ADM

User Manual

- for end users -

Revision History Table

Revision	Changes Since Previous Revision
Rev1	This is the initial release of the document

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Definition of terms

Tag Collection Period	The time (typically 24 hours) interval between two consecutives scheduled data SMS transmissions
Read Time Table	A table that defines the frequency of tag reading cycles within 24 hours
SMS Time Table	A table that defines the time of the day when the data SMS is sent
Tag Registration	First read of a tag in a tag collection period

Acronyms

ADM	Automated Delivery Measurement
GSM	Global Standard for Mobiles
LOS	Line-of-Sight
RTT	Read Time Table
RTC	Real Time Clock
SIM	Subscriber Identity Module
SMS	Short Message Service
STT	SMS Time Table
TCP	Tag Collection Period
UHF	Ultra High Frequency
UTC	Coordinated Universal Time

1. OVERVIEW

ADM is a remote data collection device used to provide accurate last mile mail delivery measurements. The ADM is placed inside a mailbox or above a mail door slot. When a test letter (letter that contain a tag) is placed in the proximity of an ADM, the tag inside the envelope is excited and its unique ID is read. The ID and the time of read are then transmitted to a backend application over the GSM network using SMS.

The ADM concept is illustrated in Figure 1.

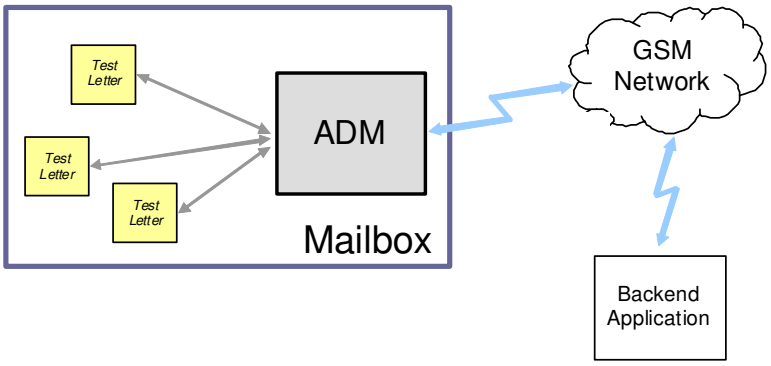

Figure 1 – ADM Concept

1.1 Main Characteristics

Overall Dimensions *(target)*
- Length: 185mm (including battery pack)
- Width: 85mm
- Height: 20mm (with small battery pack)

Reader
- 433MHz receiver, Integrated antenna
- 125kHz transmitter, Integrated antenna

GSM Modem
- 2-Watt EGSM 900/GSM 850 radio section
- 1-Watt GSM 1800/1900 radio section
- Integrated antenna

Data Backup
- USB Flash Drive

Digital Interface
- Micro B USB receptacle for debug and service console

LEDs
- Power, Busy and GSM

Power
- Li-Polymer rechargeable cells

Environment
- IP64 with battery pack
- IP20 w/o battery pack
- RoHS compliant

1.2 Physical concept

The ADM consists of a main unit and a detachable battery pack. The ADM physical concept is illustrated in Figs. 2-3

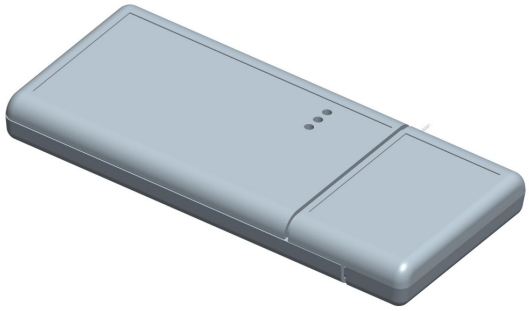

Figure 2 - ADM Assembly

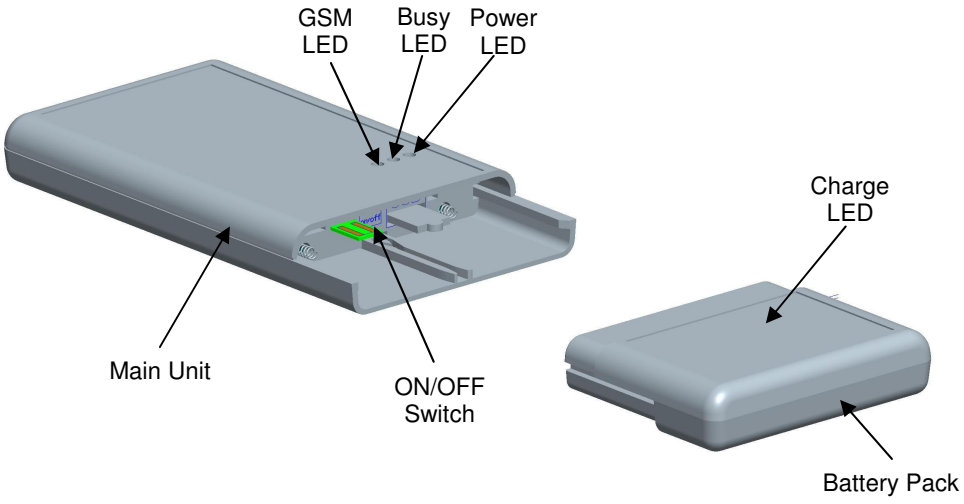

Figure 3 - ADM Main Unit and Battery Pack

Main physical characteristics

- Push-in push-out (double click) battery pack lock mechanism
- ON/OFF slide switch
- Reset button

2. MODES OF OPERATION

The ADM has two modes of operation: a) normal mode (power saving), b) continuous mode:

a) In normal mode, the unit is in sleep most of the time. It wakes-up regularly, based on a Read Time Table (RTT). The RTT specifies the frequency of reads (e.g. every five minutes) during a specific time interval (e.g. 8 hours). The RTT spans over 24 hours. One can define up to eight time intervals in 24 hours; each interval can have a different read frequency. In power saving mode, a read cycle can also be triggered by vibration/shock/motion (if the vibration sensor is enabled). The power saving mode is recommended for mailbox installation.

b) In continuous mode, the ADM is on all the time. The exciter generates continuously low power LF field designed to catch test letters that are momentarily in the proximity of the unit. This mode is intended for door slot installations.

One can combine power saving mode and continuous mode in the RTT. As an example, an ADM can read tags continuously from 7:00AM to 4:00PM, every 10 minutes from 4:00PM to 9:00PM and no reads from 9:00PM to 7:00AM next day.

3. FUNCTIONAL ARCHITECTURE

Essentially, the ADM is a battery powered, active RFID reader equipped with a GSM modem. It performs the following main operations:

a) Generates LF excitation field

b) Receives UHF signal from tags

c) Transmits data and status information over SMS

d) Receives configuration command and parameter over SMS

3.1 LF Exciter

3.1.1 Operation

The exciter generates the low frequency (LF) field that is used to wake up tags. Once the tag receives the LF signal, it responses on UHF. The excitation signal incorporates a (programmable) unique address (LF field identifier). This LF identifier is received by the tag's 125 kHz receiver and

it is echoed back on UHF. In this way, the RFID system is able to determine which ADM excited the tag.

3.1.2 Excitation Distance

Table 1 – Excitation Distance

Mode of Operation	Conditions	Value		
		Min	Typ.	Max
Power saving and continuous normal-excitation modes	ADM installed on metallic surface, tag in front of the unit (±45° angle), all tag orientations, max. field strength	35cm (see Figure 6)		
Continuous low-power excitation mode	ADM installed on metallic surface, tag parallel to the long side of the ADM, min. field strength	5cm (see Figure 7)		

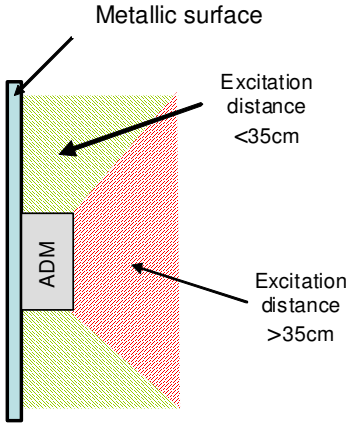

Figure 4 – LF Excitation Zone

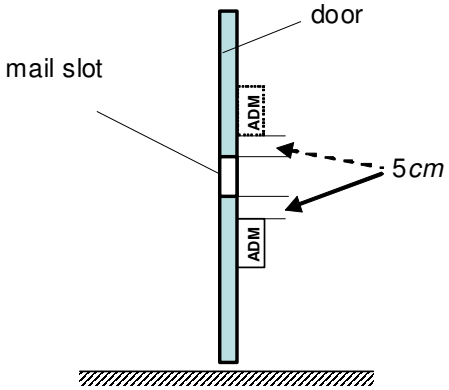

Figure 5 – Door Slot Installation

3.2 UHF Receiver

The UHF receiver is a narrowband FSK receiver operating in the 433.92 MHz frequency band.

3.2.1 Receive Distance

Table 2 – UHF Receive Distance

Conditions	Value		
	Min	Typ.	Max
No obstacles, any tag orientation	10m		

3.2.2 Tag message filtration

Only the first read of a tag in a TCP is stored ("tag registration"). However, the ADM can be programmed to also store the last read of a tag in a TCP (i.e. last time the tag was read prior to be removed from the mail box). In the event a tag is removed before the second read cycle in a TCP, the two registrations are identical. This feature is not applicable in continuous mode.

Tag registrations are collected in a non-volatile buffer ("tag buffer"). The tag buffer can store up to 60 registrations. After the capacity of the tag buffer is reached, new registrations are ignored.

3.3 GSM Modem

The ADM communicates with the server (backend) over the GSM network using SMS. It sends data and unit status information and receives configuration commands and parameters. The operating frequencies in GSM, DCS and PCS modes are conform to the GSM specifications. The GSM modem uses an 880~960MHz, 1710~1990 MHz, 0dB Gain integrated antenna.

The GSM modem supports phase 2 GSM11.14 – SIM 1.8V and 3V. The SIM card reader allows for hot removal of the SIM.

3.4 Test Tag

The ADM integrates a test tag used to monitor unit's health. The test tag consists of a low power UHF transmitter, a LF (125kHz) receiver and a microcontroller. The test tag is powered on once a day. After that, it receives the ADM LF field. Once excited, the test tag transmits a burst of 40 identical messages pseudo-randomly spaced in time. These messages are received by ADM's 434 MHz receiver and processed like any other messages. Their presence confirms that the ADM is functioning properly even if no other messages from other tags are registered.

3.5 USB Ports

The ADM has two USB ports: a host port and a slave port. The USB ports are not accessible in normal operation. One has to remove the battery pack in order to have access to the two ports. The two ports are only for debug and service and should not be used by the end user.

3.6 LEDs

The main unit is equipped with three LEDs: Power, Busy and GSM. They are normally off and are only activated for 20 seconds each time when the battery pack is inserted or removed.

3.6.1 Power

When activated, the power LED is solid white if the power system is OK. If an uncharged battery pack is inserted, the power LED flashes 3 times/second (provided that the internal battery is not discharged as well).

3.6.2 Busy

When activated, the busy LED (blue) is on while the unit is busy (e.g. booting, reading tags, sending and receiving SMS).

3.6.3 GSM

When activated, the GSM LED indicates the quality of the GSM signal:

- If the GSM signal is strong enough, the LED is green
- If the GSM signal is unavailable or marginal, the LED is red

The GSM signal quality information is only collected during SMS operation and therefore the indication accuracy depends on how long the unit has been in operation.

3.7 Power Supply System

The ADM is powered by Li-Polymer rechargeable cells. The main power source is the external battery pack. The secondary source is a backup battery, built inside the main unit. The battery pack powers the ADM circuitry and at the same time charges the backup cell. The ADM works properly even if the backup battery is fully discharged, as long as the battery pack is connected and not depleted. The user only needs to charge the battery pack.

3.7.1 Battery pack

The battery pack has two ports: a charging port (micro-B USB receptacle) and a load port (battery contacts). The battery pack can be recharged from a dedicated charger or a PC USB port.

The battery pack has an LED to indicate the charging status:

- LED is red while charging
- LED turns green when the pack is fully charged
- LED goes off when the charger is disconnected

Table 3 – Battery Pack Characteristics

Parameter	Conditions	Value		
		Min	Typ.	Max
Battery Life	Power saving mode, excitation every 5min, one SMS/day, max. LF field	28 days		
	Continuous mode, one SMS/day, min. field strength	7 days		
Charge Time	1A charging current		4 hours	
Recharge Cycles		500		
Charge Temperature		0°C		+45°C
Storage	1 year	-20°C		+45°C

3.7.2 Backup battery

The main unit is equipped with a backup battery that allows the unit to continue operate for a limited time without the battery pack. The backup cell is only used when the battery pack is depleted or not connected.

Table 4 – Backup Battery Characteristics

Parameter	Conditions	Value		
		Min	Typ.	Max
Battery Life (per charge)	Power saving mode, excitation every 5min, one SMS/day, max. LF field	3 days		
	Continuous mode, one SMS/day, min. field strength	16 hours		
Recharge Cycles		300		
Charge Temperature		0°C		+45°C
Storage	1 year	-20°C		+45°C

4. ENVIRONMENTAL

- Operating temperature range: -20°C - +60°C (except USB flash drive)
- Storage temperature range: -20°C - +45°C (1 year)
- Drop test: 1m drop on concrete surface, no structural and functional damage

5. REGULATORY

FCC compliance notice

Caution:
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

IC compliance

This Class B digital apparatus complies with Canadian ICES-003.
Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.