Softrónica
Ing. Electrónica Software y Comunicaciones

ICODE Radio-Frequency identification equipment

Technical manual

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General Index

1.- INTRODUCTION

1.1.- RADIO FREQUENCY IDENTIFICATION SYSTEMS

A Radio Frequency Identification (or RFID) system is a form of labelling of goods, products or people, where the labels, called **transponders** or **tags**, contain an electronic device that communicates with a reader by means of a radio link.

In this way, the information contained in the tag is received by the reader, so that it is possible to identify from a given distance, without any phisical contact, the object on which the transponder is fixed or the person that carries it.

There are many different applications for an RFID system:

Air Line Companies. Labelling and tracking of baggage and passenger secure identification.

Parcel handling. Parcel labelling for its automatic classification. It is possible to encode in the tag memory all data related to control, as expedition date, origin, destiny, control number, routing information, ...

Logistics. It allows the identification of objects placed in a closed enclosure, on a conveyor belt or on stands.

«Hands free» access control. For buildings or any kind of sport events. It is possible to encode the information by means of a private key, and the unique device serial number to prevent fraud.

Manufacturing quality control. It is possible to mark products or batches in the manufacturing process, so as to maintain trazability. In every step of the process, it is possible to encode the operator identification, date, time, non-comformances, rejections, causes of rejection, ...

1.2.- RFID SYSTEM CHARACTERISTICS

RFID systems can be classified according to different features:

1.2.1.- TAG POWER SUPPLY

According to the source of power supply of the tags, one RFID system can be classified as:

- **Passive Systems** They do not require internal power supply. They obtain the energy from the magnetic field generated by the reader device.
- **Active Systems** They require its own internal power supply. They work from batteries that can last even for years.

1.2.2.- RANGE

Range is the maximum distance at which a system guarantees the correct reading or writing of a tag. The range of a system is the result of the conjunction of the features of the different parts of the system. The transmitted power of the transmitter and the sensitivity of the receiver are key features. It is also fundamental to use a properly designed antenna and tag.

- **Short Range Systems** Devices with an operating range <15cm
- **Medium Range Systems** Operating range <75cm
- **Long Range Systems** <1m operating range
- **Very Long Range Systems** >1m operating range (usually active devices)

1.2.3.- OPERATING FREQUENCY

- **Low Frequency Systems** Between 100 and 500KHz. The tags are low cost, but the operating range is usually short.
- **Medium Frequency Sistems** Between 10 and 15MHz. Intermediate operating distance with usually passive tags. Moderate cost.
- **Hight Frequency Systems** In the 900MHz or 2.4 to 5MHz bands. Using active tags, it is possible to obtain very long operating ranges, but with a high tag cost.

1.2.4.- WRITING MODE

The writing or encoding of the tags is the process used to store information in the tag memory. There are different alternatives:

- **Read-Only tags** Devices with just one unique serial number stored. It is possible to read it but it can not be modified.
- **Write-Once devices** It is possible to write just once to the non volatile memory. This information can be read many times, but it will not be powwible to modify or delete it.
- **Read/Write devices** It is possible to write part or all the memory a very big number of times (tipically 10^5 o 10^6 times).

In the non read-only devices, the writing process can be made in two ways.

- **Contact writing** It is neccesary to use a contact-programmer to write the devices.
- **Non-contact writing** The writing process takes the same procedure as the reading, that is, by means of a radio link.

1.2.5.- MEMORY CAPACITY

This is the number of bytes of non volatile memory in the tag. Typical devices include between 64 and 512 bits of memory, but new versions are expected with a higher capacity.

The devices usually include some information protection feature, so that part of the memory is factory-coded, with a unique identification number. It is not possible to change this number. It is also possible for the user to lock some part of the memory.

1.2.6.- ANTICOLLISIÓN

Some devices incorporate a so called anticollision protocol, so that a high number of tags can co-exist in the same antenna field. The reader is able then to read them individually at once.

1.3.- I-CODE

I-CODE protocol is a recent developement in the RFID field. The I-CODE tags are designed to provide a low cost and high performance solution to any RFID application.

The following are features of I-CODE devices.

- Passive Tags. They get their operating energy from the electromagnetic field generated by the reader device.
- Long range system. It is possible to operate at up to 1 meter.
- Medium operating frequency. 13.56MHz
- Read/Write tags. Up to 10^6 write operations.
- 512 bits memory capacity. Higher capacities in the future.
- Anti-collision protocol. It is possible to read a theoretical maximum of 32K tags in the same RF field.
- Low cost tags.
- For retail or distribution applications, the device includes some special functions: EAS (*Electronic Article Surveillance)*, a anti-theft bit that can be detected and give an alarm in the reader device, and QUIET, to put a tag in «sleep» state, for instance, after the good on which it is fixed is sold. Both bits can be activated and de-activated many times.

1.4.- I-CODE CHIP STRUCTURE

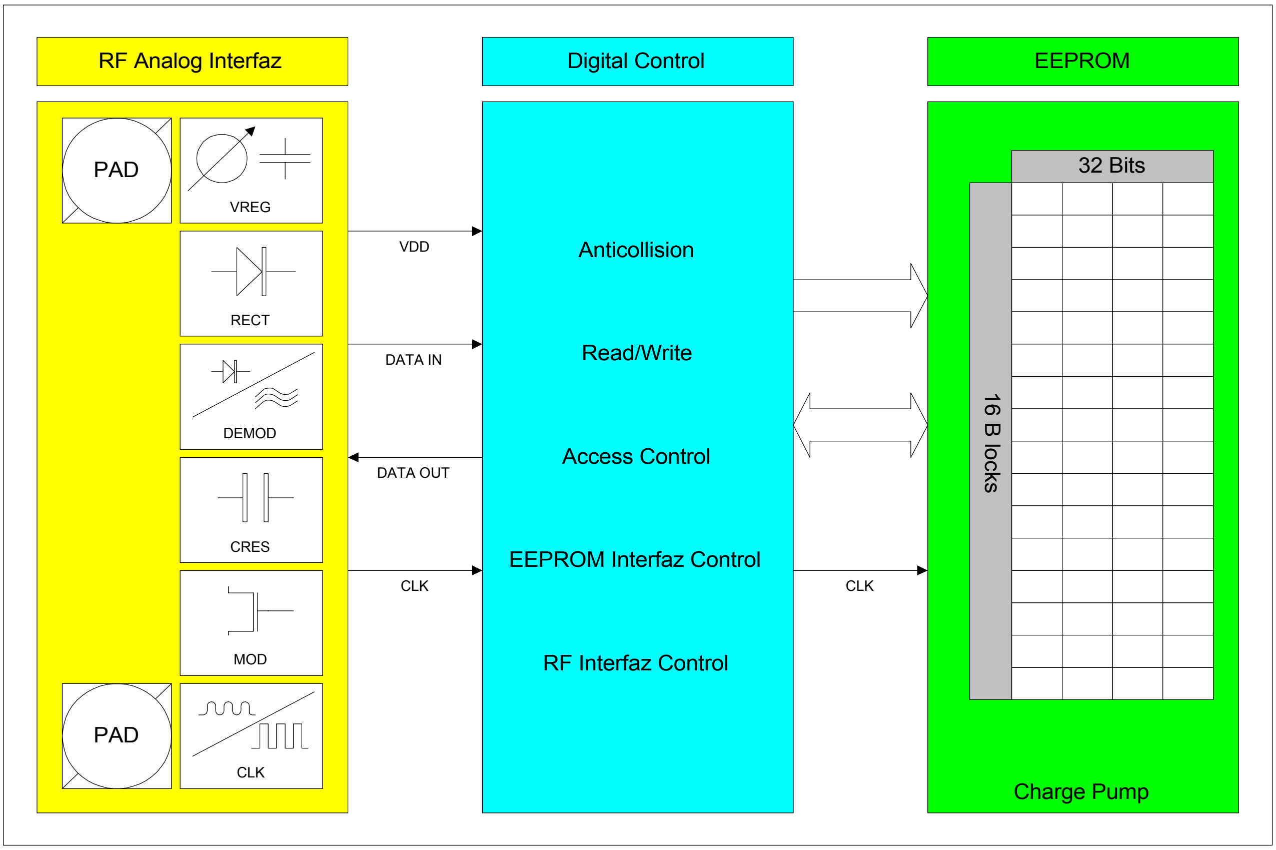
1.4.1.- GENERAL STRUCTURE

The I-CODE Label IC is a dedicated chip for intelligent label applications like logistics or retail (including EAS) as well as baggage and package identification in airline business and mail services.

The I-CODE system offers the possibility of operating labels simultaneously in the field of the reader antenna (Anticollision). It is designed for long range applications.

Whenever connected ta a very simple and cheap type of antenna (because of the 13.56 MHz carrier frequuency) made out of a few windings printed, winded, etched or punched coil, the I-CODE IC can be operated without line of sight up to a distance of 1.5m.

In the following diagram, it can be seen a diagram of the IC.



The label requires no internal power supply. Its contactless interface generates the power supply and the system clock via the resonant circiutry by inductive coupling to the reader. The interface also demodulates data that are transmitted from the reader to the I-CODE Label, and modulates the electromagnetic field for data transmission from the I-CODE label to the reader.

Data are stored in a non-volatile memory (EEPROM). The EEPROM has a memory capacity of 512 bits and is organised in 16 blocks consisting of 4 bytes each (1 block=32 bits). The higher 12 blocks contain user data (read/write access) and the lowest 4 blocks contain the serial number, the write access conditions and some configuration bits.

1.4.2.- MEMORY ORGANISATION

The 512 bit EEPROM memory is divided into 16 blocks. A block is the smallest access unit. Every block consists of 4 bytes (1 block=32 bits). Bit 0 in every byte represents the least significant bit (LSB) and bit 7 the most significant bit (MSB), respectively.

	BYTE 0	BYTE 1	BYTE 2	BYTE 3	
BLOCK 0	SNR00	SNR01	SNR02	SNR03	Serial Number (Low byte)
BLOCK 1	SNR04	SNR05	SNR06	SNR07	Serial Number (High byte)
BLOCK 2	F0	FF	FF	FF	Write enable bits
BLOCK 3	X	X	X	X	Special Functions (EAS/QUIET)
BLOCK 4	X	X	X	X	Family code/Application identifier
BLOCK 5	X	X	X	X	User data
BLOCK 6	X	X	X	X	
BLOCK 7	X	X	X	X	
BLOCK 8	X	X	X	X	
BLOCK 9	X	X	X	X	
BLOCK 10	X	X	X	X	
BLOCK 11	X	X	X	X	
BLOCK 12	X	X	X	X	
BLOCK 13	X	X	X	X	
BLOCK 14	X	X	X	X	
BLOCK 15	X	X	X	X	

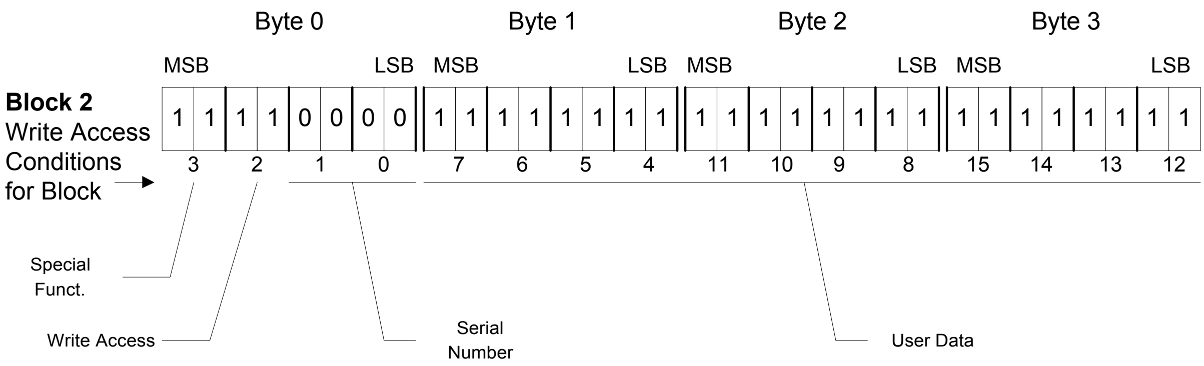
The values (in hexadecimal notation) shown in the table above are stored in the EEPROM after the wafer production process. The contents of blocks marked with ‘x’ in the table are **not** defined at delivery.

1.4.2.1.- SERIAL NUMBER

The unique 64 bit serial number is stored in blocks 0 and 1 and is programmed during the production process. SNR00 in the table represents the least significant byte and SNR07 the most significant byte, respectively.

1.4.2.2.- WRITE ACCESS CONDITIONS

The Write Access Condition bits in block 2 determine de write access conditions for each of the 16 blocks. These bits can only be set to zero once, i.e. already write protected blocks can never be written from this moment on. This is also true for block 2. If this block is set into write proteceted state by clearing of bits 4 and 5 and byte 0, no further changes in write access conditions are possible.



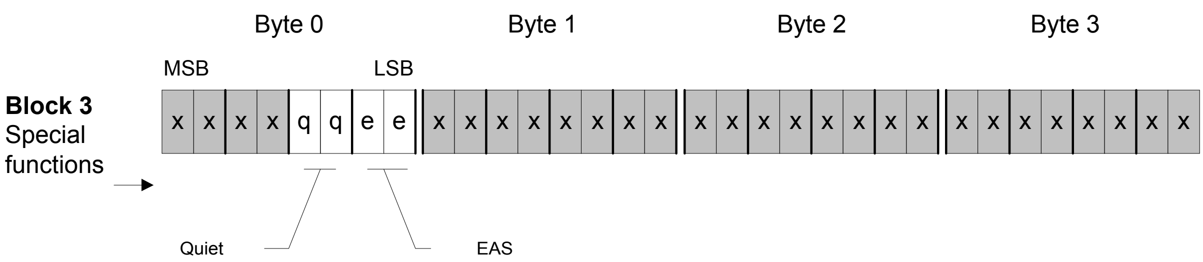
The ones in the 16 pairs of bits have to be cleared together if the corresponding block is wanted to be write protected forever (1|1 -> Write access enabled, 0|0 -> Write access disabled).

The pairs of 1|0 or 0|1 are not allowed.

Warning.- It is extremely important to be particulary careful when clearing the Write Access bits in block 2, as you can lose write access to all of the block on the label in case of a mistake. Of course you can use this feature to put the label into a hardware write protected state!.

1.4.2.3.- SPECIAL FUNCTIONS (EAS/QUIET)

The Special Functions block holds the two EAS bit (Electronic Article Surveillance mode active: The label answers at an EAS command) as well as the two QUIET bits (QUIT mode: the label is permanently disabled but can be activated again with the 'Reset QUIET bit' command). The remaining 28 bits (greyed 'x' in the following graph) are reserved for future use.



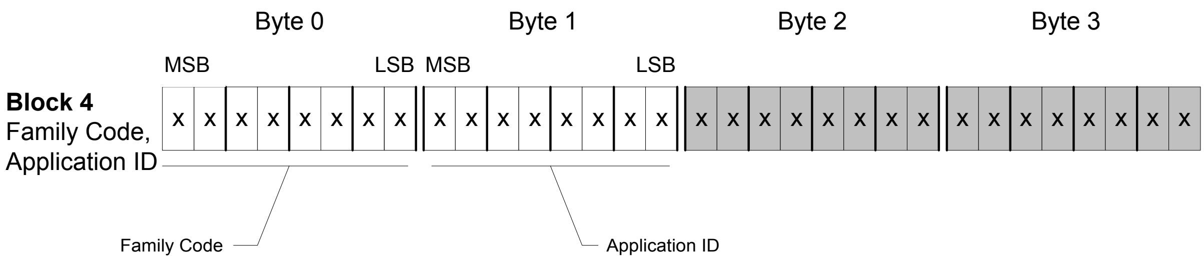
Quiet:	q|q = 1|1 -> Quiet mode enabled	q|q = 0|0 -> Quiet mode disabled
EAS:	e|e = 1|1 -> EAS mode enabled	q|q = 0|0 -> EAS mode disabled

The bit pairs 1|0 or 0|1are not allowed.

Changing of the Write Access Control or Configuration must be done in secure enviroment (by reading the current value of the block and masking in the new values for bit positions that may be changed). The label must not be moved out of the communication field of the antenna during writing! We recomend to put the label close to the antenna and not to remove it during operation.

1.4.2.4.- FAMILY CODE AND APPLICATION IDENTIFIER

The I-CODE system offers the feature to use (independently) Family Codes and/or Application Identifiers with some reader commands. These two 8-bit values are located at the beginning of User Data (block 4) as shown in the following graph and are only evaluated if the corresponding bytes at the reader commands are unequal to zero.



The greyed bytes are for customer usage as well as the remaining blocks (5 to 15) are.

1.4.2.5.- CONFIGURATION OF DELIVERED IC'S

SL1 ICS30 01 ICs are delivered with the following configuration by Philips:

Serial Number is unique and read only

Write Access Conditions are allowed to change

Status of EAS mode is **not** defined

Status of QUIET mode is **not** defined

Family Code and Application Identifier are **not** defined

User Data memory is **not** defined

1.5.- COMPONENTS OF AN I-CODE SYSTEM

The number and type of the elements to form an RFID system based on I-CODE technology, changes according to the application requirements. We describe here the «building blocks» of the systems.

1.5.1.- READER/ENCODER

A reader is the device that, by means of one or more antennas, stablishes the radio link with the tags that are in its reading field. It also decodes the data received from the tags so as to make the memory contents available for processing. A reader/encoder can also write the non-volatile memory of the tags.

The basic functions of a reader/encoder are enumerated as follows:

- Generate the RF field neccesary to supply power to the I-CODE tag
- Stablish a radio link with the tag
- Encode and decode the data to be sent and the data received from the tag
- Store the decoded information received from the tags, or send it by means of a standar communication bus (usually RS232 or RS485) to a computer acting as host.

Some other added functions can be found in I-CODE readers/encoders:

- I/O ports for external control. They can be used to control sensors or semaphores or a turnstile or an external alarm in a acces control application.
- RAM memory for storing the memory contents of a large number of tags, to use the reader as a data-logger.

There are different type of reader/encoders, depending on the application where they are to be used. The main features for a reader/encoder are:

- **Transmitted power**. The RF transmitted power to the antenna. There are devices ranging from miliwatts to around 10W. This parameter, with the configuration of the antenna, define the reading range of a particular system.

Short range devices usually work with miliwatts, and to be able to work at 1m range, the device should give as much as 3-7W.

In some devices, it is possible to modify, under software control, the transmitted power. This feature is very useful when the device has to be adapted to different installation conditions.

- **Receiver sensitivity**. This is the measure of the minimum signal level that the device has to receive from a tag to be able to decode it properly. If the device´s sensitivity is not enough, it is possible that a particular tag get excited, that is, it sends it signal once powered from the reader, but the reader is not able to decode the received signal. Better than 20uV sensitivity is a must for long range devices.
- **Communications**. There are different communication protocols for the reader control from the host. Some devices operate only with one protocol. Some other are «multiprotocol» readers.

1.5.2.- ANTENNA

The antenna is the transducer needed to generate in its vicinity, an electromagnetic field distribution corresponding to the RF signal generated by the reader/encoder, to allow the energization of the transponders in the operating zone. The modulation of this field carries the information from the reader to the tag and from the tag to the reader.

The antenna is also used to get the RF signal from the tag, so that the reader obtains and adequate level for demodulation.

The right selection of the antenna or antennas for a given application is key for success in the implementation of a I-CODE system. Each type of antenna or antenna combination defines a electromagnetic field distribution in near field space. This field distribution depends on many factors:

- **Geometrical factors**. Size and position of antenna or antenna combination. All these parameters define the relation between the current that the reader generates into the antenna and the characteristic of the electromagnetic field near the antenna.
- **Electrical factors**. The antenna presents a defined electric behaviour to the reader at the operating frequency. The antenna geometry, and its material, and even the rest of the geometrical factors described before, define the resonance characteristics of the antenna.
- **Enviroment**. Some enviroment elements, as metals or ferromagnetic elements near the antenna, or temperature or relative humidity are factors that modify the RF field distribution, and also the electrical caracteristics of the antenna (resonance, Q factor, ...).

It is very important for the correct implementation of a RFID system, the control of all these factors. If any of them can not be controlled, or it changes with time, auxiliary compensation elements must be added to the system (for instance, automatic antenna tuners). This element will be described below.

It is also important that the reader or reader/encoder, includes some element for antenna tuning. These elements consist of some measurement circuitry, so that the reader can give information about Incident or Reflected power, or SWR (standing wave ratio) of the TX antenna to which the reader is connected. These measurements allow to make a manual or automatic tunning of the antenna.

The different types of antenna used for RFID are described here.

1.5.2.1.- TX/RX OR TX+RX ANTENNAS

It is possible to coneect the reader to one antenna working both as transmission and reception antenna (TX/RX). This is the easiest disposition, and is widely used in systems not requiring a very long reading/encoding range.

If the required range doesn´t allow the use of just one antenna, the use of separated transmission and reception antennas, is needed (TX+RX).

It is important not to mistake the two antennas configuration (TX+RX) with the physical presence of two different elements. In many cases, both TX and RX antennas are mounted on the same physical element, incorporating two separated antennas, with two RF connectors.

There are combinations with two TX+RX antennas, to form a wide corridor or «gate» configuration.

1.5.2.2.- ANTENNA TUNING

Antenna tuning is the process of matching or adaptation of the electrical characteristicas of the antenna to that required for the reader device for an optimum performance at the operating frequency. Specifically, the antenna has to present, at the operating frequency, the complex conjugate impedance of the reader (usually 50 ohm). This condition assures the maximum energy trasnfer beween the reader and the antenna.

There are three measures of the right antenna tuning:

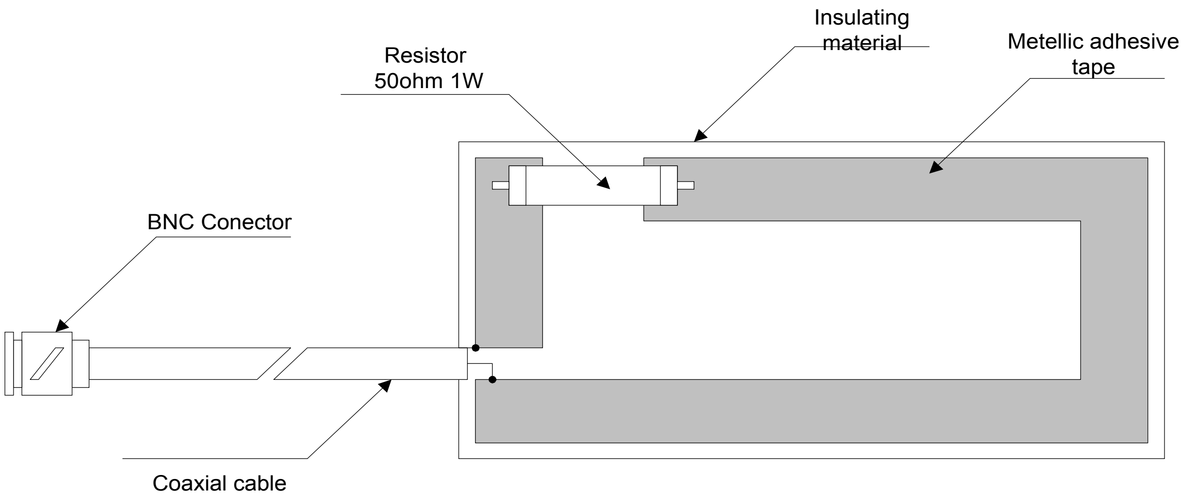
- **Direct or Incident Power** The RF power level given to the antenna by the reader.
- **Reflected Power** The RF power level that the antenna returns to the reader as a result of the impedance mismatch.
- **SWR** Matematical relation between the direct and reflected power. It is a measure of the propper tuning of the antenna. SWR values near 1 are correct. Values in excess of 2 are not adequate.

As it was pointed out before, the anatenna parameters are determined by several factors. Some of them are constructive details (shape, material, ...). These parameters correspond to the antenna itself, so it would be possible to design a fixed tuning unit for any antenna.

However, there are some other enviromental factors (temperature, relative humidity, metallic or ferromagnetic elements near the antenna, ...) that can not be completely considered in the design process of the antenna. To adjust the electrical caracteristics of the antenna once it is working in a given enviroment, a new element called **Automatic Antenna Tuner** is used.

Depending on the type of tuning, there are two type of antennas:

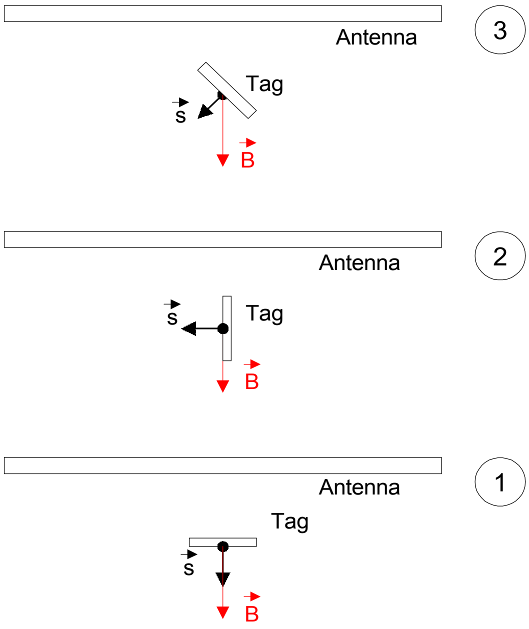
- **Non-tuned Antennas**. For systems with not very high requirements on reading range, or even for laboratory tests, it is possible to use non-tuned or wide-band antennas. This is the simplest kind of antenna because it doesn´t require tuning, and its characteristics are not affected by enviromental factors. However, it is not possible to obtain high reading ranges. The drawings for such an antenna can be seen in the following picture. It is possible to use it for laboratory tests or for a short range device. If the loop area is relatively big, the L of the antenna will be increased, and a capacitor should have to be added to compensate it.



- **Tuned Antennas**. An RFID antenna is tuned when it includes a device (tuning unit) to match the impedances of the antenna and the reader at the operating frequency, so that the energy transfer between both elements is maximized. Depending on the tuning procedure, the system can have fixed tuning or automatic tuning. The characteristic of each are described in the corresponding section.

1.5.2.3.- 2D/3D ANTENNAS

The antenna geometry, with the enviroment characteristics, define the electromagnetic field distribution around the antenna. For the reader to be able to energize the transponder, part of the generated magnetic field (**B**) in the point where the transponder is, has to be perpendicular to the plane defined by the transponder antenna. This is best described in the following diagram.



In the disposition 1 (top view), the magnetic field **B** generated by the antenna is paralell to the surface vector **s** (defined as perpendicular to the plane of the tag antenna and with magnitude equal to the area of the tag antenna). In this disposition, the induced signal in the transponder antenna has its maximum.

The opposite situation is depicted in fig. 2. Here, the field and surface vectors are perpendicular, and the induced signal is zero. The tag will not work. Fig 3 shows some intermediate situation.

We call «3D» antenna to an antenna whose geometry design guarantees that when a tag passes through the reading zone, in any position, it always finds at least one place wher the field vector is perpendicular to the surface of the antenna tag, so that the induced signal is maximum.

Of course, this doesn´t mean that the tag can be read at any point in any position, but it means that any tag passing the reading zone will go through different zones where the radio link can be made.

In systems where the position of the tags is known in advance (for instance, when they are fixed on containers, with the same relative position to the reader antenna), it is possible to use 2D antennas, but in systems in which the tag position and orientation are not known in advance, the antenna geometry should be «3D».

1.5.3.- ANTENNA TUNING UNIT

An antenna tuning unit is a device connected between the antenna and the reader, that is able to be adjusted to match the impedances seen by the reader and the antenna, at the operating frequency (see the section on antennas for a description of tuning process).

According to the tuning procedure, that is, the way the unit is adjusted, there are differen type of antenna tuning elements:

- **Fixed tuning units**. A system with

Un sistema con unidad de sintonía fija, consigue la adaptación de la antena al lector/grabador en unas determinadas condiciones ideales. Si estas condiciones corresponden a aquellas del entorno en el que se instala el sistema, y estas no se ven modificadas con el tiempo, el sistema puede funcionar adecuadamente.

- **Manual Tuning Units**. This kind of antenna tuning unit has a set of variable elemets (usually microswitches or variable capacitances), to match the antenna once it is in its envroment. With the neccesary measurement instruments, or if the reader device incorporates some SWR measurement feature, the tuning process is just a matter of searching the lowest SWR configuration. The problem with this kind of tuning units is that they are not able to adapt to external changes (temperature, metallic elements near the antenna, ...)
- **Automatic Tuning Units**. When it is neccesary to guarantee a perfect tuning of the antenna even in case of changes in the enviroment, or just to make an easier installation process, an automatic antenna tuning unit must be used. This unit, under reader control, allow its automatic adjustment, so that the reading/encoding conditions are always optimal. The installation process in this case is just a matter of selecting the propper position for the antennas, and then make an automatic adjustmente. The whole installation process can be made in seconds.

1.5.4.- SPLITTERS AND COMBINERS

In some antenna configurations (see chapter on typical configurations), it can be neccesary to use two receiver and/or two transmitter antennas. For instance, in a «gate» configuration, where it is needed to cover a wide corridor, a TX+RX combination is installed at both sides of the passage.

In this conditions, there must be an element to split or divide the transmitted signal generated by the reader, in order to feed both transmission antennas. This element is called splitter.

In reception, the signal coming from both receiver antennas, have to be combined in an element called adder or combiner.

1.5.5.- AUXILIARY ELEMENTS. I/O PORTS

In many cases, the RFID system has to include some aditional external elemnt, as semaphores, or turnstile for access control systems, or detectors, or other digital sensors. To be able to control all those elements, the reading device usually includes some digital I/O ports.

1.5.6.- *TAGS*

The tag is an element including an electronic device and an antenna, both mounted on a base material. The phisical characteristics of a tag are defined by the mechanical requirements of the application:

- Size (long, with and thickness)
- Base material
- Encapsulation
- Enviromental factors (temperature, humidity, ...)
- Durability (disposable, 1year, ...)

The electrical characteristics are defined by the antenna and chip parameters:

- Capacitance, inductance and resistance of the antenna
- Input impedance of the chip
- Area and number of turns of the antenna

From these basic parameters, some others can be derived:

- Resonant frequency
- Q Factor
- Bandwidth

It is also important to consider the variation of these parameters in the following conditions:

- When the tag is in the RF field and the chip becomes active
- When the tag is attached to the object it has to identify or in its normal use
- With temperature and humidity

All these parameters have to be taken into account for the tag to work propperly. Tag analisys systems, like the one described in the corresponding chapter are fundamental to test a tag design, to allow the measurement of all the tag parameters in every operating condition.

2.- SOFTRÓNICA I-CODE MODELS

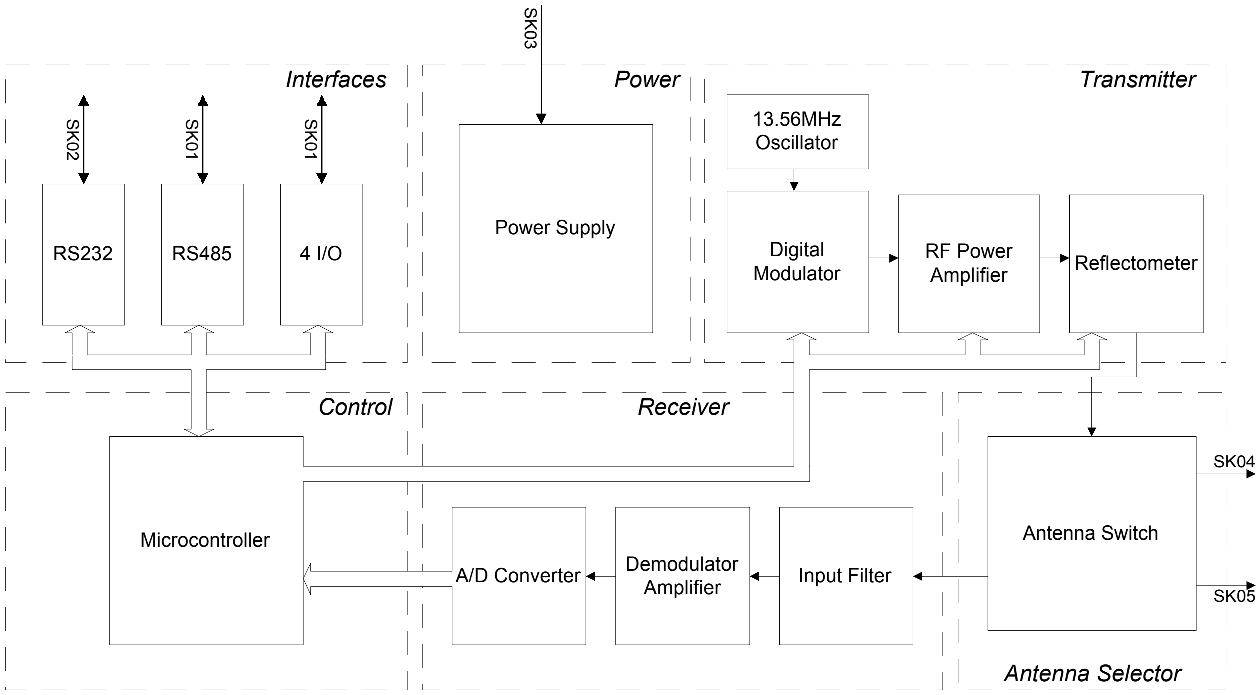
2.1.- READERS/ENCODERS

2.1.1.- RIDEL5000. LONG RANGE READER/ENCODER

The RIDEL5000 is a reader/encoder module for RFID applications in I-CODE technology, for long-range and high performance. It incorporates all the features needed to control a whole I-CODE system, included Automatic tuner control, I/O ports, ... The RIDEL5000 main features are:

- Operating frequency of 13.56MHz.
- I-CODE Protocol
- Software adjustable 0-8 W transmitted power
- RS232 / RS485 communication ports
- I/O port with 4 digital input and 4 digital output channels
- Baud Rate 9,600 to 115,200 KBd.
- Voltage Suply 24 Vdc.
- 2A maximum current consumption
- Operating temperature range -10 to 55 ºC
- RF connectors - 2 * BNC
- RS232 9 pin Sub-D FEMALE Connector for communication and firmware update
- Auxiliar connector and RS485 15 pin Sub-D FEMALE
- Self calibration system
- Flash program memory with firmware update capability throug external connector
- Direct and reflected power, SWR and internal temperature measurements
- Software adjustment for transmitted power, modulation index, IF gain and input filter tuning
- Updatable comunication protocols and operating modes
- 2 antennas (TX+RX) or 1 antenna (TX/RX) operation internally selectable
- Fan refrigeration
- Dimensions 120 x 120 x 38 mm

A block diagram of the RIDEL5000 is shown below.



The main blocks or subsystems are:

- The receiver
- The transmitter
- The antenna selector
- The controller
- The I/O interface
- The power supply

The receiver is integrated and encapsulated in a shielded box, to improve its enviroment noise inmunity and its sensibility. It is composed of an input filter, a demodulator, a signal amplifier (all of them with microcontroller adjustment), and an A/D converter to provide information to the microcontroller for measurement and self-calibration purposes.

The transmitter is composed of an oscillator, whose signal is sent to a digital modulator, and a power amplifier with incorporated temperature controll. In the transmitter output there is a reflectometer included, giving continous information to the microcontoller about the transmitted power and the antenna electrical caracteristics. It makes it possible to determine SWR and the antenna impedance phase and module.

There is an antenna selector installed between SK03 and SK04 connectors, to select between the one-antenna and two-antennas working modes.

The whole unit is controlled by means of a microcontroller. It controlls the whole radio system, the I-CODE communication protocol, the RS232 and RS485 protocols, and the I/O ports. Its key features are:

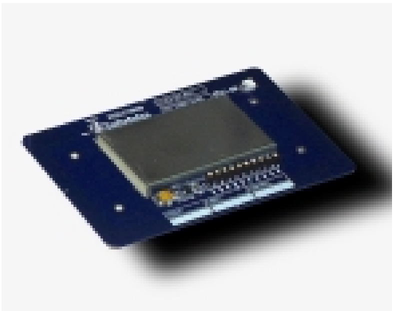
- Flash program space. It is possible to modify the internal software through a programming interface provided in the SK02 connector, by means of a special cable and PC software. This makes it possible to update the unit with new versions or different protocolos without even opening it.
- Adittional memory for stand-alone applications (storage of the read labels data).
- EEPROM for working parameters storage (communication baud rate, default transmitted power, ...)

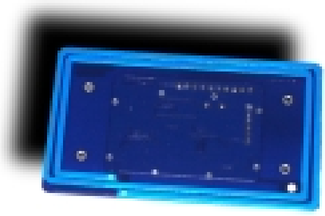
The external interface is is made out of a RS232 port for point to point conections, RS485 port for the paralell conection of several RIDEL5000 units, or other RS485 equipment.

The I/O port consist of 4 input opto-isolated channels, and 4 solid state 6A output channel. It is under microcontroller control, and it can be used to output an alarm signal, to detect movement through a volumetric sensor, ...

The power supply subsystem generates all the internal voltages needed for the unit from the 24Vcc input power source.

2.1.2.- RIDEC5000. SHORT RANGE READER/ENCODER





The RIDEC5000 is a short range and low cost I-CODE reader/encoder. It is supplied in printed circuit format to allow its integration in more complex systems.

- 13.56MHz Operating frequency
- I-CODE Protocol
- RS232 / RS485 /TTL Communication ports
- Four output channels
- Baud Rate 9,600 Bd.
- Voltage supply 3,6 to 9 Vdc.
- Max current consumption.:

  Version A

  Voltage supply 9Vdc 90mA.

  Voltage Supply 6Vdc 72mA.

  Version B

Voltage Supply 5 Vdc 90mA

Voltage Supply 3,5 Vdc 55 mA.

- Operating Temperature -10 a 55 ºC
- Built-in antenna
- Operating range 8cm max.
- DIMENSIONS

  3,37'' * 2,1''

  *85,6 * 53,91 mm.*

2.2.- ANTENNAS

2.2.1.- ANTLR5000. 3D LONG RANGE ANTENNA TX+RX 175X60

The ANTLR5000 is an I-CODE antenna designed to work with the RIDEL5000. It includes a transmission and a reception antenna on the same base element.

It operates with the RIDEL5000 and the automatic tuning unit ANTUN5000 and/or ATUSP5000 (see chapter about standard configurations) to make complete reading/encoding long range systems.

The TX+RX set has been designed to work in «3D» mode, so that tags passing near the antenna at any position will be activated. The relative position of both antennas has been carefully designed to obtain an optimal reading range and to minimize the mutual influence of both antennas.

It is made of glass fiber, with an IP65 enclosure in the base, to fix the electronic equipment. Its dimensions are 175x60cm. The thickness of the reading zone is only 32mm. The lower part (with the enclosure) is 77mm thick.

Softrónica can also supply the inner part of this antenna without the glass fibre for integration in some other enclosures. This is just a 147x59x6 mm element with bot antennas inside.

2.2.2.- ANTAR5000B. MEDIUM RANGE 3D TX+RX ANTENNA 60X60

Small size 3D antenna for medium-long range applications.

It includes a transmission and a reception antenna on the same base, with a box in the lower part to mount the automatic tuning unit. Its size (60x60) and mechanical characteristics makes it ideal for industrial applications, as conveyor belt mounting.

The ANTAR5000B operates with the RIDEL5000 reader/encoder and an automatic tuning unit (ATUSP5000) to make complete reading/encoding long range systems.

It is just 15mm thick in most of the surface. The box for the tuning unit is 35mm.

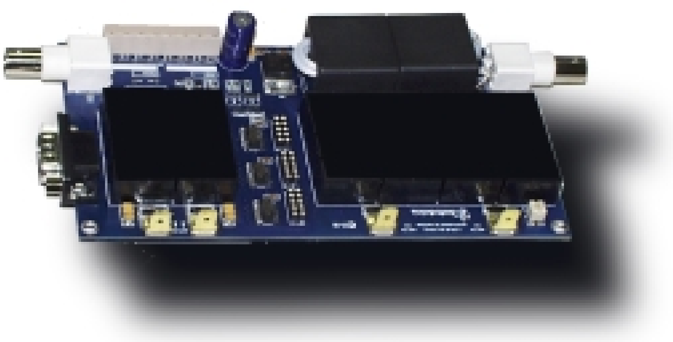
2.2.3.- ANTMR5000. MEDIUM RANGE 2D TX/RX LOOP ANTENNA 47.5CM

The ANTMR5000 is a loop antenna for I-CODE applications. It is designed to be connected to the RIDEL5000 in one antenna (TX/RX) configurations. Its operates in 2D with a intermediate reading range (about 70cm depending on the transmitted power and the type of tag).

It is made of PVC, and includes a manual tuning element in its base. It is rated for 4W maximum transmitted power.

2.3.- OTHER ELEMENTS

2.3.1.- ANTUN5000. AUTOMATIC ANTENNA TUNING UNIT

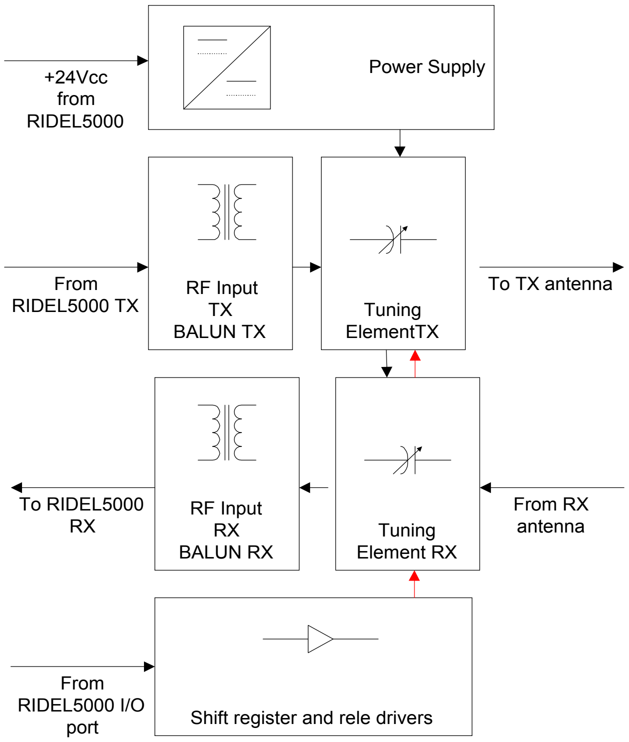


The ANTUN5000 is an automatic antenna tuning unit for coupling the RIDEL5000 long range reader/encoder to its antenna. It works under the RIDEL5000 control. This is the element that makes the SWR measurements and controls the variable elements in the ANTUN5000.

The ANTUN5000 is used un «gate» configurations (see chapter about typical configurations), in the slave antenna. It can also be used in «door» configuration to tune the only antenna.

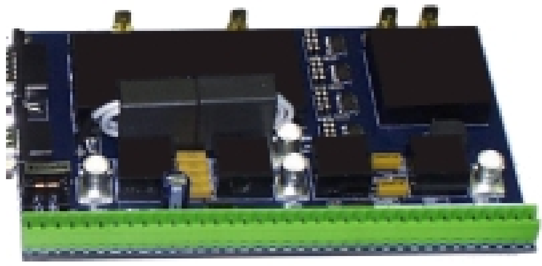
The RIDEL5000 controls this unit through a serial protocol. the inputs are opto-isolated. In complex configurations, this unit works with the ATUSP5000 (master tuning unit). In the chapter on typical configurations, the connection diagram for standard configurations is shown.

The device is supplied as a printed board for its integration in other elements, or for its mounting inside the ANTLR5000 or ANTAR5000 electronic enclosures. The internal structure of the ANTUN5000 is described in the diagram.



The device is connected to the RF BNC connectors of the RIDEL5000 for TX and RX, by means of 2 BNC connectors. The power supply and control come also from the reader/encoder, through the I/O connector. The TX and RX antennas are connected to two pairs of FASTON connectors.

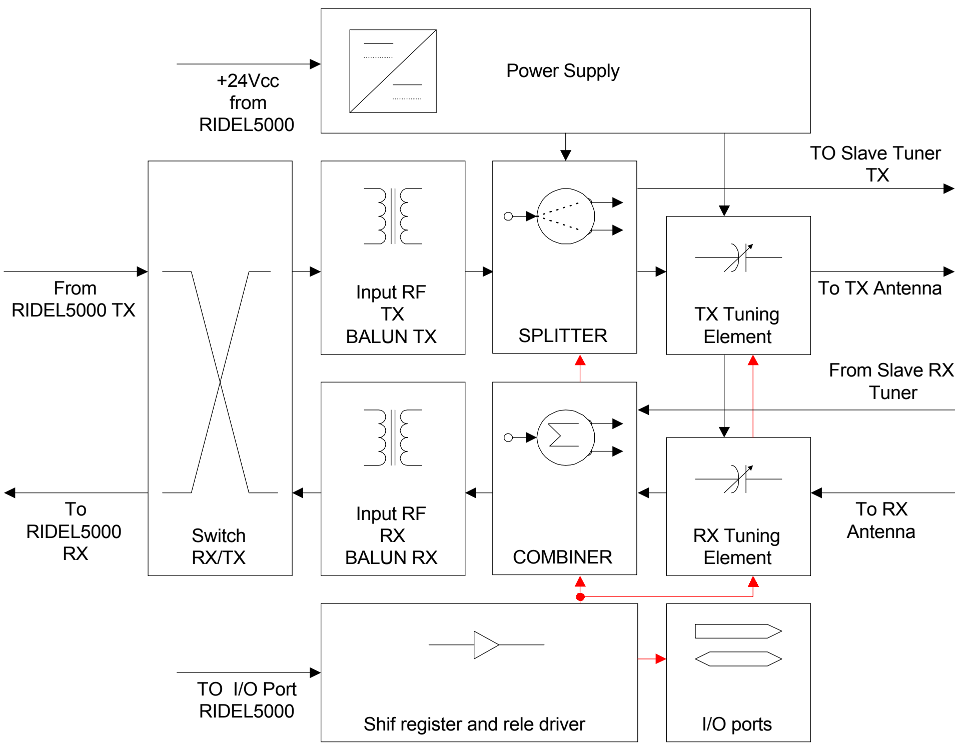
2.3.2.- ATUSP5000. UNIDAD DE SINTONÍA AUTOMÁICA CON SUMADOR, SPLITTER, IO



The ATUSP5000 is an automatic antenna tuning unit used for the coupling of the RIDEL5000 long range reader/encoder to its antenna. It is designed to operate in «door» or «gate» configurations (see chapter on typical configurations), working as a master tuning unit. It includes the splitter and combiner elements for the combination of two TX+RX antennas.

It allows the coupling of both the TX and the RX antennas. It is controlled and powered from the RIDEL5000. The control is made throug a serial protocol with opto-isolated inputs.

The ANTUSP includes a I/O digital port for controlling external devices (semaphores, alarms, sensors, ...). It is powible to connnect it directrly to the RIDEL5000 delta connectors. Its internal configuration is described in the following diagram:



The RIDEL5000 is connected through its TX and RX connectors to the ATUSP5000 inputs. First there is a TX/RX switch to make the tuning of the RX antenna.

Then there are two baluns for the TX and RX antennas. The RF TX signal goes then to a splitter, to divede the signal for the master and the slave TX antennas.

The RX signal follows the opossite way, through a combiner. The signal to the master RX antenna, pass the tuning elements, controlled from the RIDEL5000.

2.4.- KITS

2.4.1.- TAG ANALYSIS KIT

This is a measurement system designed to make non-contact RF tests and measures on tags. The kit includes a RFTST1000 analizer, a TAGAN1000 antenna and a PC virtual instrumentation software under Windows, to graphically show the measurements.

It includes a synthesized generator with 1Hz resolution in the 20KHz-50MHz range, and three analog inputs with logarithmic amplifiers with 85dB dinamic range. The set allow the complete tag analisys from an electrical point of vierw, considering its tuning, and the efects of the RF field. The RF transmitted power level is software adjustable.

The PC software displays the received information in a spectrum analyzer format. It is also possible to use a set of markers to make accurate numerical measures. The Q and f0 measurements are automatically performed,

2.4.2.- «*STARTER KIT*» ICODE

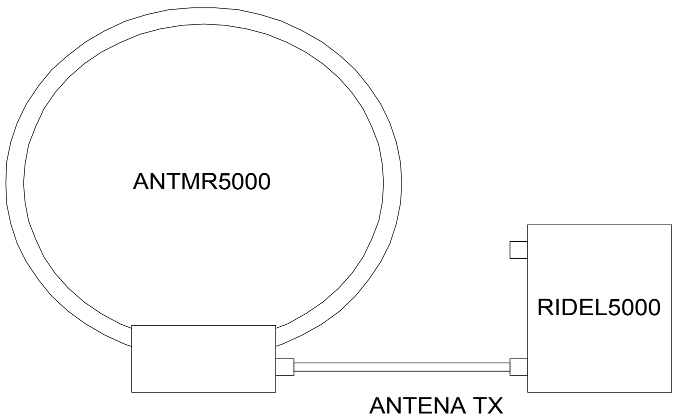
The I-CODE starter kit is a set of elements to allow the easy demonstration of all the capabilities of a RFID system based on the Softrónica range of I-CODE equipment. It is also very useful in the process of application developement in the laboratory.

It is composed of the following elements:

- 1 RIDEL5000 long range reader/encoder
- 1 ANTMR5000 medium range TX/RX loop antenna
- 1 RIDEL5000 power supply
- 15 tags
- RIDEL5000 technical documentation
- Demo software user´s guide
- DLL´s documentation
- 1 disk with Demo program and DLL
- Power, communication and antenna cables

3.- TYPICAL CONFIGURATIONS

3.1.- 1 RX/TX ANTENNA

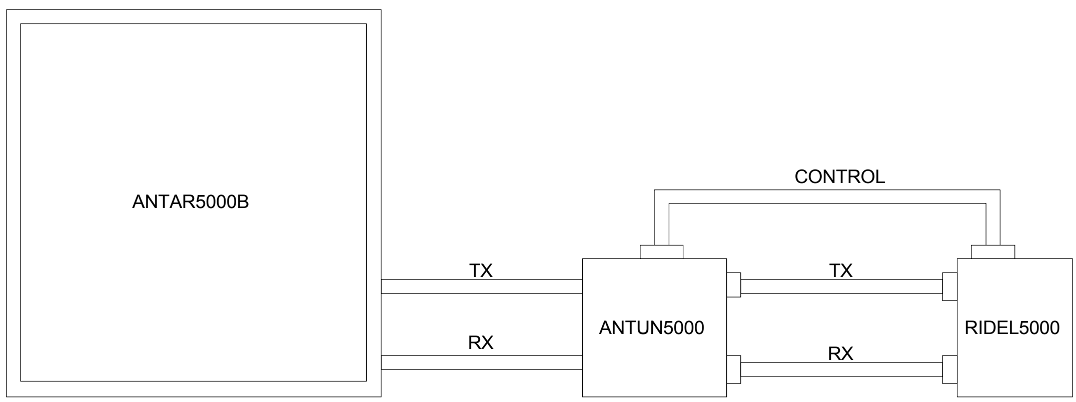


In the 1 antenna TX/RX configuration, the RIDEL5000 reader/encoder uses the same antenna for both receiving and transmitting. In the figure, it is shown the use of the reader with the ANTMR5000 antenna. In this case the antenna has its own manual tuning unit in its base, so that it is not neccesary to use any external tuning unit. This configuration can also be used with a non-tuned antenna.

This is a very simple and low cost configuration, and it can be used whenever the reading range or stability requirements are not very tight.

To use this configuration, the RIDEL5000 has to be configured, by means of an internal jumper. The RF TX output is then used for both TX and RX.

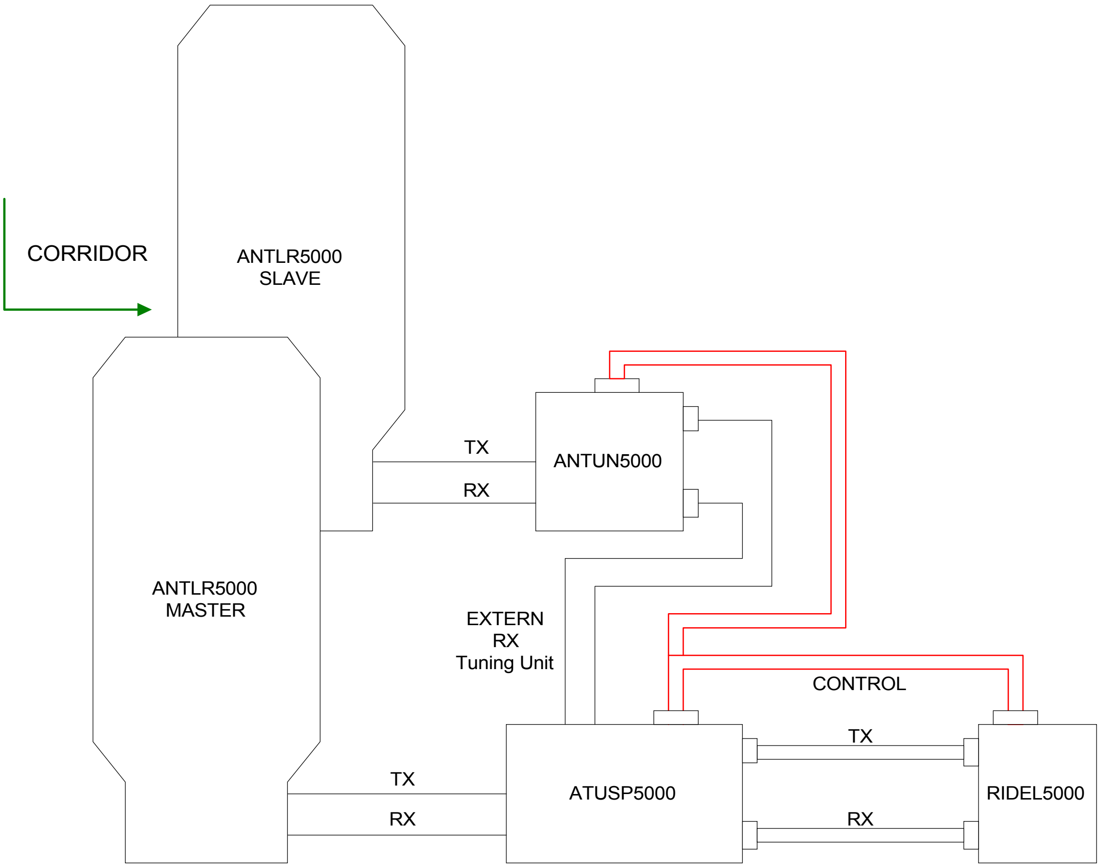
3.2.- SEPARATED TX+RX ANTENNAS. DOOR CONFIGURATION



In the door configuration, a antenna module with TX and RX separated antennas, as the ANTAR5000B, is connected to a simple tuning unit model ANTUN5000, that goes in the enclosure fixed to the back of the antenna. The TX antenna tuning is then automatically made. The RX antenna tuning will be manually made from the PC under software control.

The tuning unit is connected to both RIDEL5000 RF ports. The control and power supply of the tuning unit come also from the reader/encoder.

3.3.- 2 TX+RX ANTENNAS. GATE CONFIGURATION



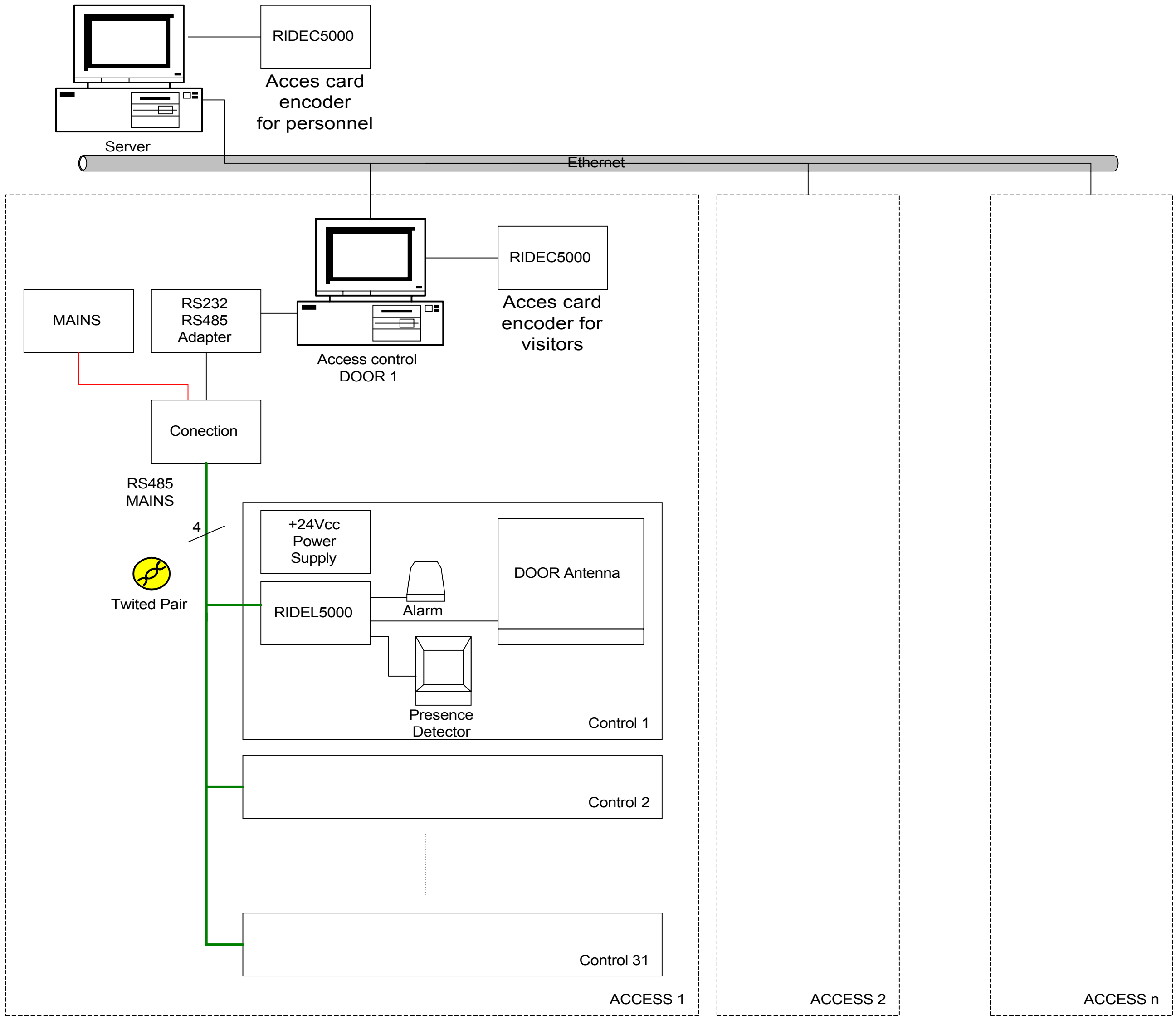
In the gate configuration, the objective is to cover a zone between two TX+RX antennas (a TX and a RX antennas each). In this case, it is neccesary to use a ANTUN5000 tuning unit as master, for the tuning of one of the antennas. The other antenna shall be tuned with a ATUSP5000 as slave.

The master tuning unit, includes also the splitter and combiner needed to use two TX and two RX antennas.

The control is made from just one RIDEL5000 long range reader/encoder, by means of a serial opto-isolated interface. In this configuration, if an ANTLR5000 antenna is used, all the electronics can be enclosed in the box in the base of the antenna.

3.4.- APPLICATION EXAMPLES

3.4.1.- ACCES CONTROL



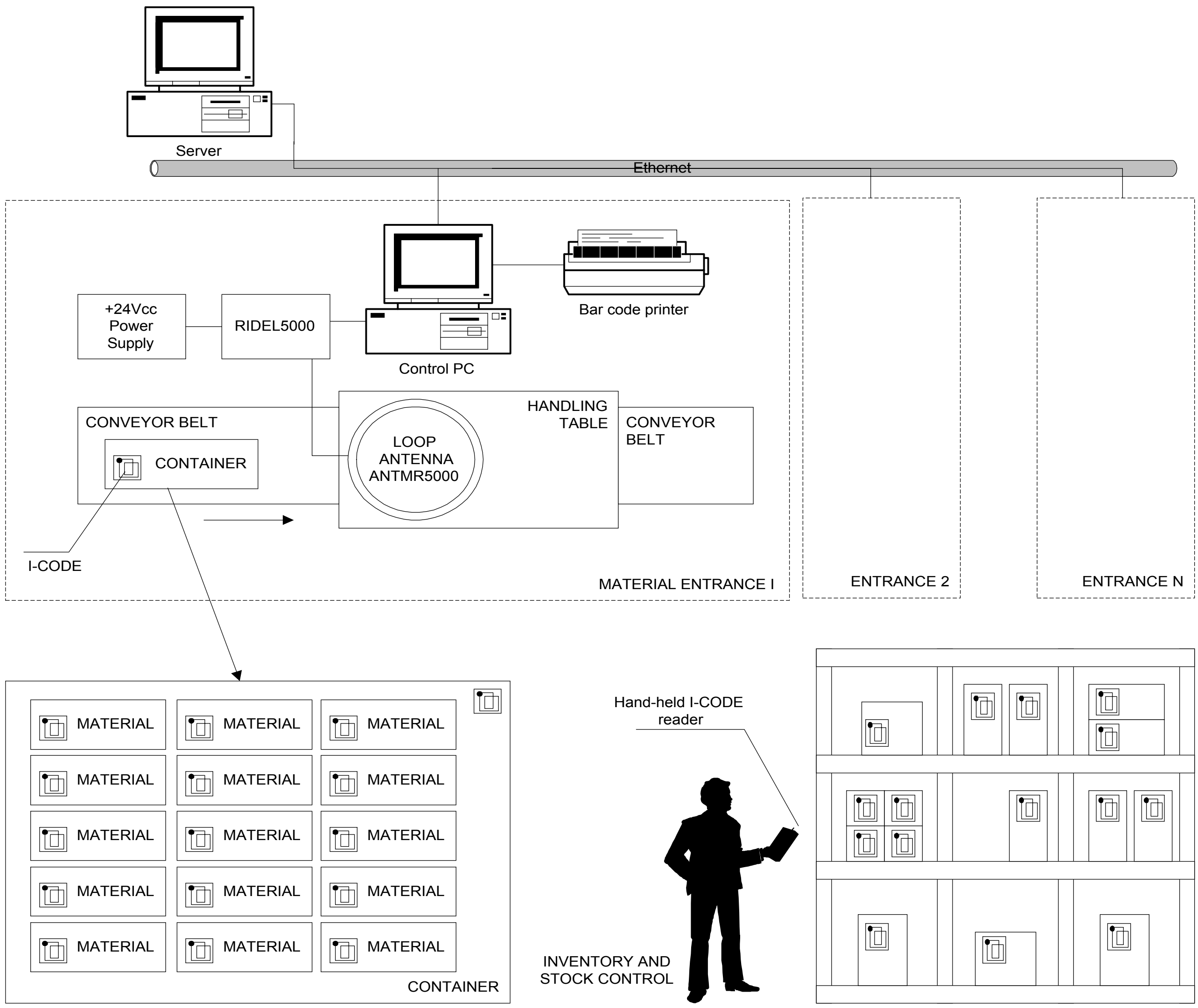
This is an access control applications with I-CODE cards. There can be two types of access cards for this application. One for visitors and other for inner personnel.

There can also be cards with different access level, so that some special zones can have restricted access, or the visitor can have access granted only for the zone he has to visit. The cards can also include some expiration date.

All this information is stored in every card, with a compression and encoding algorithm based on the unique serial number of the tag, with a secret encoding key. As a result, the tags are «formatted», and the system can still work off-line, in the event of a failure in the host or the control network (RIDEL5000 in stand-alone mode).

The computers are linked in a LAN. Each access include a card encoder for visitors, and the central computer includes another card encoder for inner personnel. The encoders are made with a short range I-CODE reader/encoder RIDEC5000.

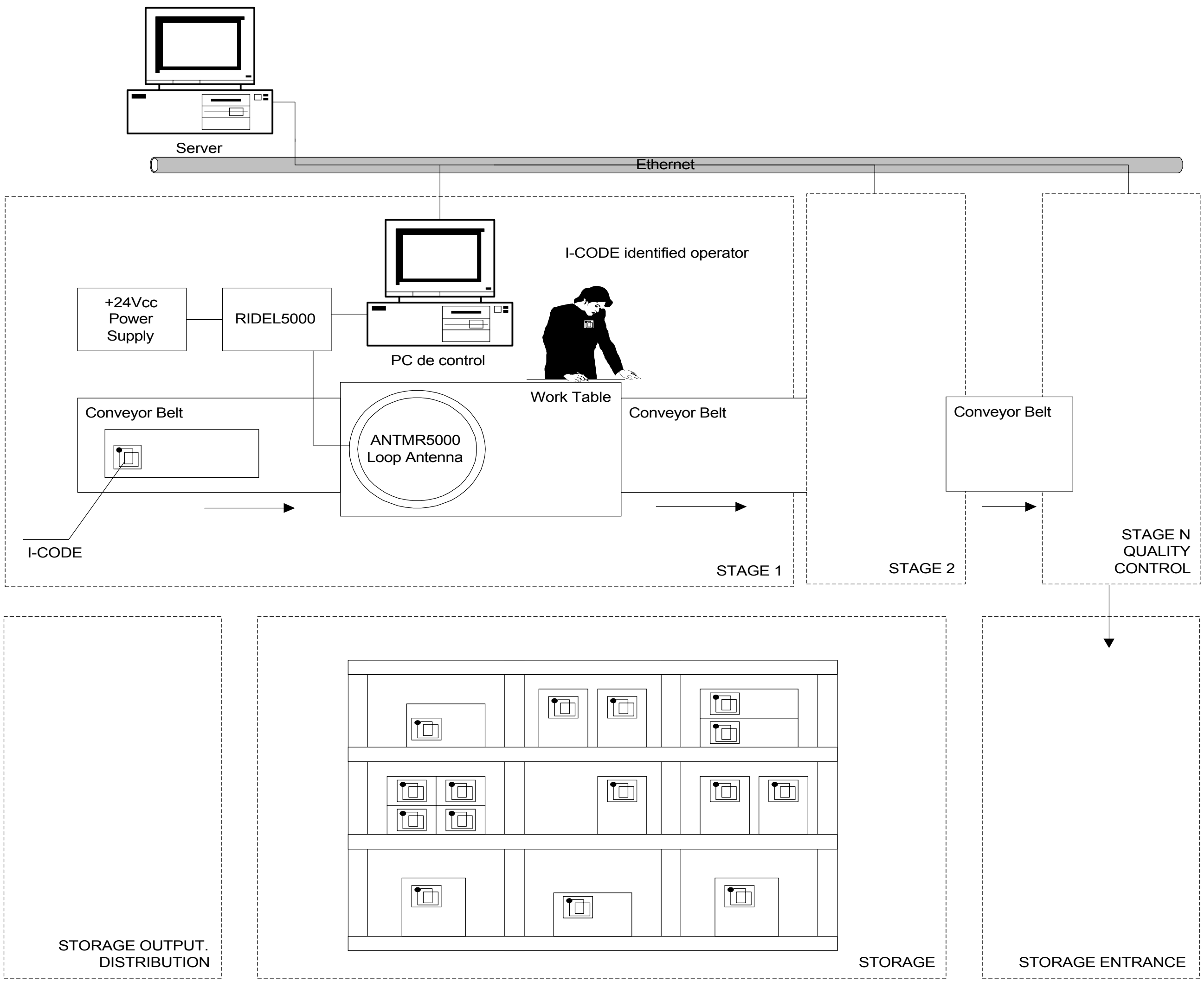
3.4.2.- LOGÍSTICS



The figure shows a logistics and warehouse control. Input goods are received in one or several entrances. The tags are read with a RIDEL5000, that also writes relevant information in the tag memory.

It is possible to attach tags to every individual item or to the container, so that everything can be read at once or separately. Once the materials have been placed in their stands, an operator can check the stock or make inventory control by means of a hand-held reader. It is also possible to include short range antennas in the stands if real-time stock control is neccesary.

3.4.3.- MANUFACTURING



In the manufacturing process, I-CODE is used to guarantee the product trazability in the different manufacturing steps. In the first place, a tag is attached to the product to be manufactured, or to the container of the batch. From this moment, in every step in the production chain, relevant information is included in the tag memory (date, operator , problems found, tests, acceptance...).

In the last step, information related with quality control is added, as described in the corresponding procedure (batch inspection, individual measurement, ...). The product is always propperly identified.

After quality control, the producto goes to the warehouse, where it can be identified by means of its tag. The same happens when the product leaves the factory. The anti-collision feature allows the system to work with batches. The products are also marked for fraud control.

4.-ICODE SYSTEM IMPLEMENTATION PROCESS

In this chapter, we provide a guide to implement a RFID sytem based on I-CODE technology. We describe some simple steps to follow.

4.1.- PROCESS ANALISYS

First of all, it is neccesary to maka an analisys of the process where the new system is to be implemented. It is important to describe in detail the following points:

- Detailed description of the present process operation
- Detailed description of the pretended process operation after the new I-CODE system implementation
- Description and quantification of the improvements to be achieved

4.2.- REQUIREMENT DEFINITION

General requirements have to be described for the system to be developed. In this section, it is neccesary to describe, at least, the following technical specifications:

- Reading zone dimensions and required distances and ranges
- Tag parameter definition. Size, base material, way of attachment, position to fix it, ...
- Reading procedure. Position and speed of the tag or tags in the moment they are to be read

4.3.- SYSTEM DEFINITION

In this section, and from the previous analisys, the characteristics of the system to implement will have to be stablished:

- Global structure of the system. Process points, communications, adittional hardware (PCs, LAN,...), new functions, software, ...
- Detailed definition of the elements defined. Requirements for every process point (number of readers, antennas, auxiliary elements, ...), adittional hardware definition, mechanics, ...

4.4.- PILOT SYSTEM IMPLEMENTATION

The objective of a pilot system is to make the personnel to become used to the new system, and to detect failures or improvements in the system features. It also helps for the new technology to be positively accepted by the people that is going to use it, by means of a gradual implementation.

This step should finish making a test procedure, for evaluation, comparing the results with the objectives defined at the beginning of the process.

4.5.- FINAL IMPLEMENTATION

Once the pilot system is evaluated, the final system will be implemented as required by the application.

4.6.- QUESTIONNAIRE. PROJECT DEFINITION

Functional Description of the system

Reading zone dimensions

Tag requirements

Pass speed and position of the tags during the reading process

Number of simultaneous tags

Description of elemen on which the tag is attached

Reading or writing requirements

Antenna enviroment description

Communication requirements

General diagram

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Control de versiones

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