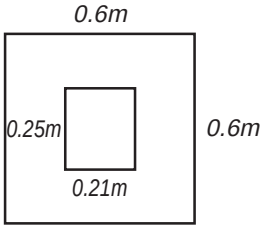
Note: separate Rx antenna not usually necessary.

In the few circumstances where the two side loops described above will not give their normal range, it is probable that noise is reducing the loop's receive range. If this happens then try using a separate receive antenna as described below:




**Separate transmit and receive side loops**
**300mm x 600mm (1'x2') or 600mm x 600mm (2'x2')**

| | |
|---|---|
| Transmit loop: | 300mm or 600mm x 600mm |
| Recommended turns: | 4 or 3 respectively |
| Wire size | 1.00mm², 18AWG, 32/0.2 |
| Receive loop: | 210mm x 250mm |
| Recommended turns: | 8 |
| Wire size: | 0.5mm², 20AWG, 16/0.2 |
| Normal range at centre: | 1.5m (5') |




The Tx and Rx loops should be coplanar, with the Rx loop mounted centrally within the Tx loop.

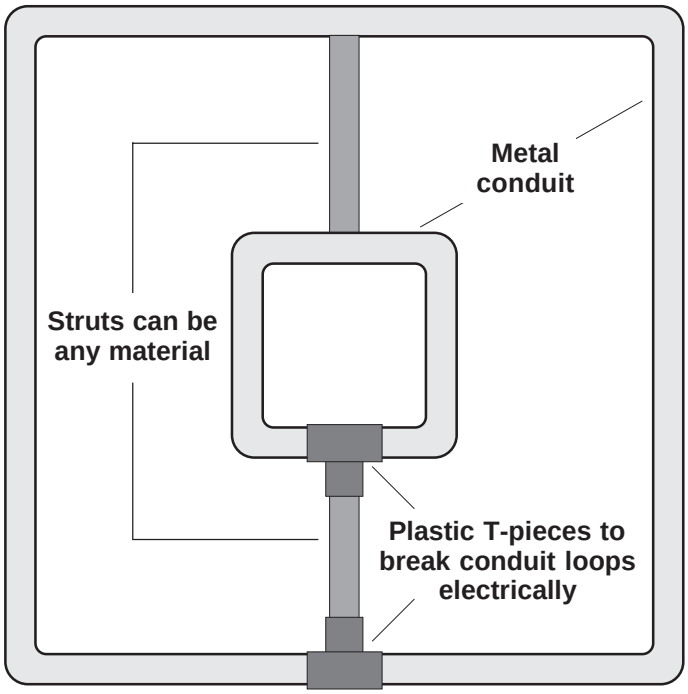
## Position

For personnel applications, mount the side loop so that its centre is 1 metre above the floor. This is a good compromise for varying heights of people with cards worn around the neck or at the waist.

For other applications, mount the loop so that its centre is the same height as the cards or tags to be read.

## Installing

The side loop can be installed between a partition wall, or behind a brick wall, or buried under plaster. It can also be formed inside plastic conduit. Metal conduit can be used but the metal must be broken so that it forms no closed loops, as shown in the diagram below.




## Connecting a side loop

Connect a **combined transmit and receive** side loop as shown in the diagram at the beginning of this chapter, in the section entitled "Connecting the Reader Interface, Loop Coupler and loop antenna (combined transmit and receive)". Connect a side loop with **separate transmit and receive** antennas as shown in the diagram at the beginning of this chapter, in the section entitled "Connecting the Reader Interface, Loop Coupler and loop antenna (separate transmit and receive antennas)".

## Setting up

Tune the loop using a multimeter and the Loop Coupler switches as descibed in the section on “Setting up the system” earlier in this chapter.

Measure the transmit range around the loop antenna using an 851 Field Meter or 922 Test Card. If you wish to reduce the transmit range of the loop, turn RV1 on the Loop Coupler circuit board counter-clockwise until the Field Meter or Test Card shows that a Card will be read reliably at the range you require.

## Adapting side loops to different situations

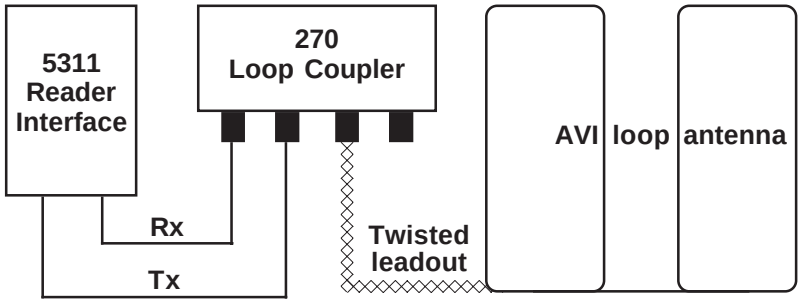
The dimensions recommended have been found to give satisfactory results in most cases. If, however, you have an application where the recommended sizes and shapes are difficult to achieve, you can vary them by experiment and still get good performance.

General guidelines to follow:

- Keep the area of the loops approximately as specified.
- Avoid aspect ratios greater than 2:1.
- The loops do not have to be rectangular: minor irregularities in their shape to avoid obstacles should not reduce the performance.
- If you have to change the area significantly you can add or subtract turns to compensate: add turns if you reduce the area and subtract turns if you increase it.
- It is unlikely that you will gain any benefit by reducing the size of the Tx loop. Equally, the Rx loop is probably optimum at the size specified.

# Section 3 - AVI loop (for automatic vehicle identification)

Automatic Vehicle Identification is accomplished using a 5311 Reader Interface which drives an AVI loop antenna buried in the roadway. The vehicle carries a Vehicle Tag attached to its underside.



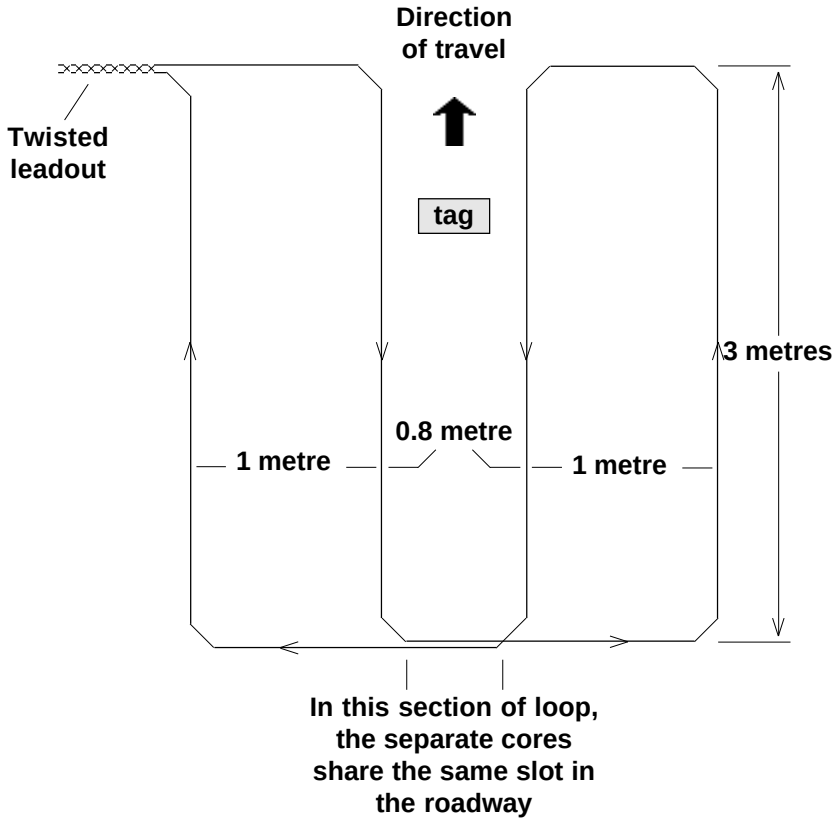

The 5311, 5312 and 5270 Readers can be configured to use the special AVI routines to interrogate a vehicle tag if the RF noise level is too high for standard interrogation to work. AVI interrogation is more rigorous and takes a minimum of 0.8s to read the tag code, but can take significantly longer if the vehicle is producing a lot of RF noise. The driver must therefore draw to a halt over the road loop in order to ensure positive recognition. This also permits appropriate action to be taken if the vehicle is not authorised to gain entry.

## Installing

The **5311 Reader Interface** should be installed in a building and not outside.

The **loop antenna** should be insulated multi-strand of at least $1mm^2$ cross sectional area (eg 32/0.2) buried to a depth of about 25 to 35mm in the roadway. Cable for the AVI loop must be suitable for direct burial, eg BELDEN 9438.

Its dimensions and direction of laying are shown in the following diagram.

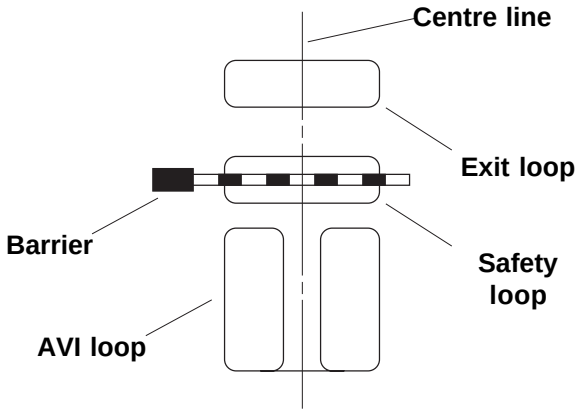



The wires from the loop to the Loop Coupler should be twisted and kept to the minimum practical length, which should not exceed 10m in any case.

The corners of the loop should be cut at 45 degrees to reduce stress on the wire. When the wire has been layed into its slot it should then be covered with epoxy resin, cement or any other suitable filler. If molten bitumen is used the wire insulation must be specified to withstand the high temperature.

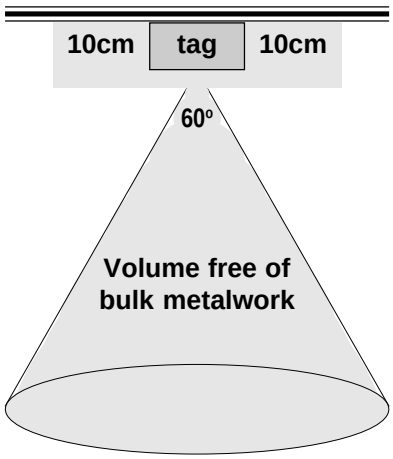
Most concrete road surfaces are laid using steel reinforcing rods. These will reduce the field available from the loop. Under most circumstances the system performance margins will be adequate to deal with this. It is however worth checking before confirming a loop location. The best way to do this is to tape the loop to the road surface and check the field level, see “Testing” below.

If a safety loop and/or exit loop are fitted, they should share the same centre line as the AVI loop:




The **Vehicle Tag** should be fixed under the centre of the vehicle at the front, preferably using cable ties passed through the fixing holes. The tag must be mounted with its long axis at 90 degrees to the direction of travel and at a height above the ground of between 20 and 50cm. In order to utilise the integral spacer and keep the tag antennas separated from nearby metal structures, the tag must be fixed with its moulded face furthest from the fixing point, that is with the exposed surface of the encapsulating material next to the metal of the vehicle.

When positioning the tag a 60 degree vertical cone with the tag at its apex should be kept free from all but fairly small metal structures. Similarly, no large bits of metal should be within 10cm of the ends of the tag, see diagram.



## Connecting

Connect AVI loops as shown in the diagram at the beginning of this chapter, in the section entitled “Connecting the Reader Interface, Loop Coupler and loop antenna (combined transmit and receive)”.

## Setting up

Tune the loop using a multimeter and the Loop Coupler switches as described in the section on “Setting up the system” earlier in this chapter.

## Testing

Use the 851 Field Meter to check the field level at the geometric centre of the loop. At least the first red bar should be illuminated at a height of 0.8m above the road. This test can be done with the loop taped to the road to check that the location does not have too much metal reinforcing.

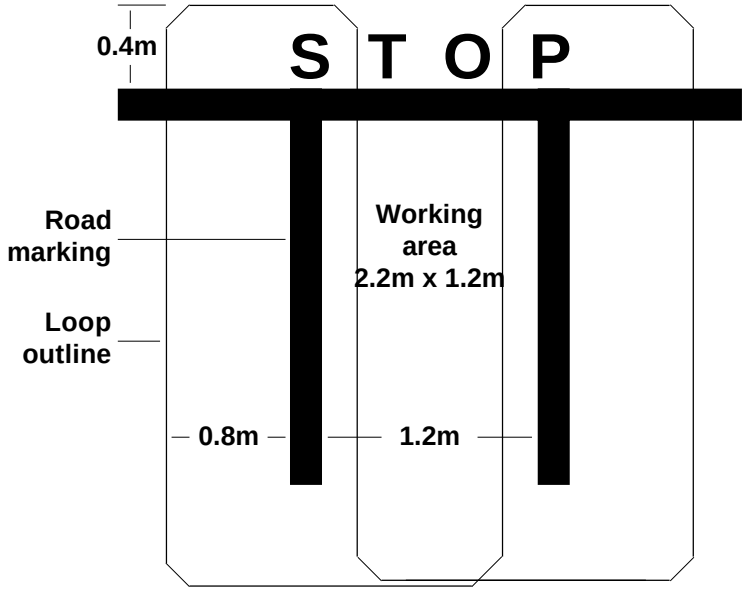
Power up the rest of the system and check for correct operation with a known tag code. Finally try several vehicles drawing to a halt over the loop.

## Operation

Operation of the system is simple. Vehicles should draw to a halt with the tag over the loop, wait to be identified and then move off when a barrier is raised, light changed, etc.

To make this process as easy as possible for the user it is worth while taking some care over positioning the loop and marking out the road, so that users always stop with their tag in the best position over the loop.

The diagram below shows the expected normal working area within the loop and the recommended road marking.




This section of handbook is confined to AVI components supplied by Cotag International. In most applications the Cotag equipment will be integrated by the Distributor with the rest of a vehicle management system. This should at least include a vehicle sensor to close the barrier after the vehicle has passed, together with a control circuit to open and close the barrier. **You must check that this equipment does not interfere with the receive circuitry in the 5311 Reader Interface**.

# Section 4 - Door loop

There are three different approaches to setting up a door loop depending on the circumstances:

- For wooden or plastic doors and door frames in surroundings which are not too noisy, you can use a single loop of 1 or 2 turns around the door acting as both transmit and receive antenna. The loop is connected to a 270 Loop Coupler (or to the Loop Coupler board inside a 5270 Reader) which is used to tune the antenna and filter the signals. The Reader drives the Loop Coupler.

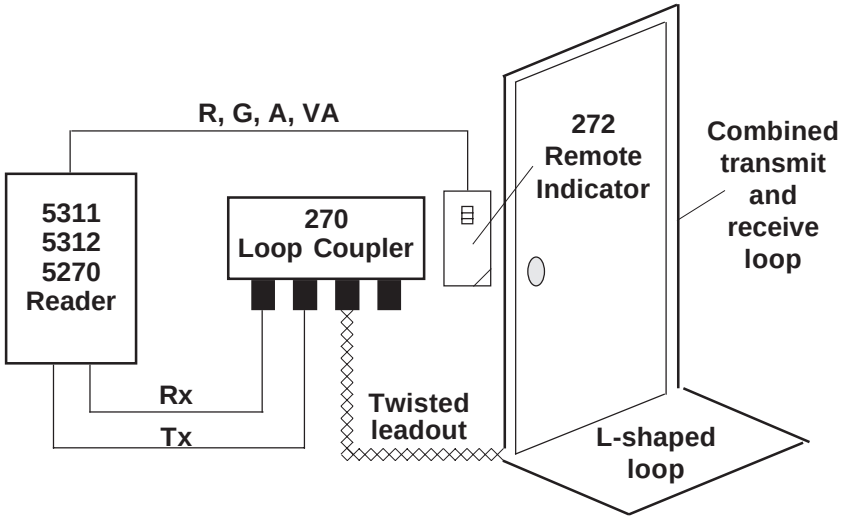
- For metal doors or frames, a loop of 2 turns must be mounted in plastic trunking at least 30mm from the metal (see later). If the construction of the door enables an L-shaped loop to be installed (see later) then the loop need only be spaced 10mm away from the metal. Metal reduces the transmit range of the system.

- For doors which are in a noisy environment, separate 250 Receive Antennas* are required. The loop antenna is used only as the transmit antenna. This necessitates changing switch settings on the Loop Coupler circuit board so that the Rx is taken from the 250 Rx Antenna and not from the loop (see later). Noise reduces the receive range of the system.

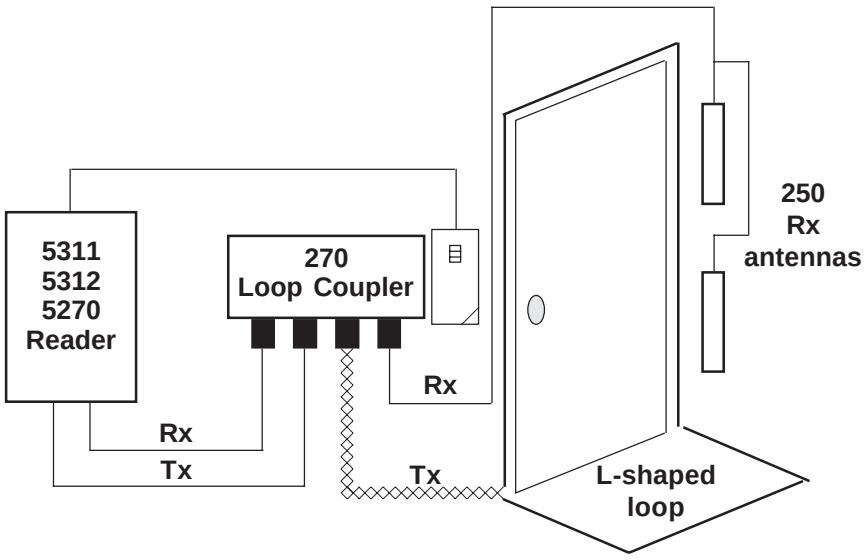
The installer can decide which of the above three methods is appropriate.

**Tags with orthogonal antennas (such as the Industrial Tag and Agricultural Tag) also require the use of a 250 Receive Antenna.*

The following diagram shows the hardware used to connect a door loop to the 5311 Reader Interface. This is the most common type of installation, using the loop antenna for both transmit and receive.




If there is too much RF noise in the reading area then the loop is used for transmit only and two 250 Receive antennas are arranged so as to cancel the noise as shown in the following diagram - see later for details.



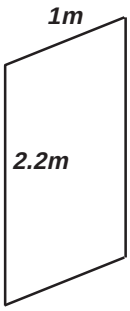

Note: if you are using the 5270 Loop Reader, the Loop Coupler circuit board is inside the 5270 Loop Reader's case and the Tx and Rx connections shown in the above diagrams are already made.

## Site survey to check for electrical noise

With a single loop it is impossible to use noise cancelling techniques so it is very important to check the site before contemplating installing a loop. **Always perform the site survey during a normal working day, when all personnel are at their desks and all equipment is switched on**. Using an IAM and noise probe on the CAL setting the reading should be less than 100 over the entire loop area. When checking noise you should be aware that situations can change. Noisy equipment may be turned off when you check the levels and when turned on may reduce the loop receive range. Some noise sources may be portable or may move. Be especially careful of colour video monitors used on personal computers. These produce very large amounts of noise in certain directions. They should be kept at least 10 metres from the loop in all directions. This includes offices on floors above and below the loop. If noise becomes a problem you can try connecting the attenuator circuit in the Loop Coupler as described in the section on “Noise” at the beginning of section 1 of this chapter, or if that fails you must install separate receive antennas, see later.

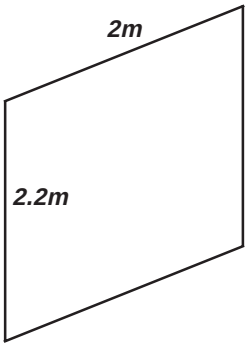
## Dimensions of door loops

Good results have been obtained with the following configurations:



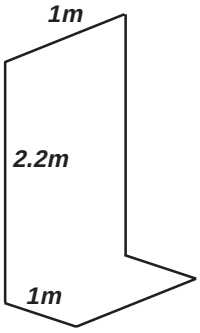

**Single door, non-metallic, 1m x 2.2m (3'x7')**
**Flat loop**

| | |
|---|---|
| Loop dimensions: | 1.0m x 2.2m |
| Recommended turns: | 1 or 2 |
| Wire size: | 1.0mm², 18AWG, 32/0.2 |
| Normal range at centre: | 1.5m (5') |



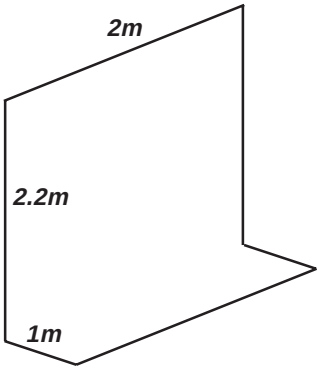

**Double door, non-metallic, 2m x 2.2m (6'x7')**
**Flat loop**

| | |
|---|---|
| Loop dimensions: | 2.0m x 2.2m |
| Recommended turns: | 1 |
| Wire size: | 1.0mm², 18AWG, 32/0.2 |
| Normal range at centre: | 1.5m (5') |




**Single door, metal construction, 1m x 2.2m (3'x7')**
**L-shaped loop**

| | |
|---|---|
| Loop dimensions: | 1.0m x 2.2m x 1.0m |
| Recommended turns: | 2 |
| Wire size: | 1.0mm², 18AWG, 32/0.2 |
| Normal range at centre: | 1.5m (5') |



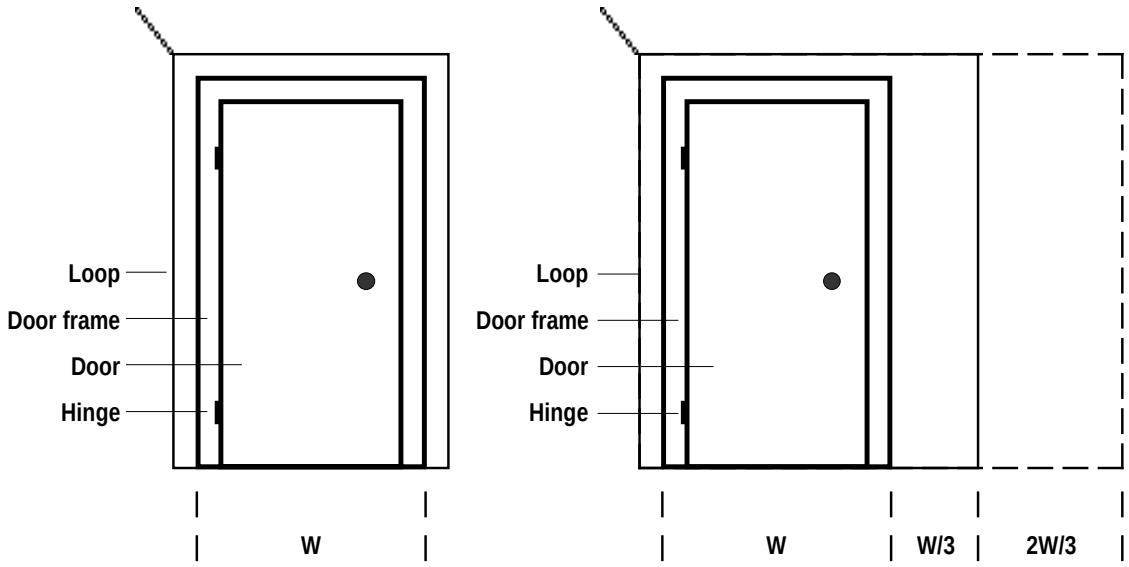

**Double door, metal construction, 2m x 2.2m (6'x7')**
**L-shaped loop**

| | |
|---|---|
| Loop dimensions: | 2.0m x 2.2m x 1.0m |
| Recommended turns: | 2 |
| Wire size: | 1.0mm², 18AWG, 32/0.2 |
| Normal range at centre: | 1.5m (5') |

## Installation of a simple combined Tx/Rx loop

For best results the loop wire should be 1.0mm² (18 AWG) stranded such as 32/0.2mm. Smaller wire or solid core wire will reduce the effectiveness of the loop and is not recommended.

In operation, it is best for the card to approach the middle of the loop. When access is gained through a normal single door, people tend to walk through the opening gap and will, therefore, be to one side of the door frame. To give the maximum freedom of approach to the door, the loop should be offset to the opening side of the door as shown in the diagram (this is not applicable to double doors).




This may be harder to install but it improves the performance considerably. The exact amount of the offset is not critical but between a third and a whole extra door width gives the best results.

The lead-out may be at any convenient position and the wires of the lead-out should be twisted together well, with not less than fifteen twists per foot or fifty twists per metre. These ends should then be connected to the Loop Coupler within a cable length of ten metres from the loop.

The Loop Coupler may be mounted in any convenient position allowing access for the cables through the cable glands. During commissioning the loop must be tuned using the switches in the Loop Coupler so this should be considered when siting the unit.

## Setting up

Tune the loop using a multimeter and the Loop Coupler switches as descibed in the section on “Setting up the system” earlier in this chapter.

Measure the transmit range around the loop antenna using an 851 Field Meter or 922 Test Card. If you wish to reduce the transmit range of the loop, turn RV1 on the Loop Coupler circuit board counter-clockwise until the Field Meter or Test Card shows that a Card will be read reliably at the range you require.

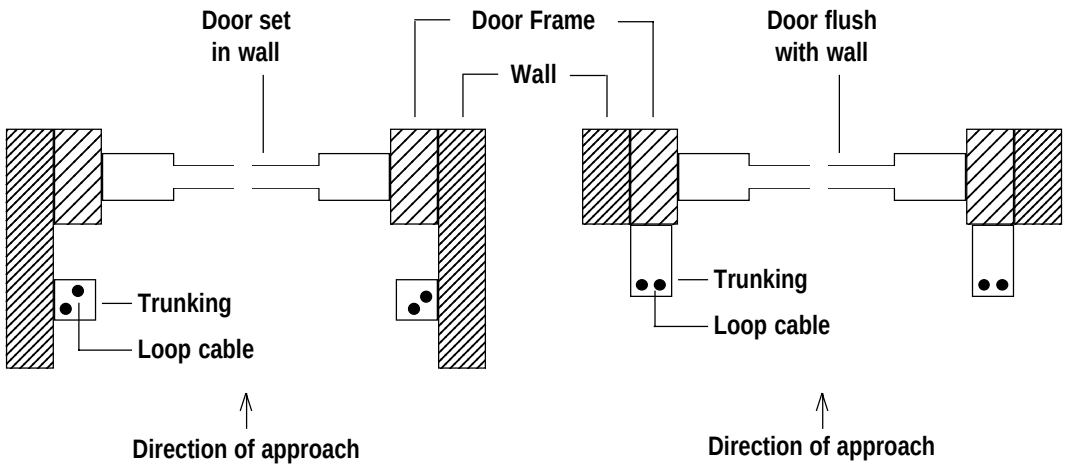
## Combined transmit and receive loops with metal doors

Metal doors and door frames can reduce the effectiveness of a single loop antenna considerably. If the door or frame metalwork forms a closed loop itself, it will draw power from the loop antenna reducing the transmit range. The actual reduction in range will depend very much on the size and construction of the doorway.

If it is essential to mount the loop near the metal door then ideally the closed loop should be broken by modifying the door construction. If this is not possible, you may be able to site the loop in the corridor leading up to the door rather than near the door itself; this will solve the problem.

If the construction of the doorway enables you to install an L-shaped loop, this is usually the best solution and should give good transmit range without being spaced away from the metal frame. The dimensions of the L-shaped loop are described in the earlier section entitled “Dimensions of door loops”. It should have 2 turns and the L-shaped part must extend out from the bottom of the door on the side you want the cards to be read. A loop around a metal door will not read cards on the other side of the doorway.

If you cannot install an L-shaped loop, the loop must be spaced at least 30mm from the metalwork as shown in the following diagram:




For doors set in walls or across corridors, the loop cable could be installed in plastic conduit or trunking or buried in the wall.

For doors fitted flush with the wall, 40mm x 25mm plastic trunking can be mounted edgewise on the frame with the loop cable fixed inside to the farthest edge from the door.

Note that a loop spaced away from a metal door will only work on that side of the door. On the other side, the range will probably be greatly reduced. You must make provision for people to exit without having their Cards read by installing a door exit button or Passive Infra Red detector (PIR) or other device to open the door from the other side.

## Using discrete receive antennas for noise cancelling

If the environment is particularly noisy, discrete receive antennas must be used in pairs to cancel the noise.

*Before you use receive antennas, first try connecting the attenuator circuit in the Loop Coupler (see "Noise" in section 1).*

Correct setting up and alignment of Rx antennas is vital if maximum performance is to be achieved with long range systems. The number of Rx antennas you should use depends on the circumstances:

- With a single small door use two Rx antennas.
- With a double or large door use four Rx antennas, a pair each side of the door.

### Locating the source of the noise

Use the IAM to locate the principal source of the noise. Use the sensitivity control on the IAM to keep the meter reading on the scale while moving the probe in the direction of increased readings until the source is identified. The best solution is to remove the source of the noise. If this is not possible then continue as follows.

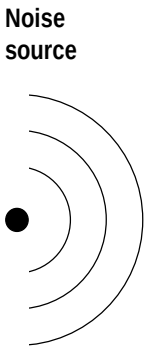
Mount the control equipment in its intended position but leave the antenna Tx and Rx feeder cables disconnected.

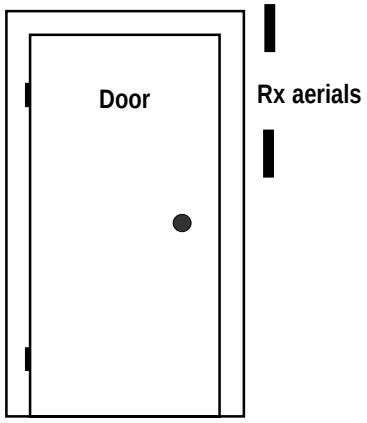
If the principal source of noise is less than 3 metres from the proposed site of the Rx antennas then either relocate the noise source or the antenna position, otherwise you will never get it to work.

If the noise source is situated at a distance greater than 3 metres from the Rx antennas, continue with the installation of the Rx antennas.

### Aligning Rx antennas

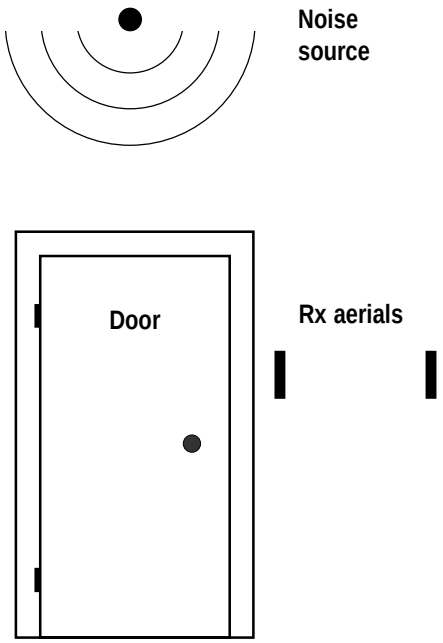
1. In most situations the Rx antenna will pick up least noise in the vertical orientation.




With two Rx antennas, if the noise source is from the side then one antenna should be positioned vertically above the other with a separation of about 60cm, as shown in the diagram on the left.

If the noise source is from above or below then the antennas should be separated horizontally, see diagram below.




The technique relies on the fact that a distant noise source will be almost exactly the same distance from both Rx antennas. If the signals from the antennas are connected in parallel and in antiphase then the noise will nearly cancel. The installation should be arranged so that cards are always presented much nearer to one Rx antenna than the other. The signal from that antenna will then be dominant and operation at nearly full range should be possible.

For best general performance try to position one Rx antenna just above the normal operating height of the Cards as shown in the diagrams.

Each antenna is tuned before it leaves the factory. If retuning is ever required, plug the antenna tuning cable (D01/197) into the IAM and connect one of the crocodile clips to each of the conductors of the feeder cable. Switch the IAM function selector to RxAe. With RV1 turned fully clockwise, tune the antenna by turning CV1 for a maximum reading on the meter. Note that an open circuit will give a meter reading beyond the full scale thus revealing that either the TX knob is not turned fully clockwise or there are bad or broken connections in the Rx antenna circuit. A correctly tuned antenna should give a reading of at least 40μA. If this cannot be achieved then the antenna may be faulty (such as a cracked ferrite rod).

2. Connect the antennas in parallel using screened twisted pair cable.

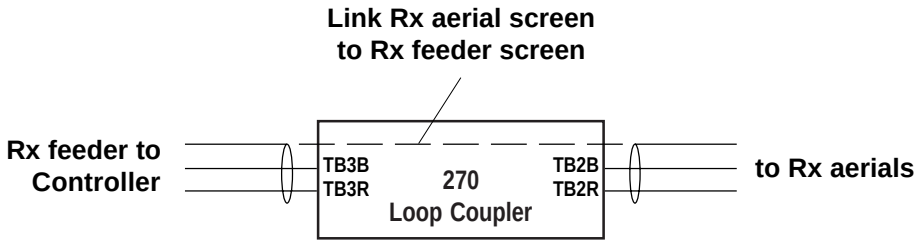
3. Monitor the combined signal from the two antennas using the Rx antenna lead D02/391 (see diagram below) with the IAM on the Noise setting. Note that either physical rotation of one antenna through 180 degrees or reversing connections to one of the antennas will reverse the phase of its signal.

View from outside


| Pin | Cable | Function |
|---|---|---|
| 2 | Blue | to Rx antenna |
| 3 | Red | to Rx antenna |
| 5 | Screen | |

Arrange for the antennas to be in antiphase, that is the connection and orientation which produce the least noise measured on the IAM. Adjust the output of the Rx antenna furthest from the intended card position by tuning RV1 in the Rx antenna to give a reading of less than 30. In the event that it is not possible to achieve a reading of less than 30, move the antennas closer together. Do not reduce the separation to less than 45cm between centres. If a reading of less than 30 still cannot be achieved try moving one antenna in an arc about the other, remembering that both should be equidistant from the noise source.

4. Secure the Rx antennas in the optimum position and connect the cables from the Rx antennas to the 270 Loop Coupler as shown below.




You must connect the Rx antenna screen to the Rx feeder screen. This can be done fairly easily inside the Loop Coupler's box because the two connectors involved, TB2 and TB3, are next to each other. The Rx antennas themselves are connected in parallel and in antiphase as stated earlier. This means that the cables from the Rx antennas will need to be joined, either using the TB2 connector in the Loop Coupler or using a terminal block outside.

When using discrete Rx antennas with the Loop Coupler in this way, you must move switches 4 and 5 on SWA on the Loop Coupler circuit board to the OFF position.

## Appendix 1

# Board layouts and description

**Figure A-1 Board layout for 5280/5288**

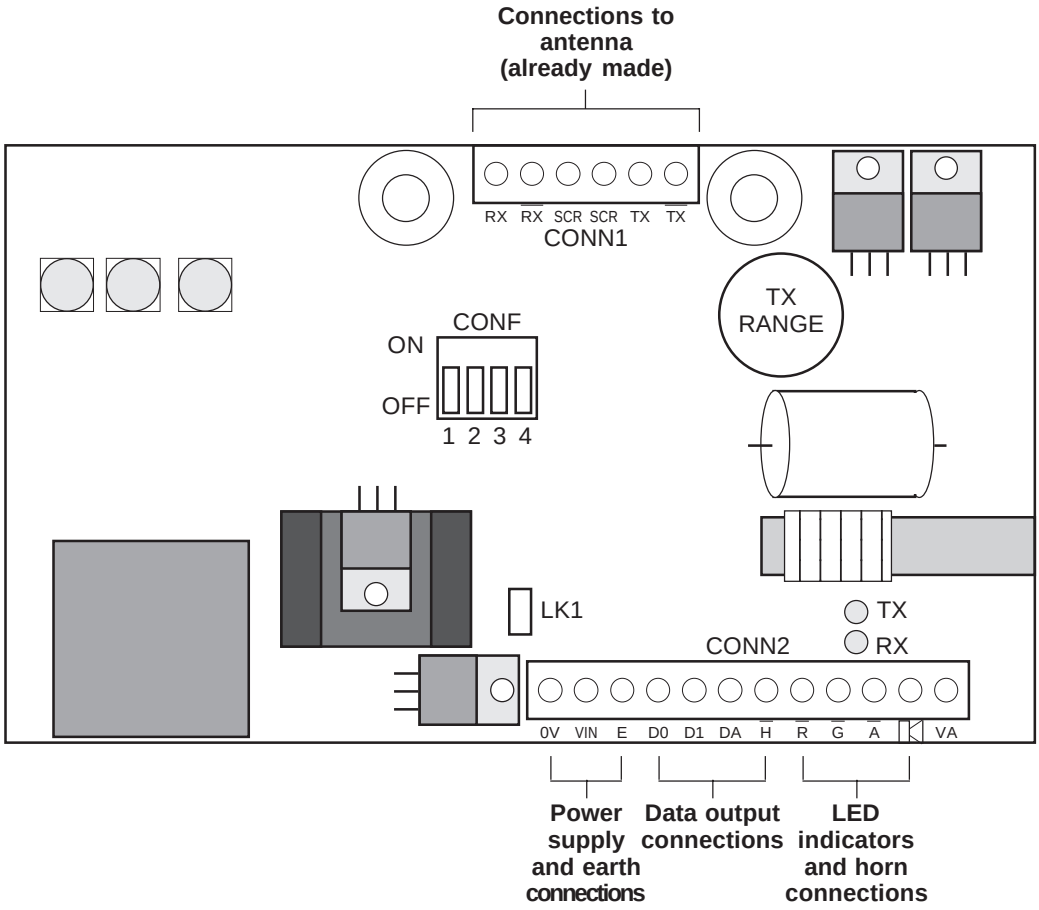


**Figure A-2 Board layout for 5311/5312**

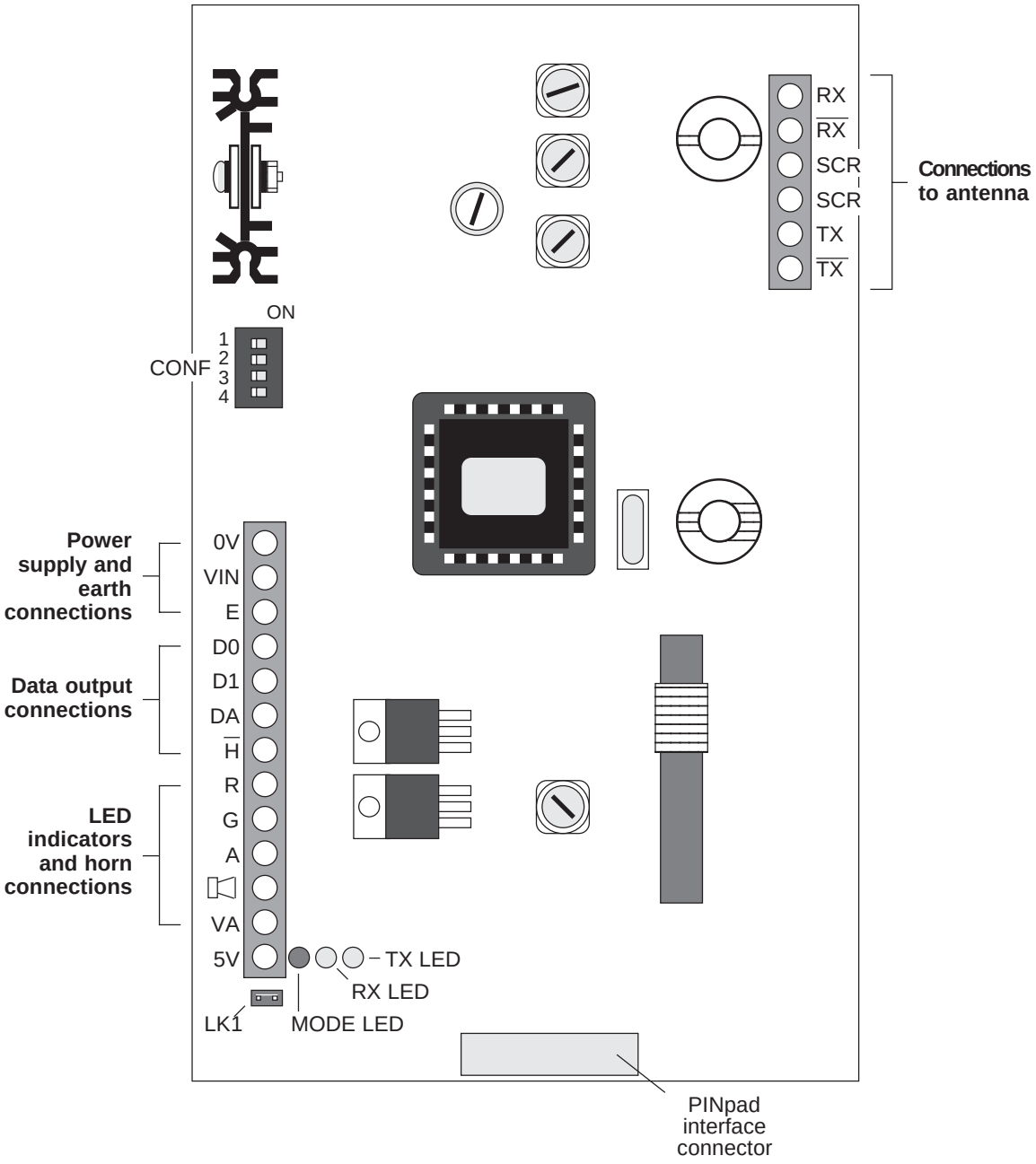
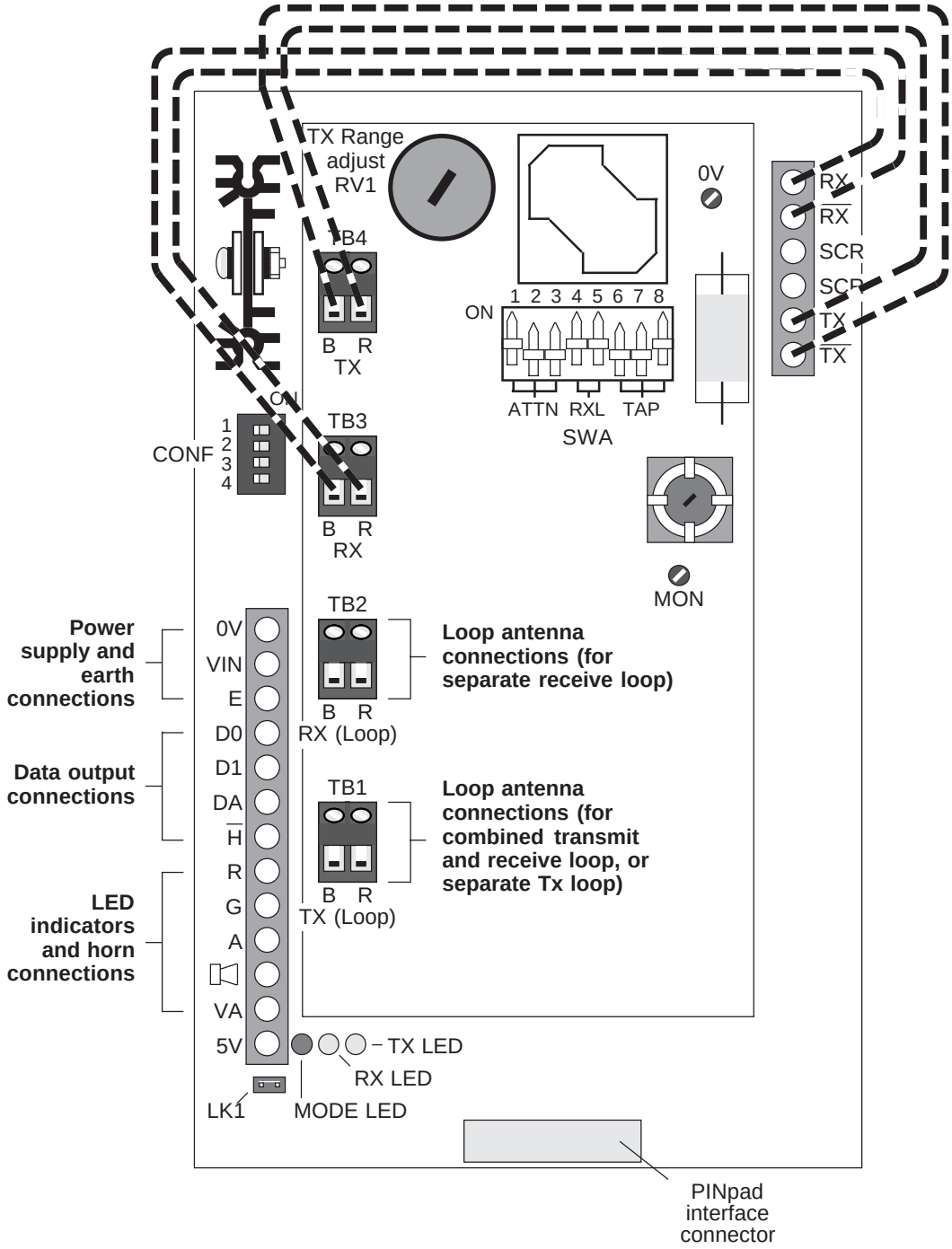


**Figure A-3 Board layout for 5270**



# Connectors

## CONN1 - antenna connections

(already connected on 5280, 5288 and 5270)

| | |
|---|---|
| RX | Receive line |
| RX | Receive line |
| SCR | Rx cable screen |
| SCR | Tx cable screen |
| TX | Transmit line |
| TX | Transmit line |

## CONN2 - power, data, LED and horn connections

| | |
|---|---|
| 0V | Power supply 0V (-ve),<br>(also ground reference for data output) |
| VIN | Power supply +12V unregulated<br>(max 15.6V, min 10.7V, 0.5A max) |
| E | Earth - link to 0V terminal |
| D0 | “Data Zero” for Wiegand<br>“Data” for Mag Stripe<br>“TXD” for ASCII |
| D1 | “Data One” for Wiegand<br>“Strobe” for Mag Stripe |
| DA | “Data Available” for Wiegand<br>“Present” for Mag Stripe<br>“RTS” for ASCII |
| $\overline{H}$ | “Data Hold” for Wiegand |
| R | Red LED cathode (-ve) |
| G | Green LED cathode (-ve) |
| A | Amber LED cathode (-ve) |
|  | Horn (-ve) |
| VA | LEDs common anode, horn (+ve) |

# CONF switch

## Operating mode and horn on valid card

| | | |
|---|---|---|
| 1 off | 2 off | Normal operation |
| 1 on | 2 off | Configuration mode |
| 1 off | 2 on | Display configuration mode |
| 1 on | 2 on | Test mode |
| 3 | | Not used |
| 4 off | | No horn on valid card read |
| 4 on | | Horn on valid card read |

Always return Reader to “normal operation” mode after using one of the other modes, or it will not work in the system.

## Transmit range on 5280/5288 Reader

Turn the variable resistor labelled TX fully clockwise for maximum transmit range. Turn variable resistor counter-clockwise to reduce transmit range to required distance - check with a 922 Test Card.

## Link

### LK1 - connects earth tracks to 0V

LK1 connects the earth tracks on the board to the 0V line so that circuit protection will work when there is no connection from the E pin of CONN2 to mains earth. If the E pin of CONN2 is connected to mains earth, LK1 should be removed. See the section on “Earthing” at the beginning of chapter 2 for advice on earthing the Reader.

## LEDs

### MODE (green - fitted to 5270/5311/5312 only) - gives visual display of various information

The MODE LED is connected in parallel with the horn output. It is easier to listen to horn bleeps than to watch the MODE LED, but a 5270, 5311 or 5312 Reader / Reader Interface may not have a horn connected, or the horn may be too far away to hear, so the MODE LED provides the information instead.

### TX (amber) - gives visual display of transmit signal

The TX LED flickers quickly when the Reader is polling the antenna. When a card is being read, the TX LED lights in long bursts.

### RX (amber) - gives visual display of receive signal

The RX LED should normally glow only faintly. If it is glowing brightly all the time then there is electrical noise being picked up by the antenna which could affect the performance of the system. When a card is being read, the RX LED lights in long bursts along with the TX LED.

## Appendix 2

# Cable summary

## 5311/5312 Reader Interface to Reading Head or Loop Coupler

Use 812 Cable for up to 300 metres, or one of the following.

Transmit and receive feeders: individually screened twisted pair cable, 0.38mm$^2$ (22AWG) or 0.5mm$^2$ (20AWG). Single-pair or two-pair cable can be used.

Eg BELDEN 8723 (22AWG twin twisted pair) - up to 200 metres maximum.

BELDEN 8762 or BELDEN 9154 (20AWG single twisted pair) or BELDEN 9402 (20AWG twin twisted pair) - up to 300 metres maximum.

Direct burial transmit & receive feeders for AVI and other applications needing cables outside:

Eg ALPHA 5610B2001 (1 pair) 5610B2002 (2 pair)

BELDEN 9883 (3 pair).

## LED and horn connections

The 280 Reading Head requires 5 cores to drive LEDs and horn. The 272 Remote Indicator requires 4 cores to drive LEDs. The 090 Reading Head requires 3 cores to drive red and green LEDs. Use any suitable cable with conductors in excess of 0.15mm$^2$ (24 AWG).

Eg BELDEN 9535 (5-core) or 9534 (4-core) or 9533 (3-core).

## Personnel Loop

Stranded single core cable, 0.5 to 2.5 mm$^2$ (20-14 AWG)

Eg 0.5mm$^2$ (20AWG, 16/0.2) BELDEN 9919

or 1.0mm$^2$ (18AWG, 32/0.2) BELDEN 9916.

Maximum length: distance from loop to 270 Loop Coupler or 5270 Loop Reader should be as short as possible and never more than 10m.

## AVI Loop

Stranded single core cable, 1.0 to 2.5 $mm^2$ (18-14 AWG) Special "direct burial" cable is required. Do not use standard PVC.

Eg BELDEN 9438.

Maximum length: distance from loop to 270 Loop Coupler or 5270 Loop Reader should be as short as possible and never more than 10m.

# Index

## ELECTROMAGNETIC COMPATIBILITY EUROPE

*The use of CE marking on a product implies conformity with the above Directive.*

CE

## DECLARATION OF CONFORMITY

*This is to Certify that the products listed below:*

**1) are designed and manufactured to the pertinent safety requirements of the European Low Voltage Directive 73/23/EEC (Standards EN 60065 or EN 60950)**

**2) have been tested and are Certified as complying with European EMC Directive 89/336/EEC (Standards ETS 300-339 or ETS 300-683)**

**3) have been tested and are Certified as complying with European Telecommunication Standard i-ETS 300-330** (rf. devices only)

**COTAG 5000 Series Reader**

(EMC [RA] Certificates 11001 and 11472 dated March 95 and April 96)

***the above Certificates include both active and passive tag transponders***

- **We declare under our sole responsibility that the above products are in conformity with the above technical standards.**
- **We commit ourselves to deliver each product in full compliance with the indicated standard(s).**

**Approved** Peter Kimpton **Date** 7th June 1999.

QUALITY MANAGER FOR BEWATOR COTAG LIMITED

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