Library L100 Reader

User's Guide

Revision 3.1b

TAGSYS

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Publishing Information

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Read This First

Welcome to the TAGSYS RFID System. This User's Guide is designed to help you get up and running quickly using this high-quality Radio Frequency Identification (RFID) system. It describes all you need to know about how to install and use the TAGSYS system and its associated applications.

This document describes how to:

- install the Library L100 Reader,

- select the best-adapted configuration for your application,

- troubleshoot any eventual problems.

This guide is designed for all TAGSYS partners and for TAGSYS Expert Network customers implementing a low-cost and high-performance RFID solution.

This document does not require any previous knowledge of Radio Frequency Identification (RFID) technology.

Conventions

Symbol	Meaning
	CAUTION: A note that advises users that a specific action could result in the loss of data or damage the hardware. **WARNING**: A note that advises users that a specific action may result in physical harm.
	A note that provides additional information that helps the user perform a task or obtain the best performance from the product.

Abbreviations and Acronyms

AFI	Application Family Identifier
AON	All Or None
API	Application Programming Interface
ASK	Amplitude Shift Keying
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DLL	Dynamic-Link Library
DPU	Digital Processing Unit
DSFID	Data Storage Format Identifier
DSP	Digital Signal Processor
EAS	Electronic Article Surveillance
ETX	End of Text

HPI	Host Port Interface
I/O	Input/Output
IFD	Interface Device
ILS	Integrated Library System
LED	Light Emitting Diode
LSb	Least Significant Bit
LSB	Least Significant Byte
MSb	Most Significant Bit
MSB	Most Significant Byte
OS	Operating System
PC	Personal Computer
PCB	Printed Circuit Board
RAM	Random Access Memory
RF	Radio Frequency
RFID	Radio Frequency IDentification
RFU	Reserved for Future Use
RPU	Radio Processing Unit
RTC	Real Time Clock
SAM	Security Access Module
STX	Start of Text
TTF	Tag Talks First
TTL	Transistor-Transistor Logic
TTY	TeleTYpe
UID	Unique Identifier

Glossary

Anti-Collision Tag capability making it readable while other tags are present in the RF field.

Antenna An aerial that receives and/or transmits radio frequency signals. Aerials are manufactured in a variety of forms, shapes and sizes.

Baud A unit of measure of data transmission speed representing the number of signal changes per second.

BNC Connector Cylindrical metal connector with a copper core that is located at the tip of a coaxial cable, and is used to connect cables together. It attaches by pushing and twisting the outer cylinder on to two locking pins.

Reader See Reader.

Data Storage Format Identifier Identifies the structure of the data stored in the smart label.

Digital Signal Processor This part of the Radio Processing Unit (RPU) performs real-time smart label decoding and manages the Medio L200 configuration.

Dynamic-Link Library Executable routines that are stored as separate files with DLL extensions and executed only when needed by the program.

Host Port Interface Interface used to access the DSP memory.

IEC Connector Three-pin connector used on sockets that carry mains electricity to the computer. All PCs use a male IEC connector and mains lead with a female IEC connector.

Interrogation Pulse A signal transmitted by the reader to activate the smart label's transponder.

Monitoring Port Parallel Port granting access to the HPI. It communicates directly with the Radio Processing Unit

Multi-Read See Anti-Collision

Nibble Half a byte (4 bits)

Packaged Reader A reader in its casing.

Phase Shift Difference of phase between the 13.56 MHz field emitted by two antennas. This feature is dedicated to rotating field applications and three-dimensional volume smart label detection.

Protocol A set of rules governing a particular function, such as the flow of data/information in a communication system (communication between a smart label and a reader or a reader and a PC or host computer).

Quiet Protection Mask Reserved for the C270 (I-Code™). This mask records the timeslots that may contain a selected chip in quiet mode.

Radio Frequency Identification System (RFID) An automatic identification and data capture system comprising one or more readers and one or more smart labels in which data transfer is achieved by means of suitable modulated inductive or radiating electromagnetic carriers.

Radio Processing Unit This unit controls the main features of the Medio L200, such as the RF channels, the multiplexer and the smart label decoding.

Reader Electronic system for the communication between smart labels and host computers.

Reader Talks First Chip protocol for exchanges between the reader and the chip, whereby the chip waits for a command from the reader to which it responds.

RS-232 Electronic Industries Association (EIA) standard for serial interfaces between computers and peripherals which defines the function, the electrical characteristics and the timing of signals.

RS-485 Electronic Industries Association (EIA) standard for multipoint, differential data transmission. It allows multiple nodes to communicate bi-directionally over 1 or 2 twisted pairs.

Smart Label Small, flexible tag from the 13.56 MHz TAGSYS product line. A smart label is made of a chip connected to an etched antenna.

Tag See Smart Label.

Tag Talks First Chip protocol for exchanges between the reader and the chip, whereby the tag sends information continuously, without waiting for a specific command from the reader.

Transceiver A combined transmitter and receiver.

Transponder A combined receiver/transmitter that automatically transmits a signal when a 'trigger' is received by it. The trigger is often a pulse, called an interrogation pulse.

If you need assistance

Please contact your nearest TAGSYS sales representative or the TAGSYS welcome desk at:

Telephone:	+33 (0) 4 91 27 57 00
Fax:	+33 (0) 4 91 27 57 01
E-Mail:	info@tagsys.net

Contact for Comments

We welcome your feedback to help us provide high quality documentation.

For technical comments, please contact our welcome desk:

Telephone:	+33 (0) 4 91 27 57 00
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Please remember to quote the Document Reference Number 10242A0, your job title and your company.

Quality Issues

TAGSYS implements stringent quality controls at all stages of its manufacturing process. However, should you find a defect with this product, please notify your customer service representative using the dedicated Product Return Form.

Telephone:	+33 (0) 4 91 27 57 36
Fax:	+33 (0) 4 91 27 57 02

Table of Contents

1   For Your Safety

1.1   General Use

The Library L100 Reader is designed to be rugged and reliable and to provide years of trouble-free service. Please observe the following general tips:

- Take care not to scratch the device. Keep the device clean. When working with the device, use only TAGSYS-approved accessories.

- This device is not waterproof and should not be exposed to rain or moisture. Under extreme conditions, water may enter the circuitry.

- Take care not to drop the device or subject it to any strong impact.

- Protect the device from extreme temperatures. For example, do not leave the device in front of a window on a hot day, and keep it away from heaters and other heat sources.

- Do not store or use the device in any location that is extremely dusty, damp, or wet.

- Use a soft, damp cloth to clean the device. If the surface of the device becomes soiled, clean it with a soft cloth moistened with a diluted window-cleaning solution.

1.2   Care and Maintenance

This device is a product of superior design and should be handled with care. The suggestions below will further increase the lifetime of this device.

- Keep the device and all parts and accessories out of the reach of small children.

- Keep the device dry. Precipitation, humidity and liquids contain minerals that will corrode electronic circuits.

- Do not use or store the device in dusty, dirty areas. Its moving parts can be damaged.

- Do not store in hot areas. High temperatures can shorten the life of electronic devices, damage batteries and warp or melt certain plastics.

- Do not store in cold areas. When the device warms up (to its normal temperature), moisture can form inside the device, which may damage electronic circuit boards.

- Do not attempt to open the device. Non-professional handling of the device may damage it.

- Handle the device with care. Shocks may break internal circuit boards.

- Do not clean the device with harsh chemicals, cleaning solvents or strong detergents. Gently wipe the device with a soft cloth slightly dampened in a mild soap-and-water solution.

- Do not paint the device. Paint may clog the device's moving parts and prevent proper operation. Paint with metallic contents may limit device performance.

1.3   Important Safety Information

1.3.1 Operating Environment

Follow all special regulations that are applicable in any area and always switch off the device whenever its use is prohibited, or when it may cause interference or danger.

When connecting the device or any accessory to another device, read its user's guide for detailed safety instructions. Do not connect incompatible products.

As with all RF equipment, users are advised that the equipment should only be used in its normal operating position.

1.3.2 Electronic Devices

Most modern electronic equipment is shielded from radio-frequency (RF) signals. However, other electronic equipment may not be shielded against the RF signals from your device.

Medical Devices

Operation of radio transmitting equipment, including RFID devices, may interfere with the functionality of inadequately protected medical devices. Consult a physician or the manufacturer of the medical device to determine if they are adequately shielded from external RF energy or if you have any questions.

2 Certification

2.1 Occupational Health and Safety Notices

TAGSYS Products have been designed not to exceed the limits given in the European Standard EN 50364 "Limitation of human exposure to electromagnetic fields from devices used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications" in conjunction with the European Standard EN 50357 describing how to evaluate the exposure level.

It is the responsibility of the TAGSYS Partner to install the Library L100 Reader as described in TAGSYS Documentation and with the appropriate antennas.

Modification of any TAGSYS Library System is prohibited without the written consent of TAGSYS. Unauthorized modifications may void the conformity of the equipment to safety standards and will void the TAGSYS warranty.

An RF fields survey has been carried out on all the Library System components, in accordance with AS/NZS 2771.1: Radio Frequency Radiation, Part 1. According to this standard the maximum allowable RF exposure levels (non-occupational) at 3 kHz to 300 GHz are 200 µW/cm2.

2.2 Regulatory Notices

An RFID system typically composed of an RF emission device such as the Library L100 Reader is subject to national regulations that may differ by country.

One important item to consider is the maximum permissible magnetic field intensity at a distance of 10 meters from the antenna that must not exceed 42 dBµA/m in Europe and 38 dBµA/m in US.

The Library L100 Reader meets these limits.

> **CAUTION** It is the responsibility of the TAGSYS Partner to install the Library L100 Reader as described in this User's Guide or in TAGSYS Documentation.

2.2.1 In Europe (CE and RTTE Directives)

The Library L100 Reader complies (CE Declaration of Conformity granted) with the European EMC directive.

The Library L100 Reader complies with the requirements of the Telecommunication Terminal Equipment Act (FTEG) and the RTTE Directive 1995/5/EC.

It is the responsibility of the TAGSYS Reseller to install the Library L100 Reader as described in this Reference guide or TAGSYS Documentation.

Any modification of the Library L100 Reader is prohibited without the written consent of TAGSYS. Unauthorized modifications may void the conformity of the equipment to CE and RTTE Directives and will void the TAGSYS warranty.

> **CAUTION** If a Library L100 Reader is further integrated in a different product, it is the responsibility of the manufacturer of this complementary product to obtain the required approvals for this product.

2.2.2 In USA (FCC Directive)

The Library L100 Reader has been designed to comply with Part 15 of the FCC Rules. Furthermore typical configurations based on a Medio S002 have been successfully tested with Part 15 of the FCC rules (FCC ID Numbers are listed on all system-mounted TAGSYS Antennas).

Library L100 Reader

WARNING TO USERS IN THE UNITED STATES

FEDERAL COMMUNCIATIONS COMMISSION (FCC) RADIO

INTERFERENCE STATEMENT 47 CFR Section 15.105(b)

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 receiver.
- Connect the equipment into an outlet on a circuit different to that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

NO UNAUTHORIZED MODIFICATIONS

47 CFR Section 15.21

CAUTION: This equipment may not be modified, altered, or changed in any way without signed written permission from TAGSYS SA. Unauthorized modification may void the equipment authorization from the FCC and will void the TAGSYS warranty.

ANTENNA REQUIREMENT

47 CFR Section 15.203

CAUTION: This equipment must be professionally installed. The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded. Non-professional installation or installation of the equipment with an improper antenna may void the equipment authorization from the FCC and will void the TAGSYS warranty.

Operation is subject to the following two conditions: (1) The system devices may not cause harmful interference, and (2) The library system devices must accept any interference received, including interference that may cause undesired operation.

2.2.3 In Canada

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

3   Overview

The TAGSYS Library L100 (L-L100) smart label packaged reader is intended for Original Equipment Manufacturer (OEM) applications.

The L-L100 reader incorporates hardware, software and other components that manage the Radio Frequency (RF) interface as well as the external connections for power, data exchange and various communication protocols.

The TAGSYS L-L100 reader is specifically designed for use in a library environment and therefore is easily integrated into Integrated Library System (ILS) applications.

Customized software, such as STXE Protocol application or the Teletype (TTY) menu application, can be easily downloaded.

3.1   Key Features

- 13.56 MHz RF multi-channel packaged reader

- Multiple tag compatibility (TAGSYS and ISO15693 smart labels)

- Standard software applications

- High RF output power, with software configuration

- Software-configurable multiplex operating mode

- Two dedicated processing units, namely a microcontroller for the customer application and a Digital Signal Processor (DSP) unit for real-time signal processing

- Serial communication with an embedded end-user application

- Multi-purpose configurable industrial I/O ports

- Parallel port monitoring

3.2   General Description

Figure 1: L-L100 Packaged Reader
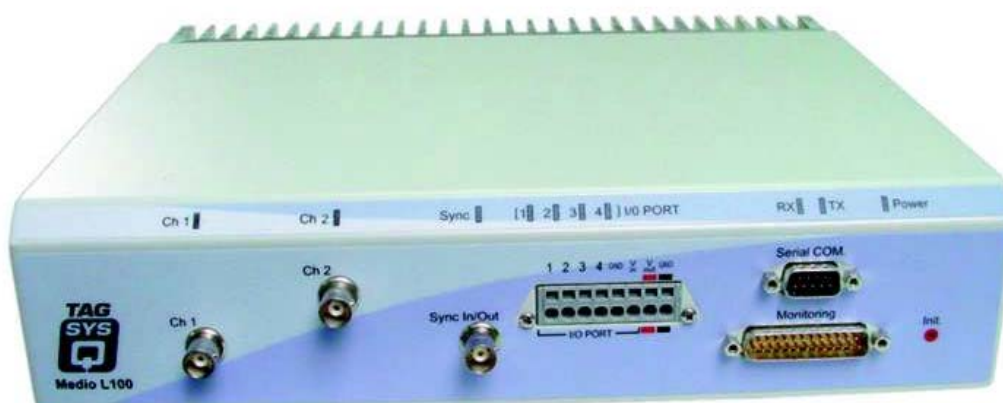
3.2.1 RF Channels

The L-L100 Reader can drive up to two antennas with each channel able to drive up to four watts. LEDs indicate which RF field (channel) is transmitting (green).

CAUTION: The antenna **MUST** be connected to the reader before the unit is turned on.

3.2.2 Synchronization Input/Output

When configured for input, this BNC connector makes it possible to use an external 27.12-MHz clock to generate the RF field, instead of the internal clock generator.

When configured as output, this connector can drive other L-L100 readers and provide the 27.12-MHz clock.

The Sync LED indicates the clock mode:

- Red: The internal clock generator is enabled and an external clock signal cannot be input.

- Green: The internal clock generator is disabled. A 27.12-MHz clock signal must be connected to the Sync In/Out connector.

By default, the internal clock mode is applied and the Sync In/Out connector is configured as an output. If the external clock mode is required, contact your TAGSYS sales representative.

3.2.3 I/O Port Connector

The L-L100 reader provides four Input/Output (I/O) ports. Each I/O can be independently configured as an input or output by the application software.

When configured as outputs, I/Os are open drain (250 mA). A pull-up supply must be connected to the I/O port reference input (V_{IN}). The pull-up supply voltage range is between 5V and 28V.

When configured as inputs, the I/O input signal range is between 0V and 28V.

I/O port LEDs indicate whether the I/O is configured for input (green) or output (red).

Please refer to Section 9, "I/O Ports" for more information.

Industrial I/O ports can only be accessed via the Data Processing Unit (DPU).

3.2.4 Init Button

The Init button aborts the embedded application stored in the Data Processing Unit memory. The L-L100 Reader is then ready to be downloaded with a new application.

The L-L100 Reader must be switched off and then back on before an embedded application takes effect.

3.2.5 Serial Connector

The serial connector is used to communicate with an external environment. User commands and data exchanges are transmitted through this port which can be set to RS-232, RS-485 or RS-422 mode by the software. Different baud rates can be defined for each mode.

The Default Mode is defined by the application software which is downloaded in the L-L100 Reader.

Tx (Transmit data) and Rx (Receive Data) LEDs indicate the activity of the serial port.

The RS-232 cable is a null modem cable.

Please refer to Embedded Application chapter for further information about Application Software.

3.2.6 Monitoring Port (Parallel Port)

The monitoring port communicates directly with the Radio Processing Unit (RPU). When the parallel cable is plugged in, the Data Processing Unit (DPU) is automatically deselected. The parallel port can be used as a monitoring tool or as a means to upgrade the L-L100 Reader firmware via the L200 Explorer.

The parallel cable uses pin-to-pin DB25 connectors. A shielded cable must be used to prevent disruptions when antennas have a high output power.

Please refer to L-L100 Reader Architecture chapter for further information about the RPU and DPU. Please refer to "L-L100 Reader Firmware Reference" for further information about L-L100 Reader Firmware.

3.2.7 Antennas

The L-L100 Reader is primarily designed for use with Aero-LI, L-SA1 and L-SA2 antennas. Nonetheless, it is also operational with other TAGSYS antennas, provided that the power applied to the antenna does not exceed antenna specifications. For more information, refer to Section 6, "Antennas".

L-L100 Reader performance has been characterized for a 3-meter long antenna cable. Optimized operation is not guaranteed with a cable longer than three meters.

4   Architecture

The L-L100 Reader consists of two main blocks:

1.   Data Processing Unit (DPU).

2.   Radio Processing Unit (RPU),

Figure 2: L-L100 Architecture
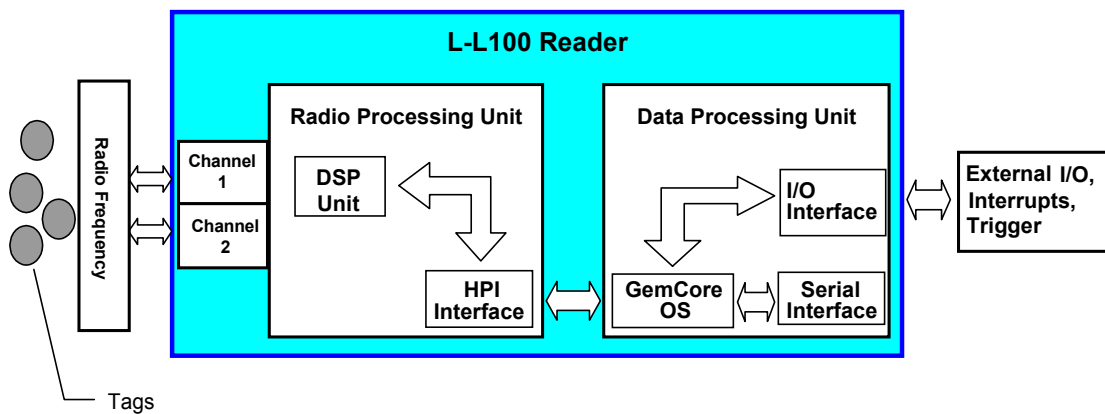
4.1   Data Processing Unit

The Data Processing Unit (DPU) primarily consists of the GemCore operating system. This unit provides all GemCore functions (RTC, backup memory, SAM module…) and features four configurable industrial I/O ports.

Figure 3: Data Processing Unit

4.2   Radio Processing Unit

The Radio Processing Unit (RPU) controls the main features of the L-L100 Reader, such as the RF channels, the multiplexer and chip decoding.

Figure 4: L-L100 Architecture

The RPU is managed by a Digital Signal Processor (DSP) which performs real-time chip decoding and manages the reader configuration.

The RPU behaves as a slave as it waits for a host command, executes it and transmits the result.
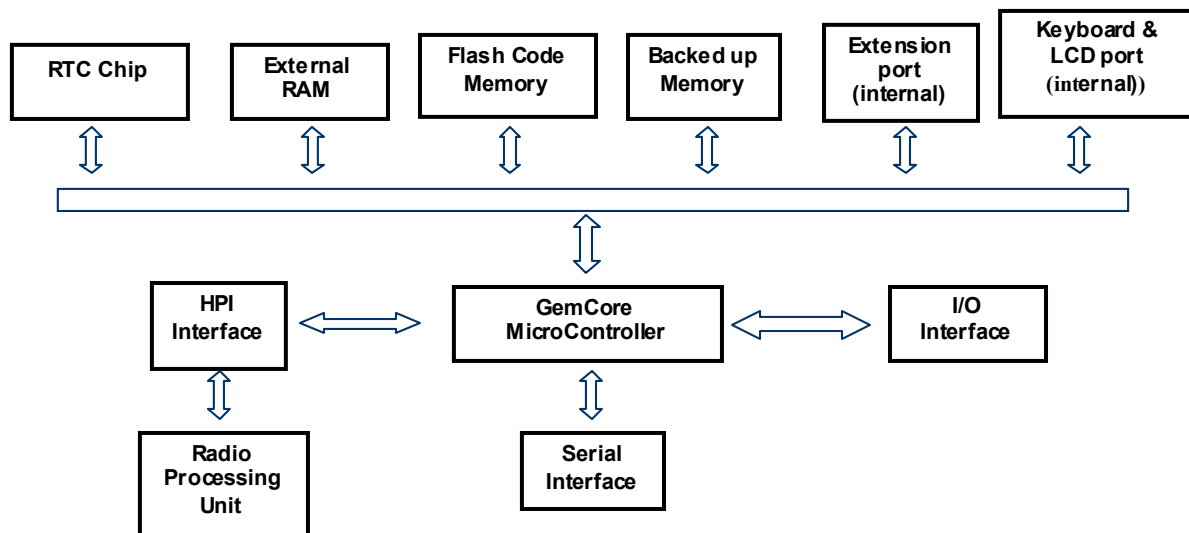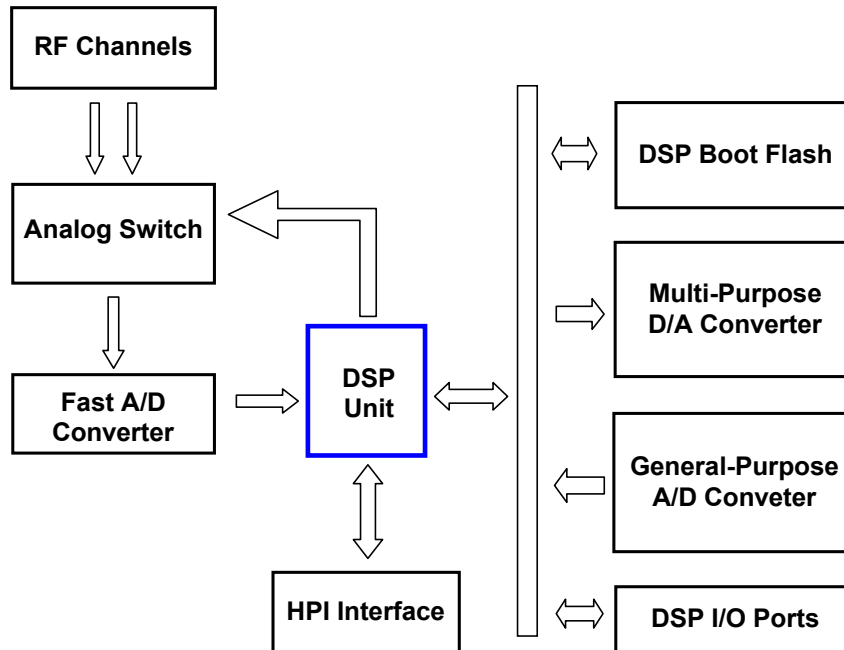
This command exchange is performed using a specific protocol (HPI protocol) and a specific interface (HPI interface). This protocol is based on the DSP dual-access memory. The host sends commands to the DSP by writing to the DSP memory. It then reads the reply in the same memory.

The L-L100 Reader firmware is stored in DSP Flash memory. This firmware is TAGSYS property. Please refer to "L-L100 Reader Firmware Reference " for further information about L-L100 Reader Firmware.

Two RF channels are available but only one can be read at a given time. The DSP controls an analog switch and connects the RF channel to be read to the Analog/Digital Converter.

4.3   RF Channels and the Multiplexer Architecture

The antenna multiplexer and the RF channels belong to the RPU.

Two RF channels are available. These channels can be enabled independently

Each channel output power can be adjusted up to 4W. The same output level is applied to all the enabled antennas.

Available phase shift values between antenna 1 and antenna 2 are 0°, 90° 180° and 270°.

On-Off Keying (OOK) and Amplitude Shift Keying (ASK) are available for reader-to-smart label communication and are managed independently for each RF channel.

Figure 5: L-L100 Antenna Multiplex
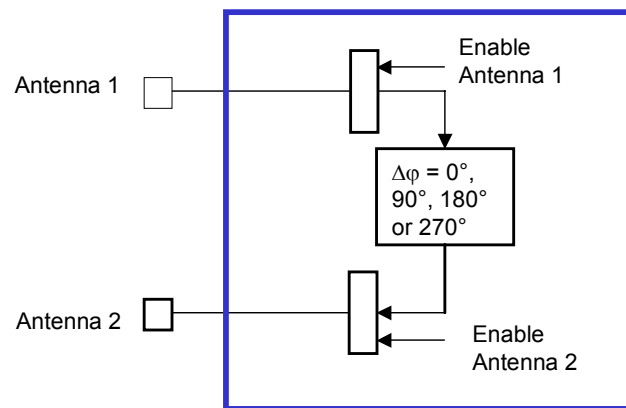
5   Embedded Application

The embedded software application is based on the GemCore operating system which is stored in the Flash memory of the Data Processing Unit.

Different applications can be downloaded into the L-L100 Reader, but only one can be stored at a single time.

Depending on the software application downloaded into the GemCore Flash memory, it may be possible to access all or part of the L-L100 Reader functions.

The STXE standard protocol application is delivered with the L-L100 Reader:

STXE Protocol is the TAGSYS standard protocol. It is compatible with most of TAGSYS range reader products. We advise to use STXE protocol in order to address all TAGSYS reader functions.

6   Antennas

TAGSYS L-L100 readers are optimized for use with TAGSYS antennas.

The antennas are factory-calibrated to an impedance of 50 Ohms which offers optimal performances when the antenna is mounted on a desktop surface.

Due to their specific design, these antennas can be safely used in proximity to other TAGSYS RFID products. They will also work, if properly installed, in metallic-type environments. In this case, performance may be reduced.

TAGSYS antennas are provided with rubber feet to operate in a standard desktop configuration. However, a mounting kit is also supplied for installation underneath a table or desk.

Antennas are delivered with a standard plastic cover. This cover can be replaced by another made of a non-metallic and non-conductive material. This cover should be as thin as possible as not to impact the performance of the stack programming function. In addition, we strongly recommend placing the antenna directly on the desk.

It may be necessary to retune the antenna once installed if the environment is highly metallic or if the antenna is installed underneath a table or desk (and depending on the material of which the desk/table is manufactured).

When installing a dual-antenna arrangement, a proximity effect may be created when using Aero LI antennas. L-SA1 and L-SA2 are specifically designed to reduce this effect.

Table 1: Antenna Characteristics

Parameter	L-PS1	Aero LI	L-SA2	L-SA1
Dimensions	255 x 216 x 20 mm. 10 x 8½ x ¾ in.	288 x 263 x 17 mm. 11⅓ x 10⅓ x ⅔ in.	440 x 370 x 18 mm. 17⅓ x 14½ x ⅔ in.	650 x 440 x 18 mm. 25 ⅔ x 17⅓ x ⅔ in
Single Ferrite	Yes	Yes	Yes	Yes
Characteristics	Single-loop	Single-loop	Single-loop	Double-loop
Housing	Plastic ABS UL 94-V0			
Weight	2.0 kg.	2.0 kg.	2.5 kg.	5 kg.
Operating Temperature	0 °C to +55 °C			
Storage Temperature	-25 °C to +60 °C			
Maximum Output Power [1]	0.25 W	8 W	3 W	
Operating Frequency	13.56 MHz			
Impedance	50±5 Ω and 0 ± 5°			
Antenna Connection	Not applicable		BNC 50 Ω	
Antenna Connection cable	Not applicable		RG-58, 50 Ω	

[1] FCC-compliant antennas are available (maximum output power of 1 W).

Table 2: Minimum Single-Antenna Station Performance

Parameter	Single-Antenna Stations			Dual-Antenna Stations	
	L-PS1	**Aero LI**	**L-SA2**	**Aero LI[1]**	**L-SA1**
Reading	3 ½ in. (89 mm.)	6 in. (152 mm.)	7 in. (178 mm.)	6 in. (152 mm.)	6 ½ in. (165 mm.)
Writing	3 in. (76 mm.)	4½ in. (114 mm.)	5 ½ in. (140 mm.)	4 in. (102 mm.)	4½ in. (114 mm.)

Minimum reading/writing distance for stacks: 4 in. (102 mm.)

[1] Multiplexed with L-L100 reader.

Performance given for single tag operation and measured on any point above the RF loop. In the middle of the loop, the performance may be greater. This does not include the L-PS1 where performance has been measured with tag centered on the station.

7   Installation

7.1   General Installation

Read/antenna/ILS layout and maximum cable distances, to be specified.

7.2   Mechanical Aspects

The L-L100 Reader is delivered with four rubber pads screwed on the bottom of the package for installation on a table or desk.

A mounting plate available with the L-L100 Reader can be used to mount the unit in various positions. When mounted vertically, the BNC connectors must be facing upwards and perpendicular to the floor.

When installing the L-L100 Reader on the mounting plate, remove the rubber pads from the L-L100 Reader and fasten the unit directly to the mounting plate.

CAUTION: The screws must be always attached to the bottom of the L-L100 Reader even if the rubber pads and mounting plate are not used.

Figure 6: Authorized Installation Positions

BNC Connectors on Top
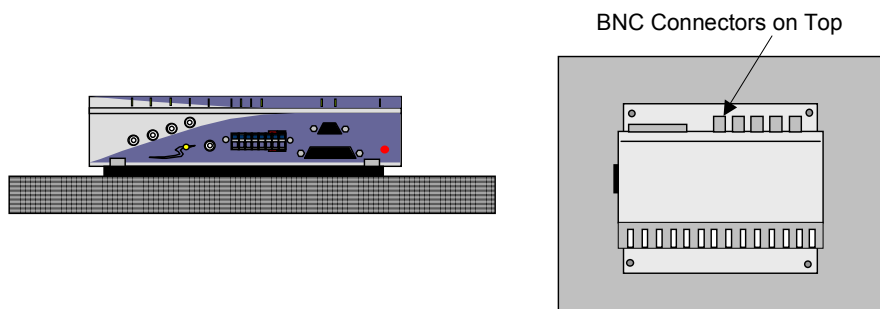
CAUTION: For continuous protection against risk of fire, use only T 2.5A – 250V rated fuses.

7.3   Cabling Requirements

All L-L100 Reader cables must be shielded. Shielding effectiveness of the material used should be of Good performance (60dB min.), especially in the frequency range of 10 to 60 MHz. The addition of ferrite clamps near the input/output will increase common mode rejection. TAGSYS antenna products are delivered with good performance shielded coaxial cables with ferrite beads already mounted to increase shielding effectiveness at low frequencies.

7.4   Operating Modes

The L-L100 Reader can be setup in one of two operating modes:

- Test/Setup mode used to test and develop your application,

- Main Operating mode for running your application.

CAUTION: The antenna **MUST** be connected to the reader unit before the reader is turned on.

7.4.1 Test/Setup Mode

The RPU host is connected to the L-L100 Reader by a parallel interface linking it to the monitoring host, which is a computer. The L200 Explorer software is designed to set-up the L-L100 Reader and to execute chip commands in a Windows environment.

This operating mode is useful to learn all L-L100 Reader basic functions and to rapidly start using the packaged reader in a specific RFID application.

The L200 Explorer software is also a powerful and easy-to-use tool to define the best RFID set-up for a custom application.

For additional information about the L200 Explorer software, refer to the L200 Explorer User's Guide.

Figure 7: Test/Setup Mode
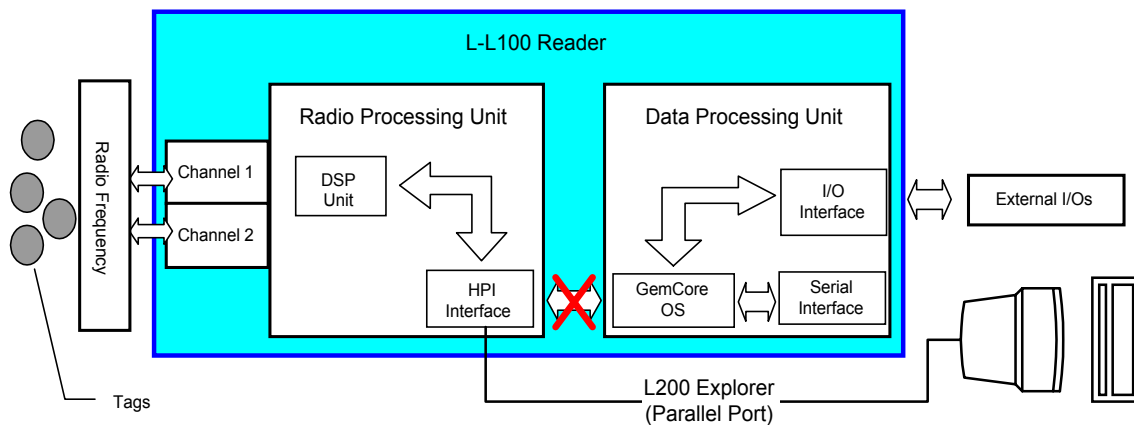
CAUTION: The antenna **MUST** be connected to the reader unit before the reader is turned on.

In this mode, the L-L100 Reader is directly connected to the host PC via the DB25 parallel port connector. Reader commands are only accessed using the L200 Explorer software.

1. Connect the antennas to the required inputs, according to application specifications.

2. Connect the L-L100 Reader monitoring port to the PC using the shielded parallel cable.

---

3. Connect the L-L100 Reader to the AC supply.

4. Start the L200 Explorer software application.

You can now configure the RPU of your L-L100 Reader as desired and start using most L-L100 Reader functions.

> Test/Setup Mode is only available when using L200 Explorer Software. In this mode, certain Data Processing Unit functions cannot be accessed.

7.4.2 Main Operating Mode

In Main Operating mode, the Data Processing Unit (DPU) is the RPU Host. The DPU can access the DSP memory via the HPI interface.

When the L-L100 Reader Main Operating Mode is used, the DPU is the interface between the RPU and the environment. In that case, the DPU can exchange data with a host system through the embedded serial port interface.

> When the Main operating mode is used, the host system is not connected to the RPU. In other words, when the host system requires a command which must be executed by the RPU, the GemCore OS receives this request and sends the corresponding command to the RPU.

The Main Operating mode is also designed for using the L-L100 Reader as a standalone device, without a host.

Once the RFID system has been completely defined and it is ready for an industrial application, the L-L100 Reader can be interfaced to specific network systems and various communication protocols. This interface is implemented using custom DPU Application Software.

> The command set and communication protocol between the DPU and the RPU are completely defined by the DSP Firmware. It therefore cannot be customized.
>
> On the other hand, the command set and the communication protocol between the DPU and the L-L100 Reader Host are defined by the DPU application software. Developing new DPU application software makes it possible to interface the L-L100 Reader with new environments and to communicate using new protocols.

Figure 8: Main Operating Mode
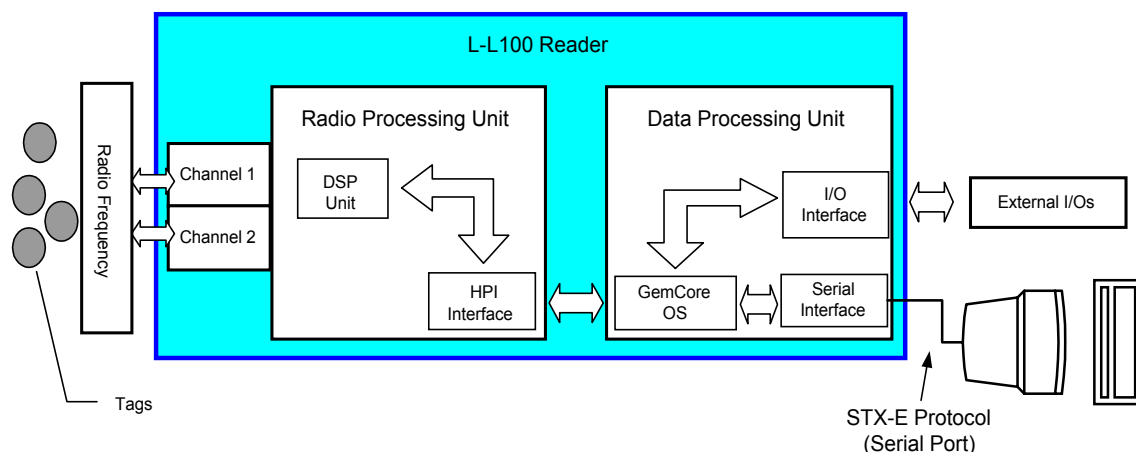
CAUTION: The antenna **MUST** be connected to the reader unit before the reader is turned on.

When your application is fully developed and ready for use, configure the Main Operating mode:

1. Connect the antennas to the required inputs, according to application specifications.
2. Connect the L-L100 Reader serial port to the PC or to the terminal using a serial cable.
3. Connect the pull-up supply and I/O ports if required.
4. Make sure that the monitoring port is not connected to the parallel cable.
5. Connect the L-L100 Reader to the AC supply.

The Application software stored in Data Processing Unit is now running and the application is ready for use.

8   Multiplexing Configuration

The L-L100 Reader is designed with two transmit channels but with only one receive channel. This means that each antenna can transmit an RF field used to read tags, but tag contents can only be read by one antenna at a single time.

Tag reading performance can be enhanced by using the L-L100 Reader to perform read operations on both antennas one after the other.

In addition, a phase shift can be applied between Antenna 1 and Antenna 2 for 3-D rotating field applications.

These parameters are selected in Multiplexing mode which allows the user to completely define a system based on its multiplexing configuration.

In particular, the following parameters are defined by the multiplexing mode:

- the transmitting antennas,

- the phase shift between the antennas,

- which antenna is read, and for how long.

8.1   Windows™ DLLs

The Library Windows™ DLLs automatically manage multiple-antenna applications for the L-L100 Reader.

The DLLs take advantage of multi-channel readers (L-L100 Library) for both reading and writing using several specific functions. For more information, refer to the Library Windows™ DLL Programming Guide.

8.2   STX-E Protocol

The STX-E Protocol can be used to develop dedicated application programs. For more information, refer to the MedioSTX DLL Programming Guide.

Multiplexing information is organized into patterns. A sequence contains between one and eight patterns that are applied one after the other in a loop. The L-L100 Reader can only store a single sequence.

Figure 9: Sequence of Patterns in a Loop

Pattern 1 ——▶ Pattern 2 ——▶ Pattern 3 ——▶...Pattern n

If n patterns are defined
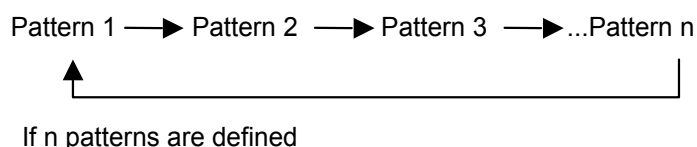
The multiplexing mode enables the user to implement several combinations on the basis of this physical configuration. The following paragraphs provide implementation examples and show how to choose the pattern.

8.3   Scanning (Reading)

The scanning parameters define which antenna is read (receives tag information), when it is read and for how long.

For each pattern, the transmitting antennas will be read a set number of times. The number of scans defines the global number of antenna read operations to be performed on each pattern. The order in which antennas are read is always: Antenna 1 (if selected) and then Antenna 2 (if selected).

The number of scans is common to all patterns, regardless of the number of antennas selected in the pattern.

Each pattern is executed for the same length of time regardless of the number of antennas selected in the pattern.

The duration of each scan period is defined as follows:

- For Reader Talks First (RTF) smart labels, the scanning duration gives the number of Read commands sent to the tags during a single scan period. (Minimum Recommended Scan Duration is 20 Read commands)

> For RTF tags, L-L100 Reader must send a Read command to tag for it to be read.

- For Tag Talks First (TTF) smart labels, the scanning duration gives the time during which the reading process is activated on one antenna during a single scan period. (Minimum Recommended Scan Duration is 100 ms.)

> When a TTF tag is detected, the read operation will be completed even if the scan duration period has expired. In other words, the actual scan duration may be longer when a TTF tag is processed at the end of the scan period.

For more information about Scan Number and Scan Duration parameters, refer to the example given in Section 8.5.3, "Enabling each Antenna separately and then both at once".

8.4   3-D Rotating Field Applications

Phase shifts can be used to detect tags in a 3-D rotating field application. Phase shifts of 0°, 90°, 180° or 270° are available.

In this case, both antennas must be enabled (transmitting) simultaneously in order for the two phases to create a 3-dimensional RF field.

8.5   Pattern Examples

8.5.1 Enabling one Antenna after Another

This is the most common example of a tag-reading pattern and requires the use of two patterns. The first one enables only Antenna 1, while the second enables only Antenna 2.

In Pattern 1, Antenna 1 is enabled and then the detected tags are read. Afterwards in Pattern 2, Antenna 1 is disabled, Antenna 2 is enabled and then the detected tags are read.

Channel	1	2
Pattern 1	Enabled	Disabled
Pattern 2	Disabled	Enabled

The advantage of this configuration is that the two antennas are not enabled at the same time, reducing interference.

8.5.2 Enabling both Antennas Simultaneously

This configuration is implemented with only one pattern which enables Antennas 1 and 2 at the same time. This configuration is best used for detecting smart labels in 3-dimensional rotating field applications. For more information, refer to Section 8.4, "3-D Rotating Field Applications".

In this case, a phase shift should be applied to one of the antennas in order to create a 3-D RF field.

Both Antennas 1 and 2 are enabled and the tags detected by Antenna 1 are read and then the tags detected by Antenna 2 are read. (Only one channel can be read at a single time.)

Channel	1	2
Pattern 1	Enabled	-Enabled

8.5.3 Enabling each Antenna separately and then both at once

Depending on the application requirements, in this configuration each antenna can be enabled separately and then both at once.

In order to implement this configuration, three patterns are necessary. The first one enables only Antenna 1, the second enables only Antenna 2 and the third enables both Antennas 1 and 2.

Channel	1	2
Pattern 1	Enabled	Disabled
Pattern 2	Disabled	Enabled
Pattern 3	Enabled	-Enabled

In this example, the scanning parameters must be carefully selected. As both the Scan Number and Scan Duration parameters are the same for all three patterns, if the Scan Number is set to 1, Antenna 2 in Pattern 3 will not be read.

If the Scan Duration is set to 100 ms. and the Scan Number is set to 2, the tags detected by Antenna 1 will be read twice (for 100 ms each time) in Pattern 1, then the tags detected by Antenna 2 will be read twice (for 100 ms each time) in Pattern 2. In Pattern 3, the tags detected by Antenna 1 will be read once for 100 ms. and then the tags detected by Antenna 2 will be read once for 100 ms.

In the event that the Scan Number parameter is set to 3, the tags detected by Antennas 1 and 2 are read three times in Patterns 1 and 2, respectively. In Pattern 3, the tags detected by Antenna 1 are read once, then the tags detected by Antenna 2 are read once, and then the tags detected by Antenna 1 are read a second time.

Each pattern will be executed for the same amount of time regardless of the number of antennas selected in the pattern.

This duration is equal to the Scan Number x Scan Duration.

9   I/O Ports

The L-L100 Reader features four I/O ports. All four I/O ports can be configured independently as a general purpose input or output.

Depending on the Application software downloaded in the DPU, the I/O port may command a relay, trigger specific commands (Windowing…) or read input signals.

The I/O Port is controlled by the DPU with commands using STX protocol. This means that I/Os are not controlled by the RPU which uses DLLs.

9.1   General Purpose I/Os

Each I/O can be configured independently as an input or output.

When an I/O is configured as input, it can be used to connect sensors or industrial logic commands to execute a specific task. For instance, the L-L100 Reader can execute a smart label Read command according to the logical level of the input command.

When the I/O is configured as output, it can command a relay or any other transducer.

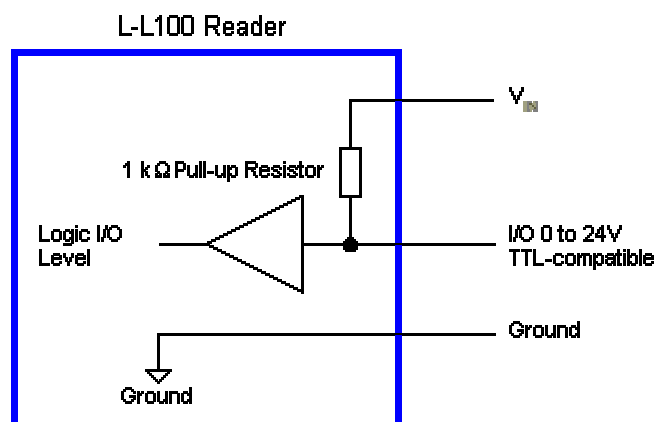- Input: Industrial logic (0V to 28V) TTL-compatible.

- Output: Open drain, 250 mA (maximum).

9.2   Internal Connections

This paragraph describes I/O electronic schematics when the configuration is set to input or output. It also gives the characteristics of the V_{OUT} supply which is available on the I/O port.

9.2.1 Input Configuration

Figure 10: I/O Configured as Input

9.2.2 Output Configuration

Figure 11: I/O Configured as Output
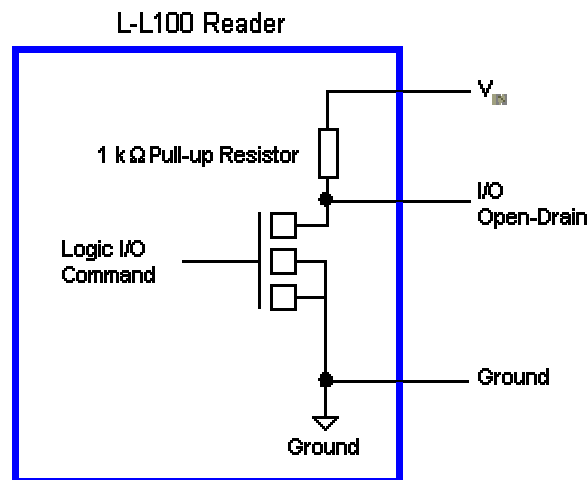
9.2.3 VOUT Characteristics

Figure 12: VOUT Characteristics
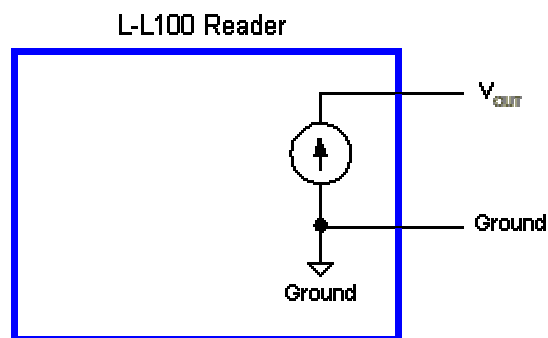
V_{OUT}:

- Output DC 28V.
- Output current max: 100 mA

9.3 Input Configurations

When an I/O port is configured as an input, the external logic signal must be connected directly to the input (0V-24V) of the requested I/O port. If the output of the external logic signal is an open-collector output, the V_{IN} signal must be connected to a supply (V_{OUT} or external supply) or to the ground to pull up/down the I/O port. In this case, all the grounds must be connected together (external logic, external supply and L-L100 Reader ground supply). The following examples show how to connect a signal (from a sensor, a push-button, etc…) to the L-L100 Reader.

Figure 13: Connecting a "Totem-Pole" Sensor

L-L100 Reader

V_{OUT}

V_{IN}

I/O   O

Ground
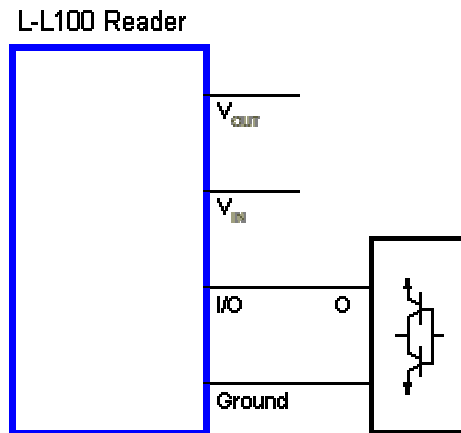
Figure 14: Connecting an "Open-Collector" Sensor (N Type)

L-L100 Reader

V_{OUT}

V_{IN}

I/O   O

Ground
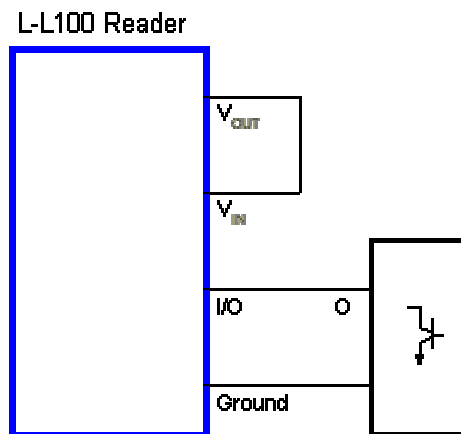
Figure 15: Connecting an "Open-Collector" Sensor (P Type)

L-L100 Reader

V_{OUT}

V_{IN}

I/O   O

Ground
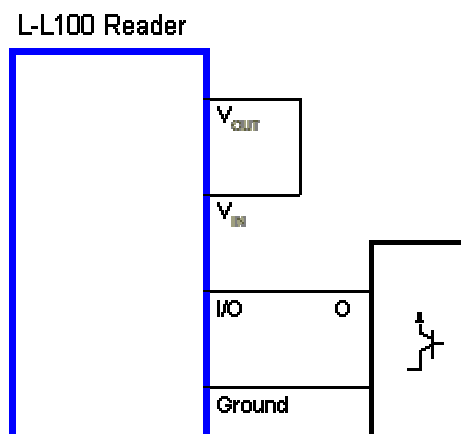
9.4   Output Configurations

When an I/O port is configured as an output, the V_{IN} signal must be connected to a supply to pull up the I/O port when it is not activated. Setting the I/O port pulls down its output to the GND. V_{OUT} supply may be used to supply V_{IN} signal and the external load. The following examples show how to connect a load (a relay, a light, etc.) to the L-L100 Reader using the internal supply (V_{OUT}) or an external supply.

Figure 16: Connecting a load using the internal supply (V$_{OUT}$)
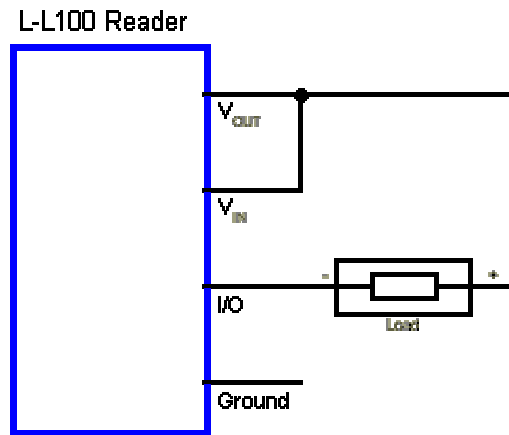
Using an external supply

Figure 17: Connecting a load using an external supply
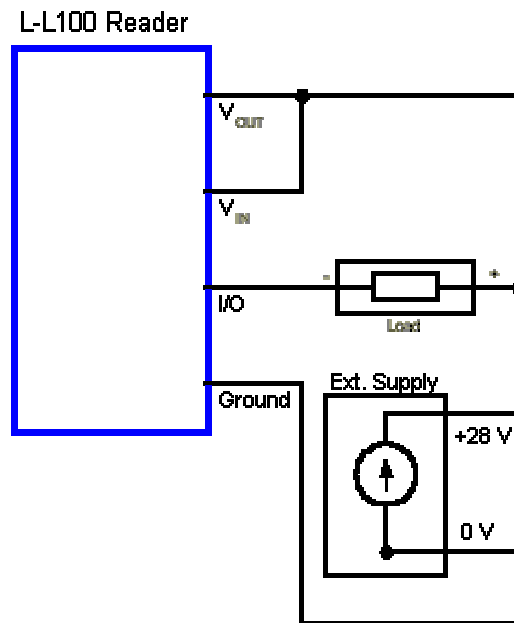
When the I/O port is set, the relay is activated. When the I/O port is reset, the relay is not activated.

10 Calibration

The L-L100 Reader features an innovative technology based on Digital Signal Processing (DSP) to optimize long-distance reading and writing performances.

In particular, the L-L100 Reader is very efficient even in industrial and noisy environments.

Environmental conditions can vary significantly according to the application-specific factors such as antenna size, output power, machines close to the L-L100 Reader, etc. Such parameters can create noise around the RFID system.

In order to optimize the performance of your RFID system, it is possible to calibrate the L-L100 Reader. The calibration consists of selecting the best trigger threshold used to capture and decode a smart label signal. The trigger threshold value corresponds to the sensitivity of the L-L100 Reader making it possible to differentiate a smart label signal from a noise signal.

If the trigger threshold value is too low, the L-L100 Reader may start decoding a signal which actually is a noise signal. In this case, the decoding efficiency of the L-L100 Reader may decrease.

If the trigger threshold value is too high, the L-L100 Reader will not decode a low-magnitude smart label signal (because it treats it as an ambient noise signal). In this case, reading distance performance may decrease.

Ultimately, a compromise must be selected to find the best trigger threshold value.

The L200 Explorer application defines the optimized trigger threshold value. Please refer to the L200 Explorer User's Guide for further information.

Default trigger threshold values stored in the L-L100 Reader upon delivery depend on the smart label type. These trigger values are optimized for Aero-LI, L-SA1 and L-SA2 antennas at middle-range power.

The calibration process is only available for C210, C220 and C240 tag types.

CAUTION: C210 and C240 decoding algorithms have been modified to improve L-L100 Reader performances. It is possible that trigger values optimized for L-L100 Reader Firmware releases previous to version 3.0 must be changed when using version 3.0 or more recent.

11 Debugging

11.1 Debugging Tools

The L-L100 Reader features debugging tools to optimize your RFID system installation and communication with the tags.

Debugging tools can only be accessed with the L200 Explorer Software and consist of:

- A real-time oscilloscope to display the antenna signals received by the L-L100 Reader,

- A real-time frequency analyzer to display the frequency information of the Antennas signal,

- Some statistic information about the quality of your RFID System environment

Please refer to "Medio L200 Explorer User's Guide" for further information about debugging tools.

12 Technical Specifications

12.1 Technical Specifications

Table 3: Technical Specifications

Parameter	Value
Size (L x W x H)	310 x 260 x 80 mm. (12.2 x 10.2 x 3.1 in.)
Weight	4.5 kg. (10 lbs.)
Power Supply	85 to 265 V AC / 50/60 Hz
Chip compatibility	TAGSYS C220 (Firmware upgrade required for other chips)
Communication Speed	Serial: Up to 38.4 Kbps Parallel: Up to 200 Kbps
Communication Interface	Serial: RS-232, RS-485 and RS-422 Parallel: Bi-directional and Enhanced
RF Output Power	Up to 4 W with multiplex capability and balanced 0° / 90° / 180° operation
Power Consumption	Up to 40 W
Operating temperature	0°C / +55°C (+32°F / +131°F)
Storage temperature	-20°C / +70°C (-4°F / 158°F)
Mechanical Interface	Rubber pads (Desktop) or metal mounting plate (with screws for vertical installation)
Conformity	CE, UL EN 300-330, ETS 300-683 European Radio FCC Part 15 (for typical configurations)
Reading/Writing Distance	Up to 120 cm (47¼ inches) in a gated antenna configuration
Antenna Compatibility	50-Ohm antenna
Application Software	512 KB of Flash memory
Inputs/Outputs	4 I/O ports independently configurable

12.2

12.3 Serial Port Pin Assignment

Figure 18: RS-232 Serial Link Connector Diagram
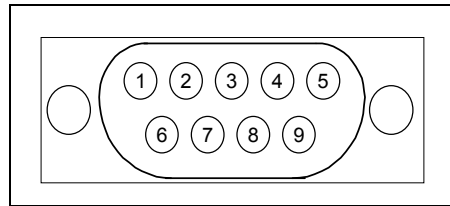
Connector	Description	Connector	Description
1	NC	6	TRx+ RS485/ Rx+ RS422
2	Rx RS232 / TRx- RS485 / Rx- RS422	7	NC
3	Tx RS232 / TRx- RS485 / Tx- RS422	8	NC
4	NC	9	TRx+ RS485/ Tx+ RS422
5	NC		

13 Electrical Characteristics

This chapter provides information about AC and DC electrical characteristics for all pins. It also gives timing characteristics for the different interfaces.

13.1 Absolute Maximum Ratings

Parameter	Value
Ambient Operating Temperature	0°C to +55°C
Storage Temperature	-20°C to +70°C
Supply Voltage (VCC pin) with respect to GND	6 V
Shutdown Voltage (SHDW pin)	6 V
Total Power Dissipation	0.8 W
Total Power Dissipation on Antenna (ANT pin)	0.2 W
DC Current Allowed on VCC Pin	200 mA
Peak Current Allowed on VCC Pin	400 mA
Input Voltage on IOx, Signal Detection and TX_TTL pins	5 V
Output Current Sunk by IOx, Signal Detection and TX_TTL pins	20 mA
Output Current Sourced by IOx, Signal Detection and TX_TTL pins	20 mA
Input Voltage Range on RX_RS232 pin	$\pm$25 V
ESD Protection on RX_RS232 and TX_RS232 pins	$\pm$15 kV

13.2 Standards Compliance

The L-L100 Reader is compliant with the following standards:

- CE
- ARIB T60 (Japanese Radio Standard Compliance)
- ETSI 300-330 (European Radio Compliance)

The L-L100 Reader is also compliant with FCC part 15 regulations.

13.3 Power Supply DC Characteristics

Parameters	Conditions	Min.	Typ.	Max.	Unit	Comments
VCC Power Input Voltage		4		6	V	
VCC Power On Input Peak Current			300		mA	
VCC Power On Input Peak Current Recovery Time				10	ms	
VCC Input Current (No I/Os connected*)	Input Voltage = 4V		185		mA	All peripherals powered RF On
	Input Voltage = 5V		140		mA	
	Input Voltage = 6V		115		mA	
	Input Voltage = 4V		25		mA	All peripherals powered RF Off
	Input Voltage = 5V		20		mA	
	Input Voltage = 6V		18		mA	
	Input Voltage = 4V			14	mA	Sleep Mode (firmware)
	Input Voltage = 5V			12	mA	
	Input Voltage = 6V			10	mA	
	Input Voltage = 4V		340		µA	Shutdown State (Pin)
	Input Voltage = 5V		420		µA	
	Input Voltage = 6V		500		µA	

(*) : The power requirements of a connected I/O increase the reader total consumption.

Figure 19: Input Current vs. Temperature
(V_{cc} Pin at 5 V – RF On - No I/O Connected)
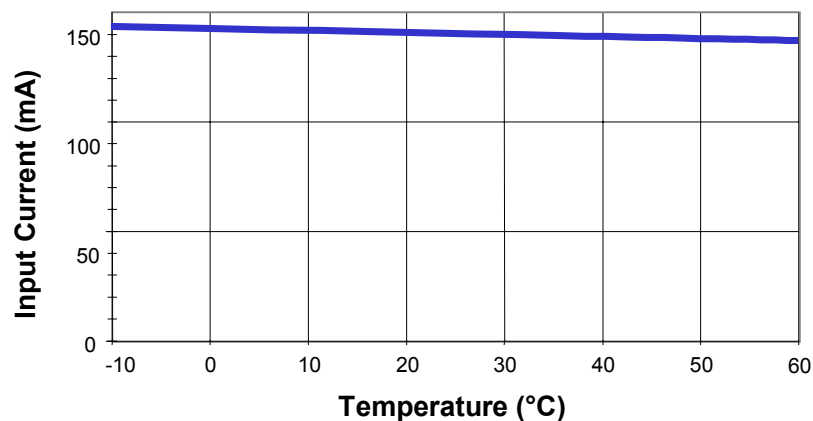
13.4 Communication Link DC Characteristics and Timing

Parameters	Conditions	Min.	Typ.	Max.	Unit	Comments
RX_TTL Input Voltage Low		0		1	V	
RX_TTL Input Voltage High		4	5		V	
RX_TTL Input Current			1		µA	
TX_TTL Output Voltage Low				0.6	V	
TX_TTL Output Voltage High		4.3			V	
TX_TTL Output Current				20	µA	Sunk or sourced
TX_TTL Output Capacitance				50	pF	
RX_RS232 Input Voltage Range		-25		+25	V	
RX_RS232 Input Threshold Low	25°C	0.8	1.5		V	
RX_RS232 Input Threshold High	25°C		1.8	2.4	V	
RX_RS232 Input Hysteresis			1.8	2.4	V	
RX_RS232 Input Resistance		3	5	7	kΩ	
TX_RS232 Output Voltage Swing	Loaded with 3 kW to GND	±5	±5.4		V	
TX_RS232 Output Resistance		300	1000		kΩ	
TX_RS232 Short-circuit Current				±60	mA	
ESD Protection on both pins	IEC 1000-4-2 Air-Gap Discharge		±15		kV	
	IEC 1000-4-2 Contact Discharge		±8		kV	
	Human body model		±15		kV	
RX - TX error on baud rate	4800 Bps		+0.16		%	
	9600 Bps		-1.36		%	
	19200 Bps		+1.73		%	
	38400 Bps		+1.73		%	
TX Inter-character time			7.5		ms	

13.5 Antenna Electrical and Timing Characteristics

Parameters	Conditions	Min.	Typ.	Max.	Unit	Comments
ANT output power			4		W	
ANT output impedance			(50, 0)		$(\Omega, °)$	At 13.56 MHz
RFOn time to RFOff	End of reception on RX to ANT. RF field turns on		1.3	1.4	ms	
RFOff time to RFOn	End of reception on RX to ANT. RF field turns off		4.2	50	µs	

Figure 20 : Output Power vs. Temperature
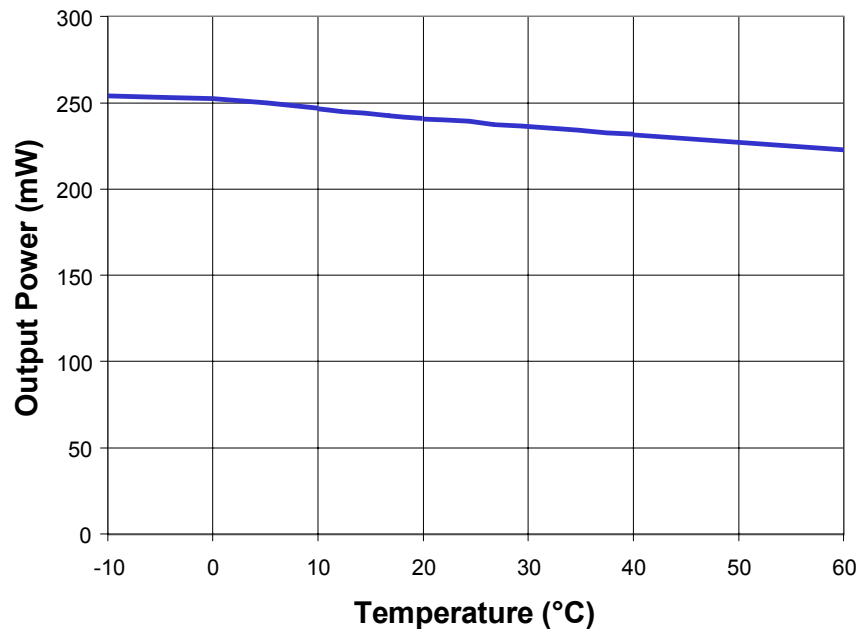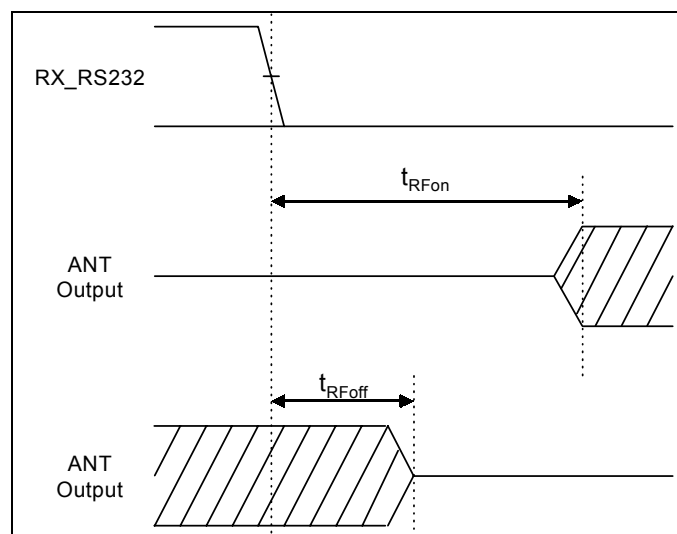**(V_{cc} Pin at 5 V – RF On - No I/O Connected)**

Figure 21: Antenna RF Switch Time

13.6 I/O Electrical and Timing Characteristics

Parameters	Conditions	Min.	Typ.	Max.	Unit	Comments
I/Ox input voltage low		0		0.8	V	
I/Ox input voltage high		2			V	
I/Ox input current		1			µA	
I/Ox output voltage low					V	
I/Ox output voltage high					V	
I/Ox output current					mA	Sunk or sourced
I/Ox output capacitance					pF	
tCV (time to change value)	End of reception on RX to I/Ox level changed		35	40	µs	
tGV (time to get value)	End of reception on RX to I/Ox level read		33	38	µs	
tFR (time to fall or rise)	Fall/rise time		10	25	ns	

Figure 22: I/O DC Characteristics and Timing
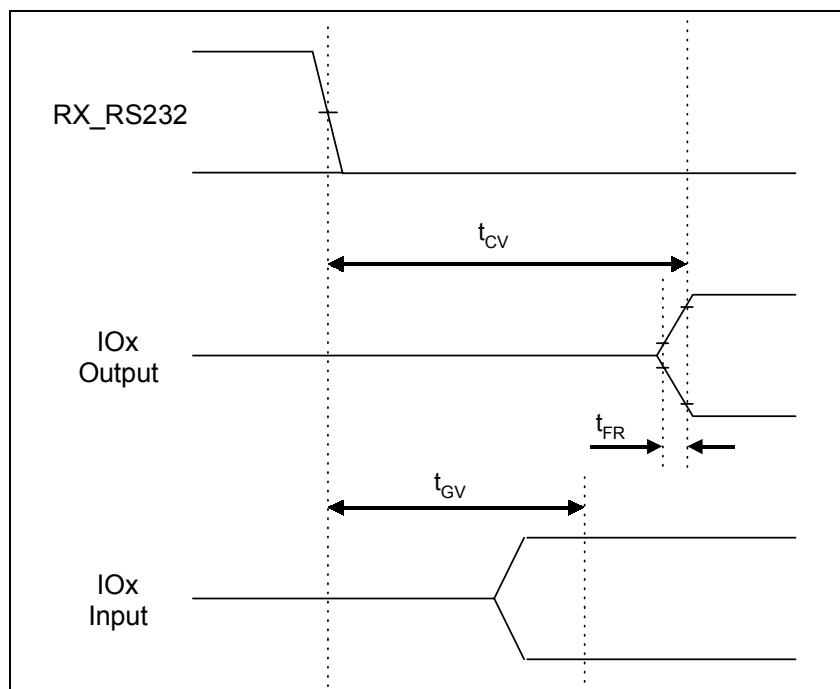
14 Warranty Conditions

14.1 Warranty

TAGSYS warrants that this Product shall comply with the functional specifications set forth herein for a period of one year from the date of delivery to the Buyer.

This warranty is valid for the original Buyer of the Product and is not assignable or transferable to any other party.

TAGSYS cannot be responsible in any way for, and disclaims any liability in connection with the operation or performance of:

- any product in which the Product is incorporated;

- any equipment not supplied by TAGSYS which is attached to or used in connection with the Product; or

- the Product with any equipment

This warranty does only cover the Product to the exclusion of any such other equipment.

Optimal operation and performance of the Product are obtained by using TAGSYS' readers, by applying TAGSYS installation guidelines and by having your installation reviewed by a TAGSYS' technical consultant.

TAGSYS warranty does not cover the installation, maintenance or service of the Product and is strictly limited to the replacement of Products considered as defective by TAGSYS and returned according to the return procedure defined below; in such case, TAGSYS will, at TAGSYS' option, either replace every defective Product by one new Product or refund the purchase price paid by Buyer to TAGSYS for the defective Product.

14.2 Warranty Exclusions

- Defects or damages resulting from storage of the Product under conditions which do not comply with TAGSYS specifications or normal usage

- Defects or damages resulting from use of the Product in abnormal conditions (abnormal conditions being defined as any conditions exceeding the ones stated in the product specifications).

- Defects or damages from misuse, accident or neglect.

- Defects from improper testing, operation, maintenance or installation.

- Defects from alteration, modification except modifications or adjustments specifically described in this Product reference guide, adjustment or repair, or any attempt to do any of the foregoing, by anyone other than TAGSYS.

- Any action on Product that prevents TAGSYS from performing an inspection and test of the Product in case of a warranty claim.

- Tampering with or abuse of the Product.

- Any use or incorporation by the Buyer or a third party of TAGSYS' Product into life saving or life support devices or systems, or any related products, TAGSYS expressly excludes any liability for such use.

14.2.1 General Provisions

This warranty sets forth the full extent of TAGSYS responsibility regarding the Product.

In any event, TAGSYS warranty is strictly limited to (at TAGSYS' sole option) the replacement or refund of the Products purchase price to TAGSYS, of Products considered as defective by TAGSYS.

The remedy provided above is in lieu and to the exclusion of all other remedies, obligations or liabilities on the part of TAGSYS for damages, whether in contract, tort or otherwise, and including but not limited to, damages for any defects in the Products or for any injury, damage, or loss resulting from such defects or from any work done in connection therewith or for consequential loss, whether based upon lost goodwill, lost resale profits, impairment of other goods or arising from claims by third parties or otherwise.

TAGSYS disclaims any explicit warranty not provided herein and any implied warranty, guaranty or representation as to performance, quality and absence of hidden defects, and any remedy for breach of contract, which but for this provision, might arise by implication, operation of law, custom of trade or course of dealing, including implied warranties of merchantability and fitness for a particular purpose.

14.2.2 How to Return Defective Products

The Buyer shall notify TAGSYS of the defects within 15 working days after the defects are discovered.

Defective Products must be returned to TAGSYS after assignment by a TAGSYS Quality Department representative of an RMA (Return Material Authorization) number. No Products shall be returned without their proof of purchase and without the acceptance number relating to the return procedure.

All Products shall be returned with a report from the Buyer stating the complete details of the alleged defect.

Call +33 4 91 27 57 36 for return authorization and shipping address.

If returned Products prove to be non-defective, a charge will be applied to cover TAGSYS' analysis cost and shipping costs.

If the warranty does not apply for returned Products (due to age, or application of a warranty exclusion clause), a quote for replacement will be issued, and no replacement will be granted until a valid purchase order is received. If no purchase order is received within 30 days after the date of TAGSYS quote, TAGSYS will return the products and charge the analysis cost and shipping costs.

All replaced Products shall become the property of TAGSYS.

The Product Return Form is included on the following page. This form should accompany any product you need to return to TAGSYS for analysis in the event of a problem.

TAGSYS Product Return Form

Customer Profile:

Company:………………………………………………

Address:……………………………………..…...……   Contact Name:……………………………………

………………………………………………………   Contact e-mail:

City & State:………………..…………………….…   ……………………………………

Zip Code:……………………………………………   Contact Phone:…………………………………

Country:……………………………………………..   Contact Fax:………………………………………..

Order identification:

Product Name:………………………………………..   Invoice Number:…………………………...……

Order Number (OEF):……………………………   Return Quantity: …………………………………

Reason for return:

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To inform TAGSYS of this return, please email it to:

valerie.guenegan@tagsys.net and to catherine.thouvenin@tagsys.net

Address to ship the product with this document attached:

TAGSYS

180, chemin de Saint Lambert

13821 la Penne sur Huveaune

FRANCE

To inform TAGSYS of this return, please also fax it to your Customer Service Representative

+33 (0) 4 91 27 57 01

Return Procedure:

The product returned will go through stringent quality controls.

A final analysis report will be sent to you as soon as possible.

Please contact the quality representative for further details

+33 (0) 4 91 27 57 36