R051-24-10-104204-1/A Ed. 1

This report cancels and replaces the test report R051-24-10-104204-1/A Edition 0

RADIO Technical report

according to standard:
FCC Part 15

Equipment under test:
PORTABLE IN-TRANSIT TRACKING UNIT
PITU I- 433.92 MHz part

FCC ID:
VJV-PITUV1

Company:
TES ELECTRONIC SOLUTION

DISTRIBUTION: Mr LE CORRE **Company: TES ELECTRONIC SOLUTIONS**

Number of pages: 31 including 4 annexes

Ed.	Date	Modified pages	Written by Name / Visa	Technical Verification Quality Approval Name / Visa
1	5-May-11	8	M. DUMESNIL M. D.	Y. JUDEAUX

Duplication of this document is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.
This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole manufactured products of the tested sample.

PRODUCT:	**PORTABLE IN-TRANSIT TRACKING UNIT**
Reference / model:	PITU I
Serial number:	not communicated
Trade mark:	VARI-TRAC
MANUFACTURER:	TES ELECTRONIC SOLUTIONS

COMPANY SUBMITTING THE PRODUCT:

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DATE(S) OF TEST:	19 August 2010
TESTING LOCATION:	EMITECH ATLANTIQUE laboratory at ANGERS (49) FRANCE EMITECH ATLANTIQUE open area test site in LA POUEZE (49) FRANCE Registration Number by FCC: 101696/FRN: 0006 6490 08
TESTED BY:	L. BERTHAUD

CONTENTS

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1.INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment: PORTABLE IN-TRANSIT TRACKING UNIT - PITU I - 433.92 MHz part in accordance with normative reference.

2.PRODUCT DESCRIPTION

ITU Emission code: 150KF1D

Class: A (commercial, industrial and business environment)

Utilization: mobile tracking unit

Antenna type and gain: integral antenna, unknown gain

Operating frequency range: 433.92 MHz

Number of channels: 1

Channel spacing: not concerned

Frequency generation: synthetiser

Modulation: frequency

Power source: 12 Vd.c

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3.NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.
They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

FCC Part 15 (2009)	Radio Frequency Devices
ANSI C63.4 (2003)	Methods of Measurement of Radio-Noise Emissions from Low-voltage Electrical and Electronics Equipment in the range of 9 kHz to 40 GHz.

4.TEST METHODOLOGY

Radio performance tests procedures given in part 15:

Subpart B –Unintentional Radiators
- Paragraph 107: Conducted limits
- Paragraph 109: Radiated emission limits
- Paragraph 111: Antenna power conduction limits for receivers

Subpart C – Intentional Radiators
- Paragraph 203: Antenna requirement
- Paragraph 205: Restricted bands of operation
- Paragraph 207: Conducted limits
- Paragraph 209: Radiated emission limits; general requirements
- Paragraph 212: Modular transmitter
- Paragraph 215: Additional provisions to the general radiated emission limitations
- Paragraph 231: Periodic operation in the band 40.66-40.70 MHZ and above 70 MHz

5.ADD ATTACHMENTS FILES

"Synoptic"
"Block diagram"
"External photos and Product labeling"
"Assembly of components"
"Internal photos"
"Layout pcb"
"Bil of materials"
"Schematics"
"Product description"
"User guide"

6.TESTS AND CONCLUSIONS

6.1 unintentional radiator (subpart B)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.107	CONDUCTED LIMITS			X		
FCC Part 15.109	RADIATED EMISSION LIMITS	X				*Note*
FCC Part 15.111	ANTENNA POWER CONDUCTED LIMITS FOR RECEIVER			X		

NAp: Not Applicable NAs: Not Asked

Note: See test results in EMITECH radio technical report N°R051-24-10-101741-5/A Ed. 0

6.2 intentional radiator (subpart C)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.203	ANTENNA REQUIREMENT	X				*Note 1*
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS			X		
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				*Note 2*
FCC Part 15.212	MODULAR TRANSMITTERS			X		
FCC part 15.215	ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS					
	(a) Alternative to general radiated emission limits	X				
	(b) Unwanted emissions outside of §15.231 frequency band	X				*Note 3*
	(c) 20 dB bandwidth and band-edge compliance	X				*Note 4*
FCC Part 15.231	PERIODIC OPERATION IN THE BAND 40.66-40.70 MHZ AND ABOVE 70 MHz					
	(a) Transmission time restrictions	X				*Note 5*
	(b) Field strength of emissions	X				
	(c) Bandwidth of emission	X				*See annex 3*
	(d) Carrier frequency tolerance within the band 40.66-40.70 MHz			X		
	(e) Exceeding periodic rate limitations			X		

NAp: Not Applicable NAs: Not Asked

Note 1: Integral antenna. Professionally installed equipment.

Note 2: See FCC part 15.231 (b).

Note 3: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

Note 4: see FCC part 15.231 (c)

Note 5: The equipment is automatically activated and ceases transmission within 5 seconds after activation (see annex 4).

Conclusion:

The sample of PORTABLE IN-TRANSIT TRACKING UNIT-PITU I- 433.92 MHz part submitted to the tests complies with the regulations of the standard FCC Part 15 in accordance with the limits or criteria defined in this report.

7.PERIODIC OPERATION IN THE BAND 40.66 – 40.70 MHz AND ABOVE 70 MHz

Standard: FCC Part 15

Test procedure: paragraph 231 / paragraph 209

Test equipments:

TYPE	BRAND	EMITECH NUMBER	Calibration date	Next calibration due date
Test receiver	Rohde & Schwarz ESH3	1058	24/01/2011	24/01/2013
Test receiver	Rohde & Schwarz ESVS10	1219	23/02/2009	23/02/2011
Spectrum analyzer	Rohde & Schwarz FSP40	4088	16/12/2009	16/12/2011
Spectrum analyzer	Rohde & Schwarz FSP7	6796	04/06/2009	04/06/2011
Loop antenna	EMCO 6502	1406	13/01/2011	13/01/2013
Biconical antenna	Hewlett Packard 11966 C	0728	18/11/2008	18/11/2012
Log periodic antenna	Rohde & Schwarz HL 223	1999	18/11/2008	18/11/2012
Double ridged guide antenna	Electrometrics EM 6961	1204	30/05/2008	30/05/2012
Preamplifier 1 - 18 GHz	DBS Microwave DB97-1852	2648	30/04/2010	30/04/2011
High pass filter	Micro-tronics HPM11630	6609	21/03/2011	21/03/2013
Preamplifier 2 - 18 GHz	Microwave DB	1922	30/04/2010	30/04/2011
High pass filter HP12/3200-5AA	Filtek			
Open area test site	EMITECH	1274	28/01/2010	28/01/2012
Power source	Hewlett Packard E3610A	4195	/	/
Multimeter	Fluke 77-2	0812	22/03/2009	22/03/2011

1

Test set up:

The system is tested in an open area test site (OATS).
The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

Frequency range: From 9 kHz to 10th harmonic of the highest fundamental frequency.

Bandwidth: 120 kHz (F < 1 GHz)
1 MHz (F > 1 GHz)

Distance of antenna: between 30 m and 3 m according the frequencies and the limits.

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal, only the highest level is recorded.

Equipment under test operating condition:

The equipment under test is blocked in continuous transmission mode, modulated by internal data signal, at the highest output power level which the transmitter is intended to operate.

Results:

Field strength of emissions

Ambient temperature (°C): 20
Relative humidity (%): 66

Power source: 12 Vd.c

FREQUENCIES (MHz)	Detector P: Peak QP: Quasi-Peak	Antenna height (cm)	Azimuth (degree)	resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
433.92*	QP	180	0	120	H	70.7	80.8	10.1
867.82	QP	100	340	120	H	48.1	61.9	13.8
1301.75	P	100	0	1000	V	45	74**	29
1735.66	P	115	0	1000	H	44.7	61.9	17.2

** Fundamental emission*
** Restricted band (see §15.205). The peak level recorded is below the average limit (54 dBµV/m)

Note: any spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported.

Test conclusion:

RESPECTED STANDARD

□□□ End of report, 4 annexes to be forwarded □□□

ANNEX 1: PHOTOS OF THE EQUIPMENT UNDER TEST

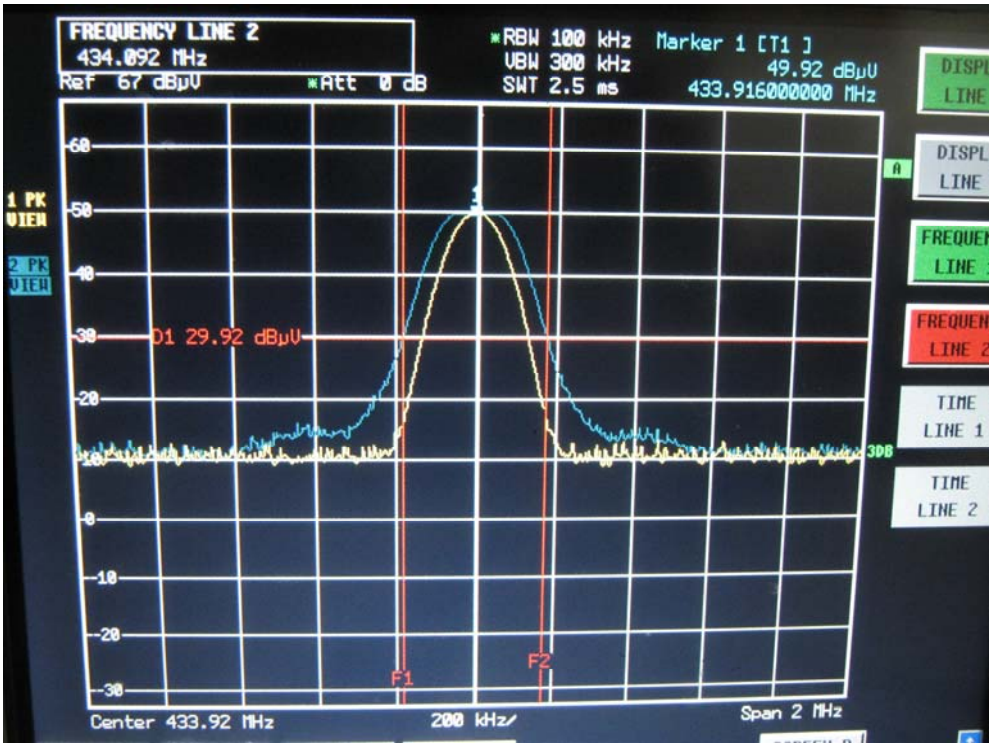
GENERAL VIEW

INTERNAL VIEW

ANNEX 2: TEST SET UP

RADIATED MEASUREMENT

ANNEX 3: BANDWIDTH OF EMISSION



F1=433.736 MHz
F2=434.092 MHz
Δ =356 kHz

ANNEX 4: TRANSMISSION TIME RESTRICTIONS

Savi Mobile Reader
Models SMR-650-217 & -218
Theory Of Operation
in Compliance with
FCC Rules
15.35
15.209
15.231
15.240

July 8, 2010

Savi Technology, Inc.
351 E. Evelyn Avenue
Mountain View, CA 94041

1.0 Introduction

The Savi Models SMR-650-217 and SMR-650-218 are examples of a Mobile RFID Reader (sometimes referred to as an Interrogator). The individual product models are designated as SMR-650-217 and SMR-650-218. The product contains two low power transmitters:

(1.) A UHF Transceiver operating at 433.92 MHz
(2.) A Low Frequency 123 kHz inductive loop transmitter operating at 123 kHz.

The UHF Transceiver is intended for use in a Radio Frequency Identification system. Its transmitter is a Low Power, Short Range device with a peak output effective isotropic radiated power (EIRP) of less than 1 milliwatt (0 dBm). All the product variants designated utilize the same transceiver operating at the same power level and complying with all FCC rules.

The Low Frequency transmitter is intended to trigger a UHF response from RFID tags passing within a few feet of the device.

2.0 Product Features

- 433.92 MHz UHF FSK (frequency shift keyed) air protocol as used in previous certified products
- 123 kHz short range inductive loop transmitter
- USB Serial interface to a 3rd party hand held computer
- Powered through a re-chargeable Lithium Ion battery, or by means of the external USB source the product is connected to.
- Weatherproof construction to IP55

3.0 Product Description

The Savi Mobile Reader is packaged in a hermetically sealed injection molded plastic case capable of meeting the hazardous environment requirements of UL-1604. An included detachable USB cable connects the unit to a separate hand held or laptop computer obtainable from several vendors. Battery recharging is conducted through the USB cable network connection.

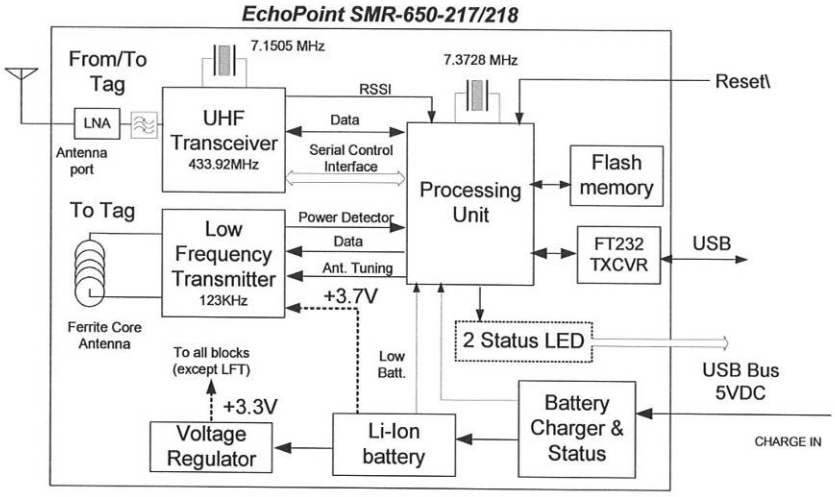
Figure 1 shows the block diagram of a the SMR-650-217 and SMR-650-218.

4.0 Circuit Card Description

A Block Diagram of the Savi Mobile Reader is shown in Figure 1. The main circuit board contains the following elements:

- Micro-Processor
- 433.92 MHz UHF Transceiver Module
- Low Frequency Transmitter at 123 kHz
- Battery
- Whip antenna with non-standard, reverse-gender connector.

Figure 1 – SMR-650-216 Block Diagram



5.0 RFID Control System Overview

5.1 System Components

The Savi RFID Control System is made up of the following system components:

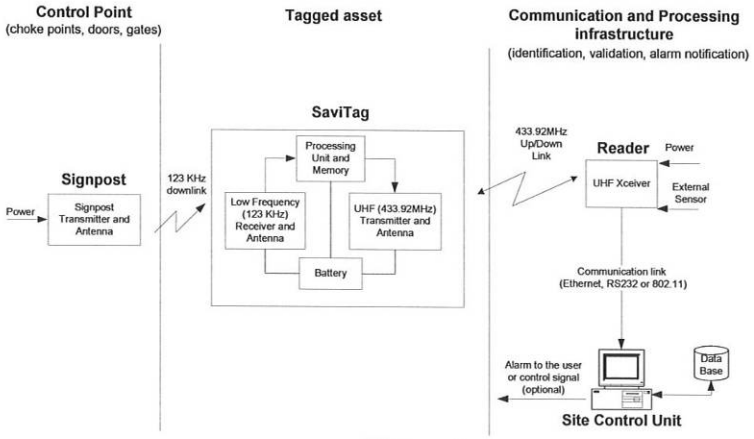


Figure 4

- **Signpost:** A 123 kHz transmitter with range of one to six meters. This LF signal is detected by nearby RFID tags which then transmit a short ID signal at 433.92 MHz, received by any Reader within 100 meters. Fixed Signposts are usually installed at access monitoring and control points, such as dock doors. The Savi Mobile Reader contains a short range (1 meter) Signpost transmitter used by an operator to stimulate individual tags.

- **Reader:** A 433.92MHz transceiver supporting EchoPoint and ISO-18000-7 RFID communications protocols. The Savi Mobile Reader may be carried by an operator to communicate with tags in container yards, warehouses, and other transportation hubs.

- **SaviTag:** A small, low power transponder receiving at 123kHz with a range of one to six meters, depending on the Signpost power. Also transmits and receives at 433.92MHz with a range of approximately 100 meters. The Tag is mounted on many types of assets or cargo, such as the door of an ISO Cargo Container. As described below, the Tag ID includes information that uniquely identifies the tag and through a relational data base, the asset on which it is mounted as being components within the overall system of access control, security monitoring, and environmental parameters.

- **Site Control Unit:** A computer with a network connection to the **Reader**. It provides access to a **Data Base Server** which checks for alarms reported by the **Tag,** and checks the relational data base to determine authorizations for access to secured areas. The Savi Mobile Reader communicates with the Site Control Unit through the commercial hand held computer to which it is attached. That unit is separately certified to FCC regulations by its manufacturer, so that the combination with the SMR is also compliant. Unintentional emissions are verified by Savi for all specific combinations to comply with the requirements of FCC Part 15.

5.2 RFID System Operations at 433.92 MHz under FCC Rules

Savi's RFID system, consisting of the Savi Mobile Reader and Tags of various types, is designed to operate at 433.92 MHz under CFR 47 Sections 15.231(a), 15.231(e), and 15.240 of the FCC Rules. [The SMR also transmits at 123 kHz under Section 15.209, as described below.] In addition, field strength limits and RF waveform duty factor measurement averaging methods comply with Section 15.209 and Section 15.35 as appropriate.

CFR 47 Section 15.231(a) allows for periodic operation of devices at 433.92 MHz, except that transmissions at regular, predetermined intervals are not permitted. Transmissions initiated by manual operation of a switch must cease within 5 seconds of releasing the switch. Automatically initiated transmissions must cease within 5 seconds. Data is permitted to be sent with a control signal.

This Theory of Operation describes in some detail how these transmissions perform various control functions, such as "Waking Up" tags or putting them into "Sleep" mode. The Savi system is designed to exchange data with tags and this information is often used to trigger an event or sequence of events, such as controlling the routing of a package or cargo container or identifying the cargo for special handling.

These applications are consistent with 15.231(a) because they are fundamentally used for control purposes. In addition, the Savi system is designed to meet all the pertinent technical requirements, including the signal strength limits and the limits on the duration of transmissions. The Savi Mobile Reader and Tag collection method under this Section is not designed to transmit signals at any defined intervals, but rather, transmits signals only in response to events that have no predetermined pattern.

CFR 47 Section 15.240 covers operations similar to those of Section 15.231(a), but provides for different timing limits for applications in locations where this mode is permitted. Notably, operation under this section is limited to identifying the contents of commercial shipping containers. Further, operations must be limited to commercial and industrial areas such as ports, rail terminals and warehouses. The location where SMR-650-21x Readers are configured to operate in the 15.240 mode must be registered with the FCC Office of Engineering Technology. Savi's User Guide instructs the end user on this requirement, and provides a reproducible form to be sent to the OET to perform the registration process.

Section 15.231(e) allows for periodic operation of devices including transmissions at regular, predetermined intervals, provided that the transmissions are no longer than 1 second, with at least 10 seconds of silence between transmissions. Savi tags which are able to operate as radio beacons or which may be triggered to operate in this mode by a Savi Signpost comply with this regulation.

Section 6.0 below describes the various RFID control operations and the 433.92 MHz radio transmissions which enable them.

6.0 RFID Air Interface Protocols and Radio Transmissions

6.1 Savi Mobile Reader Wakeup and Collection Transmission

6.1.1 Echopoint Protocol Transmissions

Savi Technology products have evolved over several generations of protocols, all of which employ variants of a process referred to as the Batch Collection System. The commercial name for the protocol in use since 2002 is the EchoPoint Protocol.

In recent years an Open-Systems RFID protocol has been standardized under the International Standards Organization under the specification ISO 18000-7. Savi has adopted this protocol for the SMR, and extended it with backward-compatibility features to support previously existing EchoPoint commands.

The ISO-18000-7 Batch Collection process is compatible with the EchoPoint version for waking up RFID Tags and collecting their status and command and control information. The over-the-air transmissions are described in the next section.

6.1.2 ISO 18000-7 Protocol Transmissions

The UHF Wakeup signal transmitted by the Savi Mobile Reader is comprised of a continuous 31.25 kHz FSK modulated signal on a 433.92 MHz carrier with a duration of 2.35 seconds. Tags detecting this tone awaken to a stand-by state and await the next signal.

Following the Wakeup signal is a 10 kHz FSK Co-Header of 100 msec duration which serves as a marker for the end of the Wakeup transmission. This marker enables Tags to conserve a few seconds of battery power by remaining in a low power state and only enable their receiver for a few milliseconds every 100 milliseconds until the Co-Header tone is detected. At that time the Tag enables the receiver continuously and awaits the next command.

With the Tags now awakened, a Collect-with-UDB command of 10 msec duration is sent. The entire signal transmission is less than the 5 second limit of Section 15.231(a). The Collect command falls within the final 100 msec of the transmission and is within the 60% Duty Factor permitted by Section 15.35 at the transmitter field strength employed in this product.

The SMR now ceases transmission. If Tags respond, their ID's will be logged as a Service Request in a queue requiring the SMR to put them to sleep or retrieve their control information.

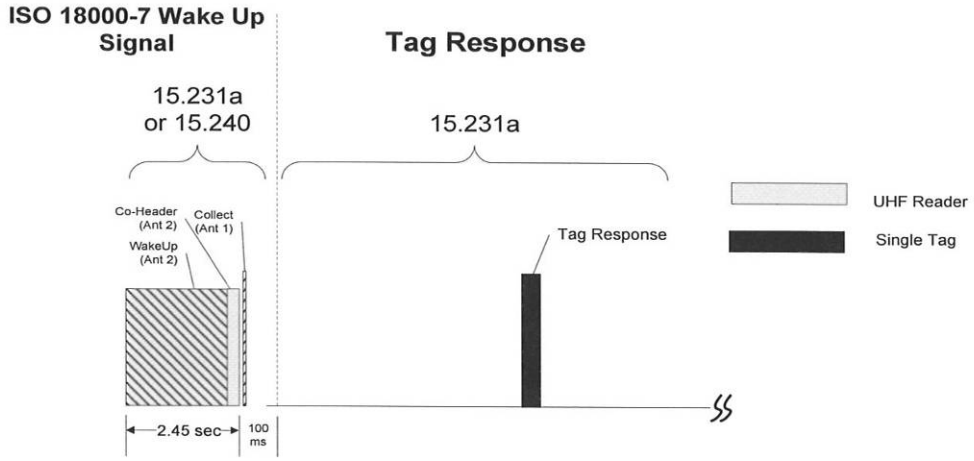


Figure 5

6.1.3 Tag Responses

Figure 5 shows a single Tag responding to the Wakeup and Collection signals from the SMR with a command and control packet typically 10 msec in duration. The Collection command notifies the Tags to respond within a variable time of approximately 60 to 600 milliseconds, depending on an algorithm adapting to the number of previous responses received. The Tags employ a random timing algorithm to space transmissions over the window as a collision-avoidance mechanism. The number of tags responding in a window can range from one to approximately 30 or more, depending on statistics and the total number of tags in range.

Tag packets are entered into a Service Request queue as received. Tags will remain awake for 30 seconds after the Collect command is received, consuming battery power needlessly. The SMR processes the Service Request Queue by sending Sleep commands as described in the following section.

Note that Tags operate under Rule 15.231(a), because they are slaves to the SMR, whose default mode is 15.231. Even in locations where the SMR is configured to operate under Rule 15.240, the tag operates under 15.231(a) because it does not autonomously transmit for the longer durations authorized by 15.240.

6.2 The Sleep Command Sequence under the EchoPoint protocol

The Sleep command is a Point-to-Point command. The SMR sends the Sleep command to Tags whose ID's were logged in its Service Queue as a result of the Collection process. Alternatively, a Tag may be logged as a result of its receiving a 123 kHz Low Frequency Signpost signal from the SMR low frequency transmitter.

Figure 6 shows a collection sequence consisting of the Wakeup, Collection and Tag responses described in Section 6.1 above. The Tag ID's constitute a Service Request to the SMR to issue Sleep commands to each individual tag. The SMR transmits Sleep commands at a rate less than the maximum 60% Duty Factor declared under the averaging requirements of Section 15.35. The sequence terminates with two final Collect commands to ensure that no tags have been missed. The SMR transmission duration for the Sleeps and Collects is less than five seconds.

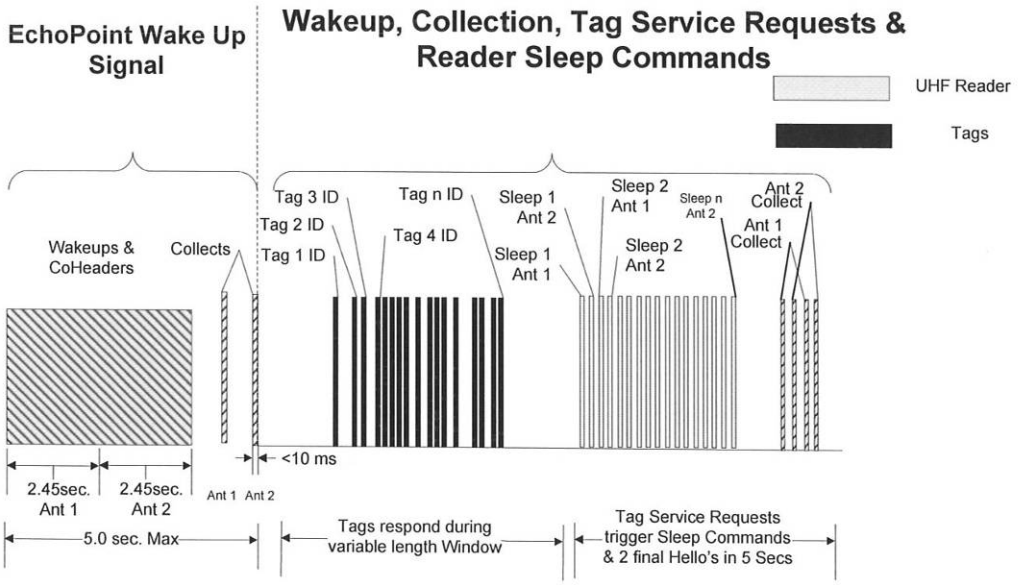


Figure 6

6.3 The Sleep Sequence under the ISO-18000-7 protocol

The ISO-18000-7 Sleep Sequence is similar to the EchoPoint sequence described above, except that the Tag ID/Service Request denotes the presence in the Tag of additional control information known as the UDB. The SMR sends a point-to-point UDB-Fetch command to the Tag, which responds with the UDB packet. Refer to Figure 7 below. The SMR then issues two Point-to-Point Sleep commands to that Tag. The SMR proceeds to service tags whose ID's were logged in the Service Queue as a result of the Collection process. The transmission duration for the Sleeps and Collects is less than five seconds.

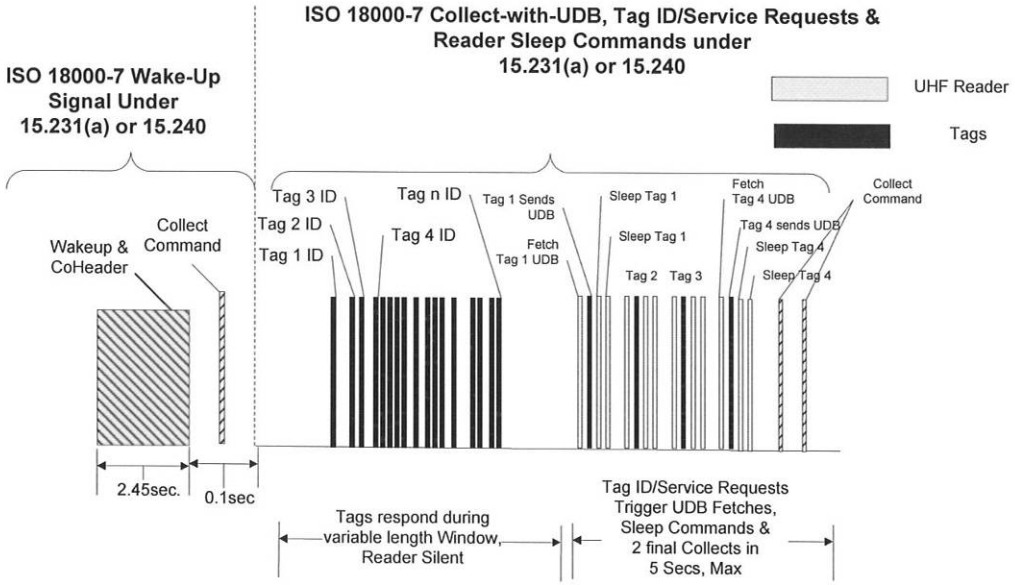


Figure 7

6.4 Empty Collection Events

SMR Collection and Sleep transmissions cease after a terminating Collect command. The SMR then listens for Tag responses during a silent period of variable duration up to one second depending on the number of tags previously detected.

If no tags respond during the silent period, it is either because there are no Tags within range or because of local RF interference with SMR to Tag communication. The possible failure of the communication link constitutes a system fault requiring immediate verification. Therefore, an Empty Collection Event occurring when the system expects that tags should be within range will be interpreted as a trigger under Section 15.231(a) for a short re-verification transmission of up to four Hello commands of 10 msec each on alternating antennas spaced over a one second interval. Afterwards, the SMR will remain silent if no Tags respond.

This re-verification transmission is also explicitly permitted under Section 15.240(b) in the event of a transmission error.

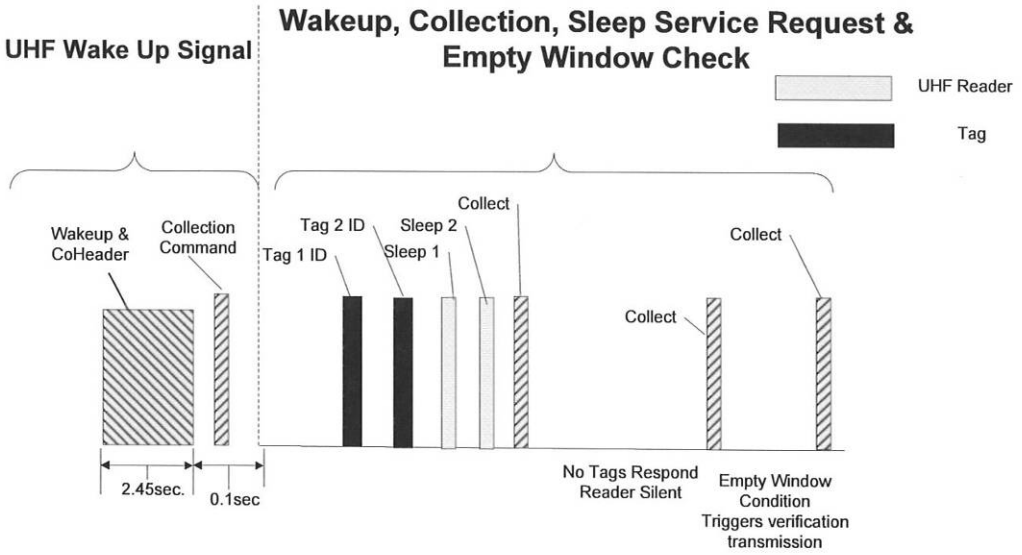


Figure 8

6.5 UHF Broadcast Mode

An SMR operating in Broadcast Mode uses control signals to, among other things, acquire the ID of a Tag within range of the SMR.

The UHF Broadcast Mode commands consist of a 433.92 MHz pulsed signal with duration less than 10 msec. These commands, which consist of a control signal and data, comply with Section 15.231(a). UHF Reader commands that may be issued in Broadcast Mode are:

- Hello command, the Collection command described above.
- Sleep_All_But [TAG ID XYZ] to cause all tags within range of the UHF Reader to go to sleep except for TAG XYZ; and
- Search and Route command that causes each Tag to identify itself if it matches criteria for certain cargo and/or routing.

In locations where operation pursuant to Section 15.240 is permitted, i.e., commercial and industrial areas, such as ports, rail terminals, and warehouses that are at least 40 km away from the sites listed in Section 15.240(e), the Tag and SMR may transmit for up to 60 seconds. Tag operation under Section 15.240 would be enabled by the SMR, which is registered in accordance with the requirements in Section 15.240(f).

Tag operations are completely under the control of the SMR. SMR's enabled to operate under Section 15.240 are installed and configured by factory-trained service personnel in locations that comply with the Section 15.240 site and registration requirements. In all other locations, Tag operations will default to modes that comply with Section 15.231 as detailed above.

A timing diagram depicting operations pursuant to Section 15.231 and 15.240 is provided in Figure 9.

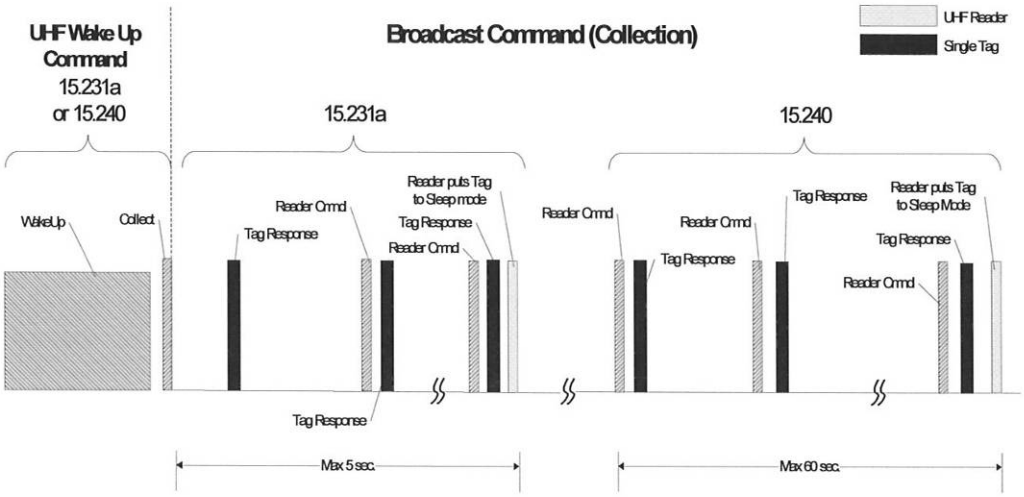


Figure 9

6.6 UHF Point-to-Point Mode
6.6.1 Point-to-Point under Section 15.231(a)

An SMR operating in Point-to-Point Mode uses control signals to transmit commands to a specific Tag. The SMR sends such transmissions after the Tag acknowledges receipt of a Wake Up signal from either the LF Transmitter or SMR. A timing diagram for point-to-point commands is depicted below. The duration of the pulsed transmissions from the SMR is less than 5 seconds in compliance with Section 15.231(a). When an operator is initiating Point-to-Point transactions, he may initiate transactions at any time, provided that each transmission ceases automatically before 5 seconds have expired.

Some point-to-point transmissions include:

- The Sleep command while performing tag collection
- A command to apply a routing code to a Tag for automated cargo handling at ports and rail and truck terminals en route to a final destination;
- A command to configure sensors to set threshold for measurements and the declaration of control limits to be logged when exceeded;
- A request to identify cargo requiring special handling for hazardous material storage and/or security purposes;
- A request to determine the system integrity of the Tag by requesting sensor status information recorded by the Tag as part of cargo security control & monitoring function.

When the SMR operates in the default mode it complies with Section 15.231(a). In this mode when the SMR reads or writes control data to or from the Tag, the transmission will not exceed the 5 second limitation of 15.231(a).

Tags operate under the control of Readers and default to the modes that comply with Section 15.231.

6.6.2 Point-to-Point under Section 15.240

In locations where operation pursuant to Section 15.240 is permitted, SMR's equipped to operate in compliance with that Section will be installed and configured by factory-trained service personnel.

Compliant Tags entering an area controlled by an SMR installed and configured to operate under Section 15.240 will be enabled to also operate under that Section. In these locations, the SMR may transmit for up to 60 seconds, followed by a 10 second silent period.

In all other locations, Tag operation will default to the modes that comply with Section 15.231.

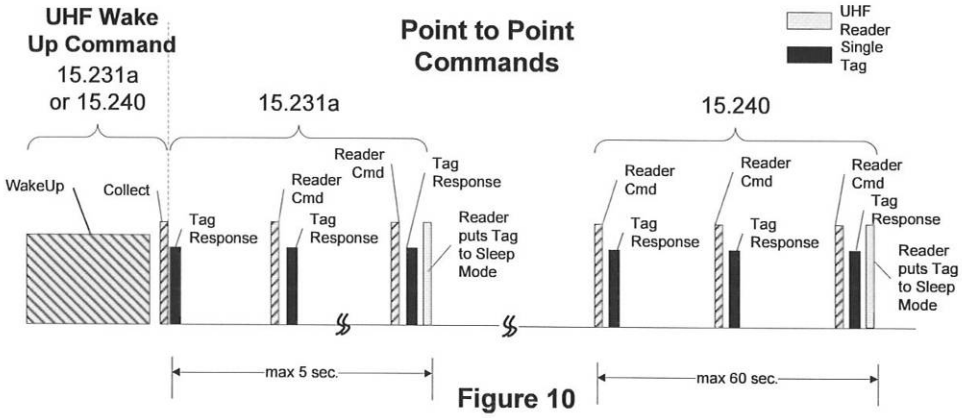


Figure 10

7.0 Low Frequency Transmissions at 123 kHz

7.1 Savi Mobile Reader Signpost Function

The SMR may be used by an operator to stimulate a Tag's Low Frequency Receiver by transmitting a Signpost Identification Signal as described below. The Tag will then transmit its own identification response over 433.92 MHz to the SMR UHF receiver, which will capture the information for use in further operator-initiated or application-driven transactions.

7.2 Savi Mobile Reader Signpost Transmission

The SMR Low Frequency transmitter consists of a ferrite core coil in a tuned circuit driven by an On-Off Keyed source to produce a low data rate magnetic field signal compliant with CFR 47 Section 15.209. Bits are encoded by Pulse Width Modulation with a 50% duty cycle.

The modulation approach uses three symbols, each one having a duty cycle of 50%, as shown below in Figure 11.

- The preamble symbol has 500 microseconds ON and 500µs OFF
- A logic '1' is represented by 300µs microseconds ON and 300µs OFF
- A logic '0' is represented by 400µs microseconds ON and 400µs OFF

The low frequency transmitter power level is fixed and is set to comply with FCC Rules Section 15.209.

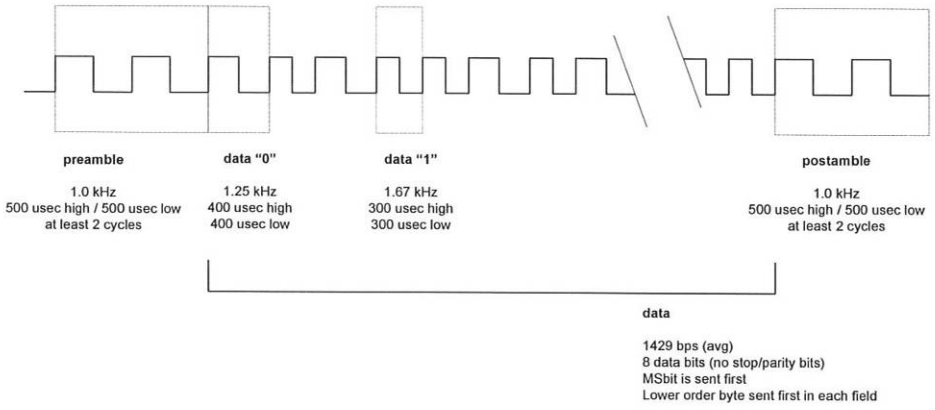


Figure 11

7.3 Savi Mobile Reader Low Frequency Message Formats

There are two types of Low Frequency Messages:

a. Broadcast to all tags within range without a command field. Tags receiving this signal transmit their Signpost Recognition Code over UHF to the SMR UHF receiver.
b. Point-to-Point command to a specific Tag ID. That specific tag performs the operation corresponding to the command and transmits the result over UHF to the SMR UHF receiver.

The frame structures of these two Low Frequency Messages are shown below.

7.3.1 LF Command Message (LF: signpost to tag)

An EchoPoint 1.2 command packet is transmitted by an handheld or signpost to one or more tags. If the signpost wishes to communicate with a specific tag, the command packet will include the tag's unique Tag ID (4 byte EchoPoint 2.2 Tag ID) value. To communicate with any EchoPoint 1.2 tag within range, the signpost will mark the packet as a broadcast packet (and will not include the Tag ID field).

This diagram shows the basic ordering and length of fields in the command packet. As a convention in this document, fields that are dropped below the baseline indicate optional fields (Owner ID) or fields that depend on the type of packet (Tag ID). The typical message length is 4 bytes (32 bits). Optional extensions may extend the message length to 11 bytes.

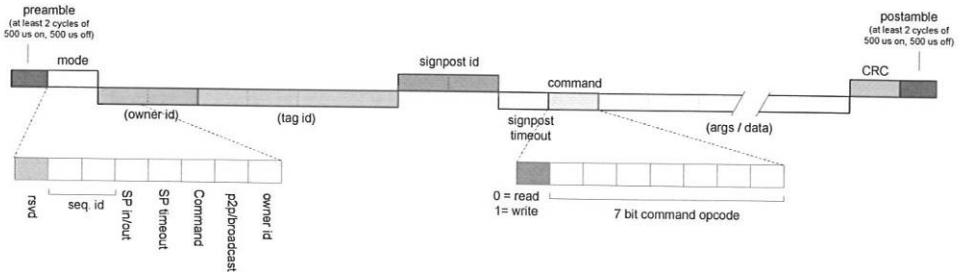


Figure 12

7.3.2 Signpost message (broadcast, no command)

A signpost message is a broadcast packet that does not include a command opcode. It is intended to communicate the presence of a signpost and transmit the unique 16-bit signpost ID value. An 8-bit CRC provides transmission error detection. The total length of the message is 4 bytes (32 bits), not including the pre-amble and post-amble.

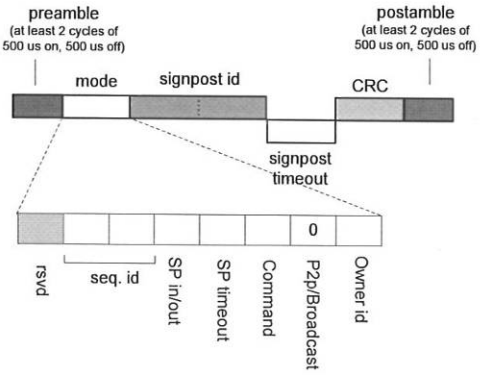


Figure 13