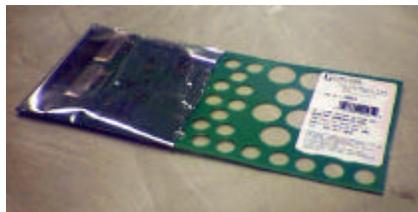
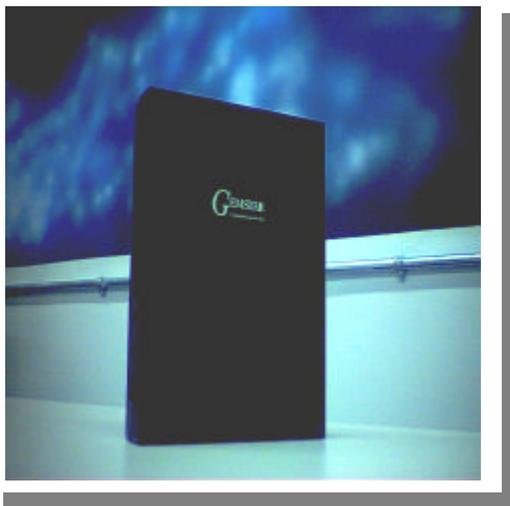




Technical Manual

Radio-Frequency Identification (RFID) Package Reporting and Tracking System



Gemstar Communications Inc.
760 Pacific Road, Unit 7, Oakville, Ontario L6L 6M5

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User Comments

In order for us to maintain the quality of our publications, we invite our customers to forward comments or suggestions to help us improve the effectiveness of this manual.

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System Overview

System Description

The Gemstar Package Reporting and Tracking System (“PackRAT”) provides Postal authorities with service performance and quality measurement data on the entire postal process. This technical manual describes the Radio Frequency Identification (RFID) system, its components and other information necessary for its regulatory approval, installation and operation. The specifications contained in this document pertain to the Gemstar GSAM-LMT Model RFID System.



Lettermail Tag

The key to the system is a flexible electronic device known as a “Lettermail Tag” which fits in a standard #9 envelope and actually travels the same route through the postal system as any other piece of mail.

A radio-transmitting device called an Activator is installed in each defined work area of a plant. Activators broadcast a signal that “wakes up” the otherwise dormant Tag when it enters a processing area for the first time. The Tag then transmits a string of data including its own unique ID and the



Activator /MicroCell

ID of the Activator that triggered it. In this way, the Tag **identifies itself, its location, and the time** it was present in that area. It actually transmits this information every three minutes to build a record of its movement and in case moving equipment temporarily blocks the transmission.

Monitoring units called “MicroCells” (also called “Readers” and similar in appearance to Activators) detect the signals from these Tags immediately and store the information. Typically there are many MicroCells at each site to ensure complete coverage of the plant.

The On-Site Controller (OSC) is the marshalling component of the RFID system and it routinely “polls” all of the MicroCells to download the information they have stored. The On-Site Controller is connected by dedicated telephone line to the host computer, the “Server”, located at Gemstar’s facilities in Oakville, Ontario.

The Server monitors the status of the RFID system and routinely collects data from On-Site Controllers across the Postal System, typically every two hours. The Tag data is stored in a database from which useful information can be extracted to measure the processes the Tag has experienced. In effect, there is a time profile recording the movement of a typical piece of mail through postal facilities equipped with an RFID System.



On-Site Controller

The PackRAT software application provides a user-friendly interface for Quality Assurance, Performance Evaluation and Operations personnel to analyze the processes in their jurisdiction. A wide variety of reports are available to interpret the data, which can also be exported to database or spreadsheet files.

It is easy to appreciate that the PackRAT RFID system provides invaluable insight into the in-process environment of the demanding postal system, enabling maximization of productivity and profits.

Technical Summary

Use and Purpose

Process Function

The Gemstar Package Reporting and Tracking System tracks and records the movement of electronic Tags through postal plants equipped with the RFID system. A brief summary of the process function of the system follows.

- The battery-powered Tag is normally in the Sleep State, passively “listening” for an activation signal every 30 seconds.
- Each work area of an RFID-equipped plant has its own dedicated AC-powered Activator that continuously transmits an activation signal containing its own ID number.
- When a Tag “hears” an activation signal, it enters the Transmit State and immediately transmits a data string containing its own ID number, the ID number of the Activator, and the current time. It continues in the

Transmit State as long as the same Activator is detected during the listening period, transmitting this data string every 3 minutes.

- When a Tag hears a signal from a different Activator (indicating movement to a different work area), it immediately transmits the new data string and starts its 3-minute cycle again.
- One of the ever-listening AC-powered MicroCells located throughout the plant receives the Tag transmissions and stores the data in on-board memory. All of the MicroCells are connected by Local Area Network (LAN) wiring.
- One AC-powered On-Site Controller is also connected to the LAN at the plant. The On-Site Controller routinely downloads the stored data from the MicroCells, relieving their limited memory.
- The Server, at a central location, routinely connects to the On-Site Controllers across the system via dedicated telephone landlines. The Server downloads the collected data along with information relating to the status of the RFID System at each site.
- The collected data is entered into a database file, which is available for download (with user restrictions) to Client computers via telephone modem dial-up service.
- Client computers upload user-defined Mail Tests (designed to track the Tags) to the Server and they are stored in the same system-wide database.
- PackRAT software enables users at Client computers to extract reports and export data from the system-wide database, enabling users to draw conclusions about the postal process.
- When a Tag fails to hear a signal from the previously heard Activator, it enters the Time-out State for one hour after the last activation signal is received. The Tag continues to transmit its data string during the Time-out State. This waiting period is to minimize anomalies caused by activator transmissions being blocked locally by moving equipment and containers.
- If an Activator is not detected during the Time-out State, the Tag returns to the Sleep State.

Purpose

Tag transmission strings are collected in a database stored in the central

Collectively, the Tag transmission strings provide a Tag's history as it is

targets. These plans can be designed for in-plant processes (one facility) and/or inter-plant processes (through a larger segment of the postal system).

The PackRAT software application running on client computers provides a convenient and easy-to-use interface with the database to allow users to extract meaningful information based on the plans they have entered.

Radio Frequencies

All RF components transmit and receive in the unlicensed 902-928 MHz frequency spectrum.

Lettermail Tag

Lettermail Tags transmit on a fundamental frequency of 904.512 MHz.

Activator

Activators transmit on a fundamental frequency of 916.500 MHz.

Further data to be provided by UltraTech.

RF Power Output and Field Strength

Further data to be provided by UltraTech.

Time Lines/Duty Cycle

Lettermail Tag

Transmission Characteristics – Transmit State and Time-out State

Lettermail Tags operate on a 3-minute (3 min) cycle, commencing immediately upon receipt of an Activator's unique signal. The duration of the Lettermail Tag transmission is 6 microseconds (6 μ sec) continuously from the beginning of each cycle.

Power transmission on the fundamental frequency of 904.512 MHz has been measured at a peak level of 87.63 dB μ V/m.

New Lettermail Tag cycles can start before expiry of the nominal 3-minute period if the Tag detects an activation signal from a different Activator.

New Activators can only be detected during the listening period, which takes place every 30 seconds (30 sec) after the commencement of a cycle for a duration of 500 microseconds (500 μ sec).

60 minutes (20 cycles) after receipt of the last activation signal, Tags enter the Sleep State and do not transmit.

Transmission Characteristics - Sleep State

The Lettermail tag does not transmit in Sleep State.

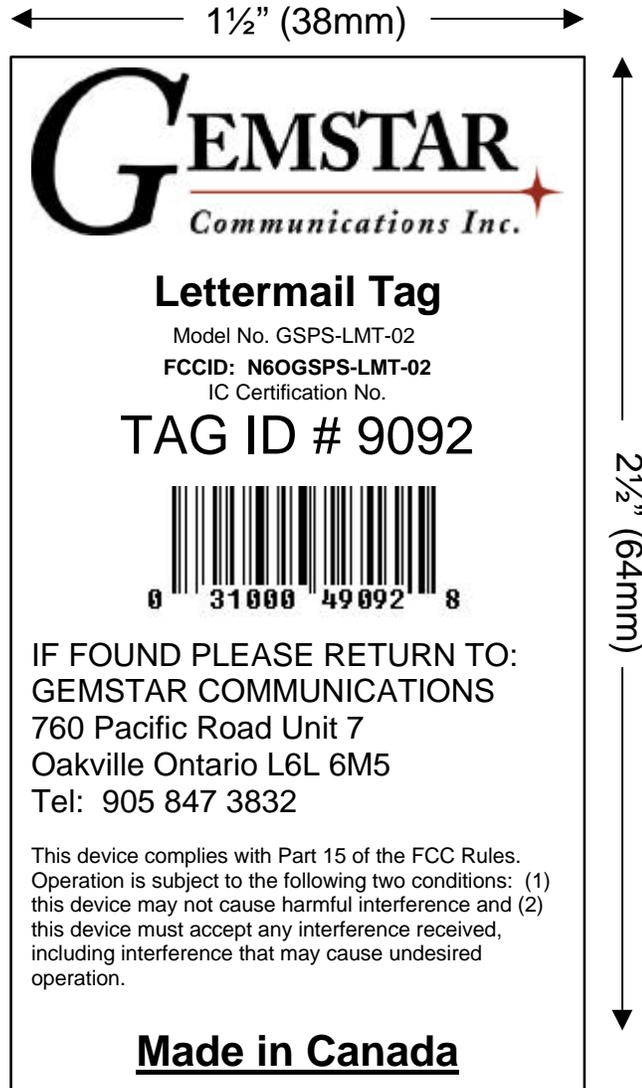
*Activator***Transmission Characteristics**

Activators transmit continuously a signal containing the unique ID of that Activator.

Power transmission on the fundamental frequency of 916.500 MHz has been measured at a peak level of 87.63 dB μ V/m.

Regulatory Approval Label Diagram

The following notice label is typical of the type that must be attached to each component of the AICS:



The following illustrations show where on the equipment the labels are to be attached:



The Tag notice label is affixed on the perforated section of the circuit board on the side of the electronic components



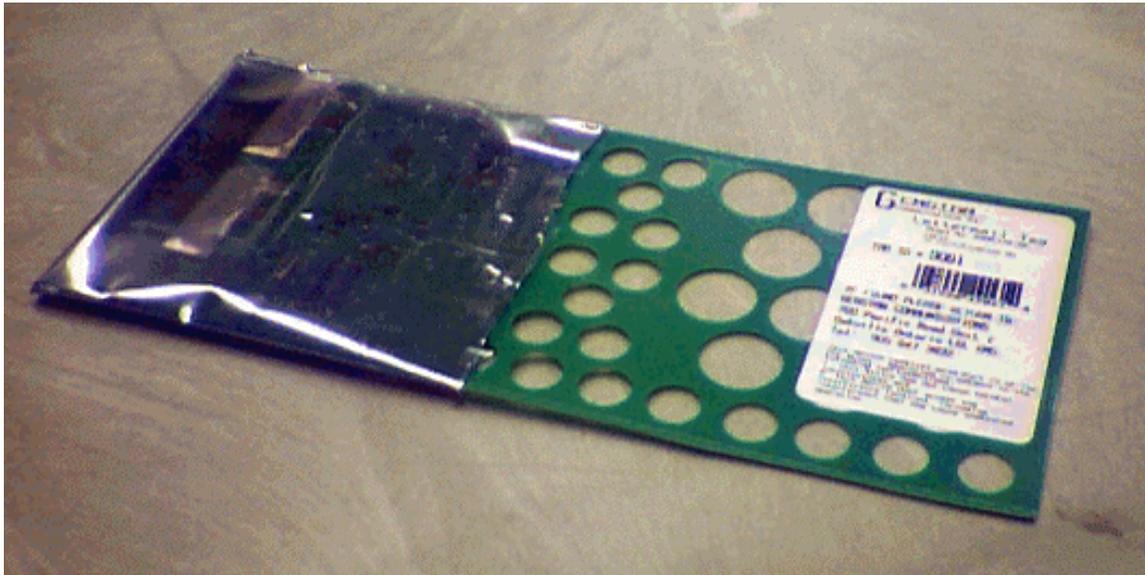
The Activator notice label is located on the embossed section of the upper case, above the AC/DC transformer.



The MicroCell notice label is affixed on the embossed area of the lower case opposite the side with the Gemstar logo.

Component Description

Lettermail Tag



Tag Function

A microprocessor-based Radio Frequency (RF) transmitting and receiving device enclosed in standard #9 or #10 envelopes for postal processing as a typical mail piece. Upon reception of a signal from an Activator, the Tag transmits a data string including the Tag identification number, the ID number of the Activator and the time, thus defining its location in a postal plant at a given time. These transmissions are received by MicroCells and stored for subsequent downloading to the On-Site Controller and then to a database stored on the central Server.

The Tag has three modes of operation: Sleep State, Transmit State and Time-out State. In the Sleep State (default), the Tag listens momentarily for an activator signal every 30 seconds. When an activation signal is received the, the Tag enters the Transmit State, still listening every 30 seconds but also transmitting the data string every 3 minutes. When the Tag stops receiving its activation signal (such as when it leaves the plant), the Tag enters the Time-out State, still transmitting and listening as in the Transmit State but only for another 60 minutes, after which it re-enters the Sleep State. The Time-out State period is designed to minimize anomalies caused by activator transmissions being blocked locally by moving equipment and containers.

For a detailed description of the Lettermail Tag's function within the framework of the entire Gemstar Package and Reporting System, see the Process Function section on page 2.

Tag Model Numbers

Package Reporting and Tracking (PackRAT) Tags are identified by 10-digit serial number, 4-digit Tag ID numbers (the last 4 digits of the serial number) and the following model number:

GSPS-LMT-02 for Lettermail Tags

The last two digits of the model number indicate the manufacturer's version of the device.

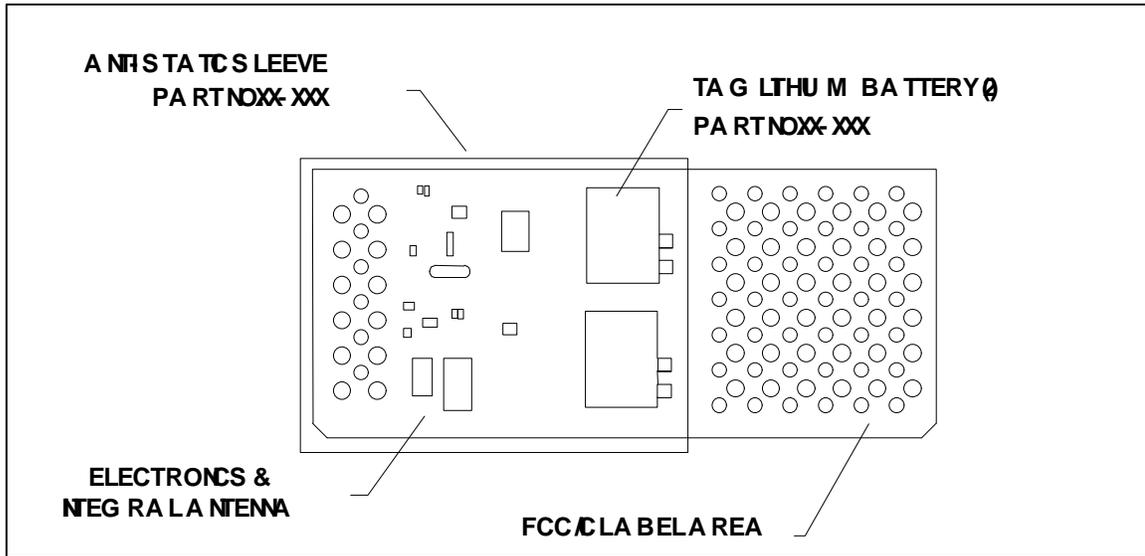
Tag Diagnostic Lights

LED NUMBER	COLOR	FUNCTION
N/A		

Tag Test Procedure

1. The Lettermail Tag Test Procedure requires use of the Gemstar GSAM Diagnostic software running on a local PC
2. Ensure a MicroCell is connected to the LAN serial port of the local PC
3. Ensure an Activator is operational at a range of at least 150 metres
4. Place the Lettermail Tag in the Test Rack
5. Observe annunciation of the correct Tag ID on the GSAM Diagnostic screen with the correct Activator ID and current time
6. Place a checkmark immediately beside the Tag ID on the Lettermail Tag Inventory List.

Tag Schematic Diagram & Parts List



Activator



Activator Function

An RF broadcasting device installed at dedicated work areas of a postal plant. Activator transmissions raise any Lettermail Tags in the Sleep State within the work area to the Transmit State.

For a detailed description of the Activator's function within the framework of the entire Gemstar Package and Reporting System, see the Process Function section on page 2.

Activator Model Numbers

Package Reporting and Tracking (PackRAT) Activators are identified by serial number and the following model number:

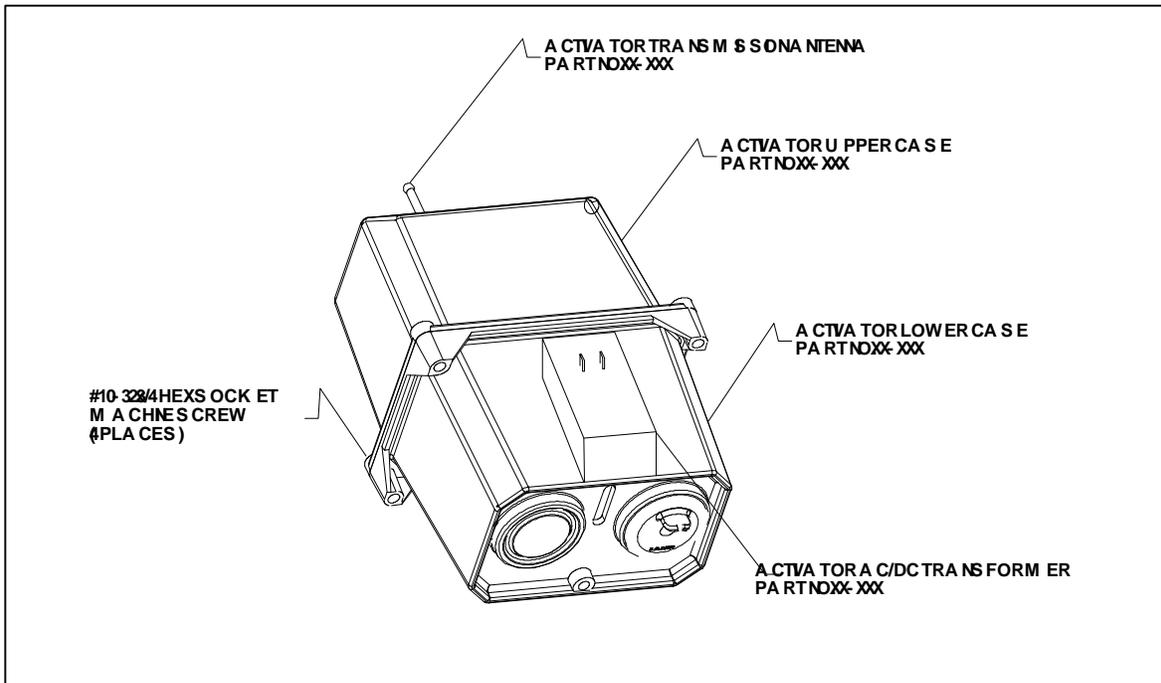
GSPS-ACT-02.

The last two digits of the model number indicate the manufacturer's version of the device.

Activator Diagnostic Lights

LED NUMBER	COLOR	FUNCTION
N/A		

Activator Schematic Diagram & Parts List



MicroCell



MicroCell Function

An RF receiving device installed at postal plants to receive and store Lettermail Tag signals. To ensure sufficient coverage of the entire plant, multiple MicroCells may be linked together (via wire LAN) within a dealership. The MicroCells report their data to the On-Site Controller (OSC).

For a detailed description of the MicroCell's function within the framework of the entire Gemstar Package and Reporting System, see the Process Function section on page 2.

MicroCell Model Numbers

Package Reporting and Tracking (PackRAT) MicroCells are identified by serial number and the following model number:

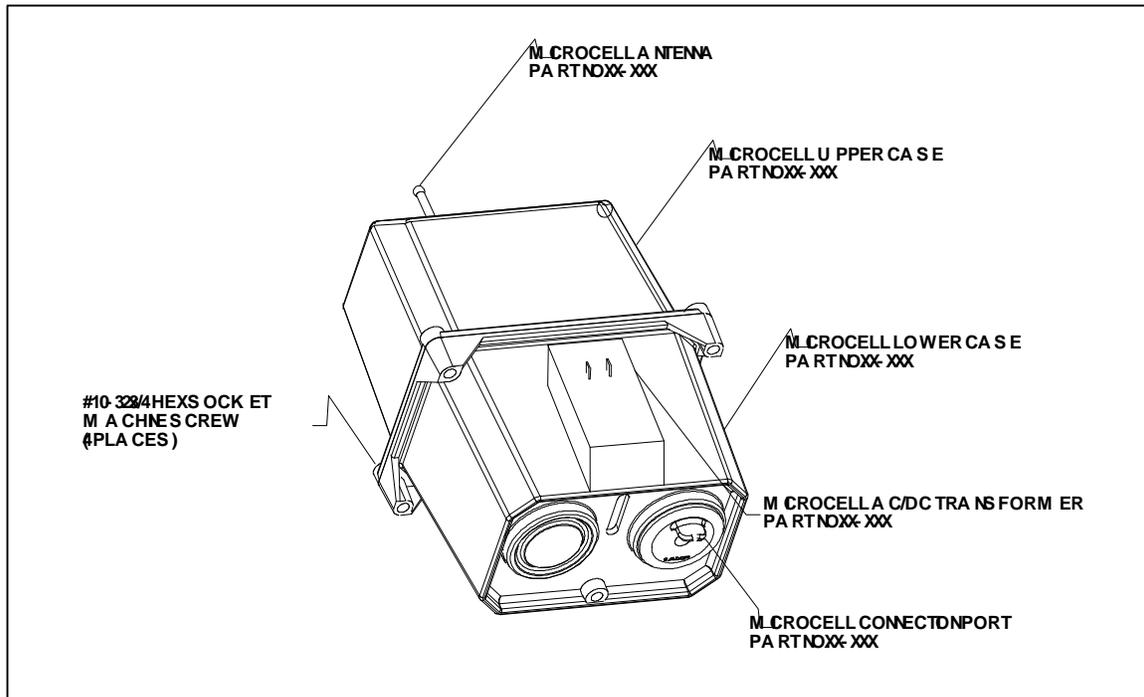
GSAM-CEL-01.

The last two digits of the model number indicate the manufacturer's version of the device.

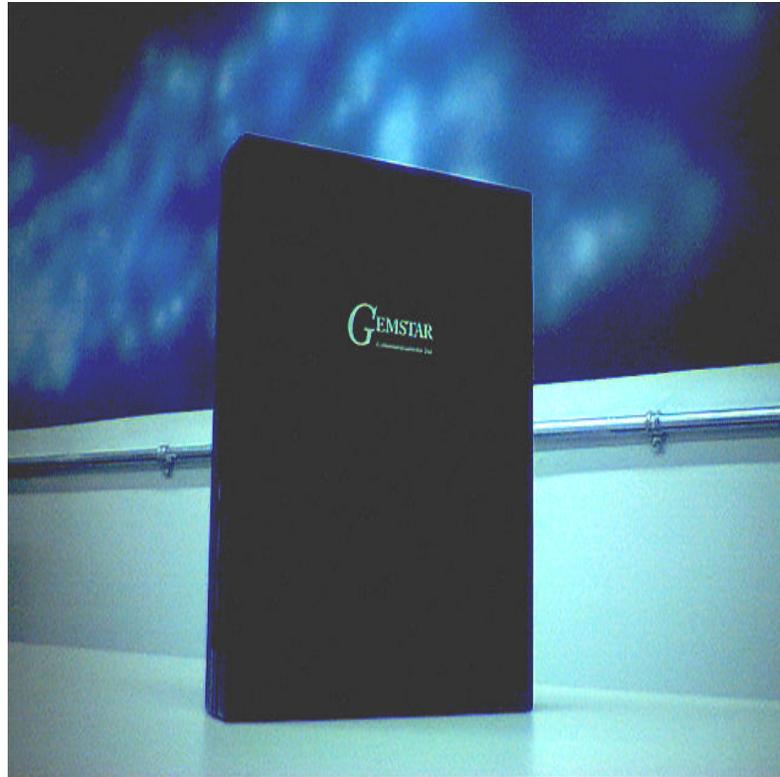
MicroCell Diagnostic Lights

LED NUMBER	COLOR	FUNCTION
D5A	RED	Power ON
D5B	YELLOW	LAN Activity (transmitting collected data)
D5C	GREEN	Receive Status 1
D5D	RED	Valid Signal Rec'd (until polling ends)

MicroCell Schematic Diagram & Parts List



On-Site Controller



On-Site Controller Function

A microprocessor based data storage device installed postal plants whose function is to communicate with the MicroCells and store the tag data until polled from the Host computer.

For a detailed description of the On-Site Controller's function within the framework of the entire Gemstar Package and Reporting System, see the Process Function section on page 2.

OSC Model Numbers

Package Reporting and Tracking (PackRAT) On-Site Controllers are identified by serial number and the following model number:

GSAM-OSC-01.

The last two digits of the model number indicate the manufacturer's version of the device.

OSC Diagnostic Lights

LED NUMBER	COLOR	FUNCTION
D6A	RED	Power ON
D6B	YELLOW	LAN Activity (any port)
D6C	GREEN	Modem connection made; on-board memory being accessed
D11	YELLOW	LAN Activity (port 0)
D12	YELLOW	LAN Activity (port 1)
D13	YELLOW	LAN Activity (port 2)
D14	YELLOW	LAN Activity (port 3)

Maintenance Procedures

Principles of Operation

The Package Reporting and Tracking system is a Radio-Frequency Identification (RFID) system employing two-way communication to define the location of individual Lettermail Tags at any given point in time in an RFID-equipped facility. The RF transmitters operate in the licence exempt 902-928 MHz frequency band and will not interfere with any electronic equipment in the facility.

The first transmission is directed from an Activator unique to a work area to any Lettermail Tags within reception range of the transmission. Lettermail Tags receiving the signal are raised to an active state (the Transmit State).

The second transmission is generated by the Lettermail Tags when they are raised to the Transmit State. The transmission consists of a data string which contains the Tag ID, the Activator ID and the time. The transmission is received by one of a number of LAN-connected MicroCells that cover the facility.

An On-Site Controller is also connected to the MicroCell LAN and it regularly downloads stored Tag data strings and stores them for later download to a central Server via telephony modem and dedicated telephone line.

Installation Guide

Installation Checklist

- Define Project Goals**
 - Refer to Canada Post Corporation Functional Specification #RFID-740522-v1.1 "Gemstar RFID System Functional Specifications" for timelines and approval testing.
- Assign Project Manager**
- Define Customer's Goals**
 - Is the customer familiar with the installation plan, how it will look and the function of the equipment?

- What level of detail does the Customer require for drawings and schedule?
 - Establish Customer's chain of authority and approval procedures for the initial order and any changes or requests during the installation period.
 - Exchange business contact numbers with Customer's person responsible for the Project
 - Are local building and electrical codes involved?
 - Does the customer have any special requirements beyond the applicable code (shielding, conduits, etc.)?
 - Is the switching of power sources required for machinery and computer equipment?
 - Obtain building/wiring drawings for modification and approval by Customer and local authority.
 - Are special insurance considerations required?
 - Define final Customer Acceptance parameters.
- Define Installation Schedule**
- Obtain required local regulatory approval
 - Coordinate with other contractors for their impact on the schedule.
 - Are there time (day/night/scheduled power outages) restrictions?
 - Are security passes or parking passes required for entrance to the facility?
 - Establish time-lines with milestones for:
 - Site Preparation
 - Delivery of Materials
 - System Installation
 - Installation Testing
 - Acceptance Testing
 - Training Period.
 - Provide copy of schedule for Customer and regulatory authority.
- Define Installation Logistics**
- Who is the Customer's on-site person in-charge? Schedule meeting to discuss communication/problem-solving.
 - Is material to be delivered to and accepted by Customer at the site?
 - Is there a secure location for the storage of material?
 - Is the customer supplying any material (wire, cabinets, etc.)?
 - Is there any specialized equipment required? Who is supplying it?
 - Are any exceptional precautions required for safety in the work environment?
 - Are there any special waste services required?
 - Are there labor union contractual considerations?
 - Are regulatory inspectors required to be present during installation?
 - Provide regularly scheduled updates to installation schedule.

- ❑ **Define Commissioning, Training and Customer Acceptance**
 - ❑ Consult the Canada Post Corporation Functional Specification # RFID-740522-v1.1 Chapter 14 – Commissioning Criteria for specific acceptance tests.
 - ❑ Is training required before customer acceptance? Establish mutually agreed upon schedule.
 - ❑ Establish training curriculum and resource materials.
 - ❑ Who is required to be present (Customer and regulatory personnel) for final Customer Acceptance?

- ❑ **Define Billing Procedures**
 - ❑ Is the Customer to be billed separately for the installation? Establish terms.
 - ❑ Is the Customer to be billed separately for the training? Establish terms.
 - ❑ Is the invoicing to be done after certain stages of completion? Establish milestones and dollar values.
 - ❑ To whom are the invoices to be addressed? Determine what information the customer requires on the invoices.

Installation Procedures

Mobile RFID Kit

The Gemstar Mobile Kit is designed to operate in conjunction with the Package Reporting And Tracking system (PackRAT). The kit is an RF receiver operating in the licence exempt 902 - 928 Mhz band and will not interfere with any electrical equipment operating in the area.

The kit comes complete with no assembly or tools required for installation. Prior to the kit being installed, ensure that a phone line as well as a 120 VAC power supply are accessible. Once you have received the kit, carefully remove the kit from its shipping box and save the box for future use.

Dimensions

Length: 47.5 cm (18 ¾") Width: 27 cm (10 ½")
Height: 43 cm (17") Weight: 10 Kg

Contents

Inside the kit you will find the following:

- 1 - 24 VAC wall mount transformer
- 1 - 9 VAC wall mount transformer
- 1 - Phone Extension line
- 1 - Tuned Antenna

If any of the parts are not in the kit please call Technical Support at (905) 847-3832.

CAUTION

Do not attempt to substitute any of the power supplies. Severe damage may result.

Installation

The following is a step by step installation guide for the kit:

1. Please find a secure place for the case where it will not be damaged or lost
2. Carefully remove the transformers, phone line and the antenna from the kit.
3. Close and lock the kit, you will not need to access anything inside anymore.
4. Plug the phone line into the wall mount jack and to the jack on the side of the kit.
5. Plug the 9 VAC Modem transformer which is the smaller of the two into the 120 VAC supply and then into the appropriate plug on the kit. **For the kit to operate properly, it is very important that this transformer is plugged in first.**
6. Plug the 24 VAC OSC transformer into the 120 VAC wall supply and then into the appropriate plug on the kit.
7. Attach the antenna on the kit.
8. Ensure the green light on the top of the kit is on constantly.
9. Ensure the red light on the top of the kit is switching on for approximately 2 seconds and off for approximately 10 seconds.

Once you have completed these steps, the unit is ready to run. If you have any problems, or the kit does not function properly, please call the **Technical Support Line at 905 847-3832.**

Permanent RFID Installation

Installation Equipment

The following is a quick reference guide to the permanent installation of Gemstar's RFID Inventory Control System.

For installation, you will need the following tools: RJ 11, RJ 45 crimping tool, drill and drill bits, 11/32 wrench, Robertson screwdriver, wire strippers, tie wrap tensioning tool.

Shipping Dimensions

The shipping dimensions of the RFID System will depend on the plant layout and the RFID System Site Location Plan. Specific values will be listed for each installation site.

Length: n/a
Height: n/a

Width: n/a
Weight: n/a

Contents

Below is a generic list of components. The quantity of each component will depend on the plant layout and the RFID System Site Location Plan. Specific quantities will be listed for each installation site.

Inside the kit you will find the following:

- Qty. - Tuned Antenna
- Qty. - MicroCell and Mounting hardware
- Qty. - Activator and Mounting hardware
- Qty. - Registered Lettermail Tag
- Qty. - RJ 11 jack
- Qty. - RJ 45 jack
- 1 - On Site Controller
- 1 - 24VAC wall mount transformer
- 1 - 9VAC wall mount transformer
- 1 - Phone Extension line
- 1 - Box of 22 awg 4-conductor solid wire
- 1 - Sniffer Kit
- 1 - Pkg. 7" Tie Wraps

If any of the parts are not in the kit please call **Technical Support at (905) 847-3832**.

CAUTION

Do not attempt to substitute any of the power supplies. Severe damage may result.

Site Location Plan

From the site drawings provided by the Customer, Gemstar will construct a detailed Site Location Plan, which will ensure the following:

- Adequate approved power outlets exist for the equipment
- MicroCells are located to provide continuous coverage of all pertinent work areas with a Tag detection range of not less than 50 metres
- Activators are located to provide continuous coverage of all pertinent work areas with a Tag activation range of not less than 150 metres
- On-Site Controllers are located away from interference-generating equipment
- Wiring routes are acceptable to Gemstar and the Customer
- The Gemstar Sniffer Kit will be used to verify detection and activation ranges

Installation

The following is a step-by-step installation guide for the system:

1. Consult the Site Installation Plan.
2. Locate the mounting area for the Activators, MicroCells and OSC.
3. Using provided mounting hardware, mount all Activators, MicroCells and OSC.
4. Run the provided wire from the OSC to each MicroCell using the home run wiring configuration.
5. Attach the provided RJ 45 jacks for the OSC as per wiring diagram, do not plug in at this time.
6. Attach the provided RJ 11 jacks for the MicroCells as per wiring diagram, do not plug in at this time.
7. Connect the OSC RJ 45 Jacks.
8. Connect the phone line provided from the OSC to the phone jack.
9. Connect the transformers from the 120 V AC to the appropriate jacks in the OSC. (Connect the smaller transformer first).
10. Ensure the green power light located at the bottom of the OSC is on.
11. The red LAN indicator light will start flashing at approximately 1 second intervals.
12. Once the above are completed, you can now connect the MicroCells. When plugging in the MicroCells, ensure the green power light is on and the red LAN indicator light is flashing approximately once every 5 seconds.
13. Use the Sniffer Kit to verify the function of all Activators.

14. The system should now be fully operational. The final step is to obtain an authorization from Gemstar. Please call the following number for authorization: (905) 847-3832.

Performance Specifications

Tag

Tx Frequency	904.512 MHz
Power Output	10-75 mW
Bandwidth	480 KHz
Rx Frequency	916.500 MHz
Sensitivity	-100dbm
Data	32-bit with CRC, 8-bit digital, 8-bit analog
Power Source	6V Lithium internal battery
Battery Life	1 year
Antenna	Self-contained
Size	21.8cmX9.5cmX0.125cm
Temp. Range	-40°C to +50°

Activator

Tx Frequency	902-928 MHz
Power Output	10-75 mW
Range	Minimum 150m radius (application specific)
Bandwidth	600 KHz
Data	32-Bit with error correction
Power Source	External 24V AC
Antenna	8" monopole with tnc mount
Size	37cm X 12cm X 8cm (with antenna)
Temp. Range	-40°C to +50°

MicroCell

Rx Frequency	904.512 MHz
Sensitivity	-100dbm
Range	Minimum 50m radius (application specific)
Bandwidth	600 KHz
Data	32-Bit with error correction
Power Source	External 24V AC
Antenna	8" monopole with tnc mount
Size	37cm X 12cm X 8cm (with antenna)
Temp. Range	-40°C to +65°

On-Site Controller

Memory	256 KB (expandable to 1 MB)
Power Source	120V AC
MicroCell Capacity	16 cells
Tag Capacity	600 (expandable to 2400)
Modem	14.4 kbps with V.32
Size	30cm X 23cm X 6cm
Temp. Range	-40°C to +65°

Host Computer Requirements

Operating System	Windows 95 or 98
Processor Speed	Pentium 90Mhz minimum
Memory	8MB RAM minimum
Video	256 VGA or higher
Digital Device	Mouse
Modem	28.8 kbps with V.32

Notice to Users

This notice is required to be provided to the user where it is not practical to display on the equipment components.

***This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference and
(2) this device must accept any interference received, including interference that may cause undesired operation.***

NOTE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

WARNING

Changes or Modifications not expressly approved by Gemstar Communications Inc. could void the user's authority to operate the equipment.

When the equipment will be used in Canada, the following notice applies:

NOTICE

This digital apparatus does not exceed the Class A/B limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus", ICES-003 of Industry Canada.

Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe A/B prescrites dans la norme sur la matériel bouilleur: "Appareils Numériques", NMB-003 édictée par le ministre Industrie Canada.

Technical Support

Service Standards

This section will detail the following items to be contained in the service agreement.

Period of the Agreement

Define the term of the agreement.
Define the term of warranty of the equipment for parts and labor.
Define the date the warranty begins (final acceptance?).

Responsibility

Define the maintenance tasks for which the Customer is responsible.
Define the maintenance tasks for which this agency is responsible.
Define the training and resource materials which will be provided to the Customer.

Service Calls

Establish the person(s) at the Customer's site who is authorized to initiate service calls.
Establish the person(s) at the Customer's site who is authorized approve the maintenance work.
Establish the contact numbers for this agency and the Customer.
Establish the response time that will be satisfactory (same hour, same day).
Establish periods when advance notice may be required (eg. rush hour).
Establish the hours of service (evenings, holidays).
Define specialized tools required for the work and who will provide it.

Billing

Establish the frequency of the billing and the payment terms in days.
Establish the billing address and department responsible.
Define the information to be included on the invoice.

Service Outside of the Contract

If service is requested that is not covered by the contract, establish who is authorized by the Customer to approve the quotation. Establish whether or not there is a dollar limit on this approval authority.

Documentation

Establish details required for Service Reports and distribution of copies of same.
Establish reliability tracking/quality assurance audit procedures and forms.

Safety and Security

Define hazardous work areas and establish protocols to ensure safety of maintenance personnel.
Acquire security passes for relevant personnel.

Troubleshooting

The troubleshooting section is under development and will be issued with the first production release of this manual.

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