coronis SYSTEMS

EVO RTM Applicative Reference Guide

Users Manual

Coronis Systems
RTM Elster AMCO Products,

Revision History

Rev.	Description	Author	Date	Comments
1	Original document	AMR	15 Sept 2006	Draft
2	Updated document	AMR	21 Sept 2006	Correspondence with CDS Sections added
3	Updated document	AMR	06 Oct 2006	Modifications following meeting between Elster AMCO & CORONIS in OCALA from 25th to 27th of September 2006
4	*Updated document*	*AMR*	*19 Oct 2006*	*Coronis internal revision only not distributed*
5	Updated document	AMR	13 Nov 2006	Approval form added
6	Updated document	AMR	15 Nov 2006	Update concerning RTM limitations in Drive By and Walk By operating mode
7	Updated document	AMR	04 Dec 2006	Update based on Bruce A. Bharat comments on revision 6 of the document
8	Updated document	AMR	24 Jan 2007	Update based on Bruce A. Bharat comments on revision 7 of the document
9	Updated document	AMR	22 Feb 2007	1) Update based on Elster AMCO comments on revision 8 of the document 2) Filtering algorithm added with activation/deactivation capabilities
10	Updated document	AMR	08 Mar 2007	***Corrections added :*** - parameters ID were false in Appendix A (encoder unit A & B), - Radio address description added and sRTM reference added (**§6**) - Frame length correction in **§5.5.5** (TOU Buckets readings with 4 port connected) - Datalogging parameter description added in section **§5.5.3**
11	Updated document	SDA	22 Mar 2007	***Corrections added :*** - Several default value (in chapters and appendix A), - Several parameters size (in chapters and appendix A), - Several access right in appendix A, - Definition of the offset in records datalogging table in **§5.5.4,** - Wrong command examples in **§5.6.3,** - Acknowledgment in **§5.12.2.**
12	Updated document	SDA	23 Mar 2007	***Corrections added :*** - Restriction on the index sampling period when TOU Buckets function is activated **(§5.5.5)**
13	Updated document	SDA	26 Mar 2007	***Corrections added :*** - Default value corrected for TOU Buckets parameter (0x60), alarm frame path (0x5A,0x5B,0x5C,0x5D) and Step time of pseudo bubble up transmission
14	Updated document	SDA	03 Apr 2007	***Corrections added :*** - Default filled value corrected for leak event table in **§5.7.4** - Restriction on the 2 LSB bits of step time bubble up (**§5.6.1**).

Rev.	Description	Author	Date	Comments
15	Updated document	AMR	26 Jul 2007	***Corrections added :*** - **§4.1:** Data max length correction (173 instead of 174), - **§4.2.2:** comments added when writing only operating mode, - **§5.4.6:** error corrected in Encoder Unit LSB Byte description, - **§5.4.7:** details on encoder data returned - **§5.12:** added part for alarm window configuration (new feature) that permits to enable alarm frames even if pseudo bubble-up is activated without generating possible collisions.
16	Updated document	SDA/AMR	15 Oct 2007	***Corrections added :*** - Completely remove from document the "Sampling activation type parameter" - Few other corrections
17	Updated document	AMR	18 Oct 2007	***Appendix C added:*** related to Wavenis products Service Commands

DOCUMENT CONTROL AND APPROVAL

Document Name	*Revision*	*Author*	*Date*
EVO RTM-UserMan	17	Adam Molnar	18 October 2007

Name	*Title*	*Company*	*Date*	*Sign off approval*
Bruce A. Bharat	Product/Project Manager	Elster AMCO		

Name	*Title*	*Company*	*Date*	*Sign off approval*
John Rouse	VP Sales - North America	Coronis Systems		
Victor Razanatsimba	Project Manager	Coronis Systems		
Adam Molnar	Project Technical Manager	Coronis Systems		

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: This device may not cause harmful interference, and this device must accept any interference received including interference that may cause undesired operation.

Caution: Any changes or modification not expressly approved by CORONIS-SYSTEMS could void the user's authority to operate the equipment.

TABLE OF CONTENTS

1.Definitions

Absolute Encoder: A meter register, that when queried by the Radio Transmitter module, will reply back to the Radio Transmitter module with the exact reading of the register odometer reading.

Automatic Frequency Control: AFC guarantees top performance over the full lifetime of devices, keeping Rx carrier frequencies aligned to Tx. AFC compensates frequency shift introduced by component aging (discrete,quartz), but also by temperature drift and even by ambient temperature differences between communicating devices.

Automatic Sensitivity Control: ASC operates like the squelch function in audio systems (ambient noise filtering) to avoid “false” wake-up when RF environment is noisy. This is a serious factor for saving power.

Back flow: A reverse flow condition, created by a difference in water pressures or tampering of the meter (i.e. reversing the physical meter), which causes water to flow back into the distribution pipes of a potable water supply from any source or sources other than an intended source.

Bubble-Up Technology: Radio Transmitter module communications technique in which the radio transmitter module automatically transmits, at pre-determined intervals, without having received a command to do so, the information it has acquired from the meter register

Datalogging: Storage of consumption data over time, so that usage may be tracked. This is achieved by the Radio transmitter module interrogating the water meter register at programmable time intervals and saving the obtained reading together with time and date in memory for later retrieval.

Link budget: A link budget is the accounting of all of the gains and losses from the transmitter, through the medium (free space, cable, waveguide, fiber, etc.) to the receiver in a telecommunication system. It takes into account the attenuation of the transmitted signal due to propagation, as well as the loss, or gain, due to the antenna. Random attenuations such as fading are not taken into account in link budget calculations with the assumption that fading will be handled with diversity techniques. It is given by the following equation:

Pout (dBm) + Gtx (dBi) - Att-Max (dB) + Grx (dBi) - Sensi (dBm) = 0

Where:

Pout (dBm) output power on the TX side

Gtx (dBi) antenna gain on the TX side

AttMax (dB) Maximum possible attenuation. It includes LOS attenuation that depends on distance and carrier frequency. It also includes signal attenuation through obstacles.

Grx (dBi) Antenna gain on the RX side

Sensi (dBm) Receiver sensitivity on the RX side

Leak Detection Algorithm: An algorithm in the radio transmitter module which uses consumption information acquired from the meter register to determine whether or not a leak is present on a specific account

Overhearing: Overhearing is when a given, unintended device, within radio range, receives another device’s transmission frequency, forcing the unintended device’s receiver to power up.

Pit Mount Interface: An adapter which allows the Radio Transmitter module antenna to rest above the pit lid for better reception and transmission reliability in a pit environment.

Pseudo-bubble up: A feature which was developed in order to counter systems that specifies X amount of readings a day via a bubble up system (see “bubble-Up Technology”). The pseudo bubble up feature will automatically send a daily profile acquired from the datalogging table to the end user in one transmission rather than via 6 transmissions. To the end user, who is receiving the data, there is no difference, other than the means in which the data was received. Hence, “pseudo bubble up”.

Pulse Register: Meter register that sends an electrical pulse at a pre-defined interval (i.e. 1 pulse equals 1 gallon). The interval is usually a volume of consumption (gallons, cubic feet, cubic meters, etc).

Quality of Service (QoS): Quality of Service (QoS) is an empirical, relative gauge of communications in a network derived by an algorithm which is balanced to minimize RF communications while finding the best communications path. Quality of Service is determined by a "balance" of 4 parameters: Device Class (application dependent: sensor, valve, actuator, gateway…), Remaining energy (no limit if powered by mains), RSSI, Number of "attached" children.

Radio Transceiver Module (Radio Transmitter module): Also known as endpoint, a radio transmitter device is attached to the water meter register and transmits vital information about the meter and consumption characteristics.

Received Signal Strength Indication (RSSI): RSSI is a measurement of the received radio signal strength (energy integral, not the quality).RSSI is generic radio receiver technology metric, which usually is invisible to the user of device containing the receiver, but is directly known to users of wireless networking of IEEE 802.11 protocol family.

Time of Use (TOU) Pricing: A tariff method in which a given utility charges different rates based on usage during different times of day.

Two Way Communications: Two-way communications is radio technology terms which refers to a device which can both transmit and receive (a transceiver) information on demand.

Wake-up preamble: A wake-up sequence used by the radio transmitter module, which is sent prior to data, as communication is initiated.

WaveBox: Elster AMCO specified collector, which has many forms of communication ability to the head end computer, including WiFI, GPRS, and Ethernet.

Wavecell: Current Coronis Wavenis/cellular network gateway. Offers full 2-way communications for automated monitoring and remote network administration.

Waveflow: Current Coronis Low-cost, battery powered utility meter monitor with ultra-long battery life.

Wavehub: Mini Network concentrator or dedicated repeater

WYSIWYG – "What You See Is What You Get": An acronym for What You See Is What You Get, used in computing to describe a system in which content during editing appears very similar to the final product. It is commonly used for word processors, but has other applications, such as Web (HTML) authoring.

Acronyms

AFC - Automatic Frequency Control

AFH – Automatic Frequency Hopping

ASC - Automatic Sensitivity Control

CPU - Central Processing Unit

DSSS - Direct Sequence Spread Spectrum

FHSS - Frequency Hopping Spread Spectrum

HCI - Host Controller Interface

IEEE – Institute of Electrical and Electronics Engineers

LLC - Logical Link Control

MAC - Medium Access Control

PAN - Personal Area Network

PDK - Product Development Kit

PHY – Refers to the physical layer of a integrated circuit

QoS – Quality of Service

RSSI – Received Signal Strength Indication

RTC - Real Time Clock

RTM – Radio Transceiver Module

SDP - Service Discovery Protocol

TOU – Time of Use

ULP - Ultra-Low-Power

WBX – Wavebox (Collector)

WF – Waveflow (Radio Transmitter module)

WNM – Wavenet Manager

2.Introduction

This document specifies all the features embedded in the **RTM Elster AMCO** radio module. A part of these features are compatible with Coronis Standard RTM. Functionalities added specifically for Elster AMCO are based on last “Statement of Conformance” document provided to CORONIS listed below :

- “Coronis Conformance Doc - Fixed - 09.28.06 AMCO v11_revised_by_AMCO.xls”,
- “Coronis Conformance Doc - Walk-by 10.2.06 v4 revised by AMCO.xls”,
- “Coronis Conformance Doc - Drive By - 10.1.06 v4 revised by AMCO.xls”.

The aim of this document is to describe functional aspects of each feature embedded into the **RTM Elster AMCO** radio module.
Each feature is fully configurable using radio signal bidirectional exchange.

3.Reference documents

Ref	*Title*	*Version*	*Release Date*
DR[1]	Project Thor – Product Specification.doc	3	03/05/05
DR[2]	cs-sup-muti-wflowapp-e02.pdf	2	03/31/05
DR[3]	Coronis Conformance Doc - Fixed - 09.28.06 AMCO v11_revised_by_AMCO.xls	11	09/28/06
DR[4]	Coronis Conformance Doc - Walk-by 10.2.06 v4 revised by AMCO.xls	4	02/10/06
DR[5]	Coronis Conformance Doc - Drive By - 10.1.06 v4 revised by AMCO.xls	4	01/10/06
DR[6]	Encoder Back flow Detection Spec r1 10.24.06.pdf	1	10/24/06
DR[7]	Wavecard User Handbook		

Note :

For each section of this document a correspondence is made with DR[1] to DR[6], in order to give Elster AMCO the ability to verify conformance between their Commercial Specifications (CDS) and Coronis RTM Elster AMCO Product Functional specifications (PFS).

4.RTM Elster AMCO Configuration access

RTM Elster AMCO as several embedded features, each one detailed later in this document, that are fully configurable using radio frames. This section describes radio frame generic format and explains how to access to the configuration of each embedded feature.

4.1.Radio exchange principle

Figure 1 below shows a point-to-point radio exchange principle between a USB Waveport (Waveport is a Coronis radio modem generally used as the initiator of the radio exchange) and a Standard Coronis RTM.

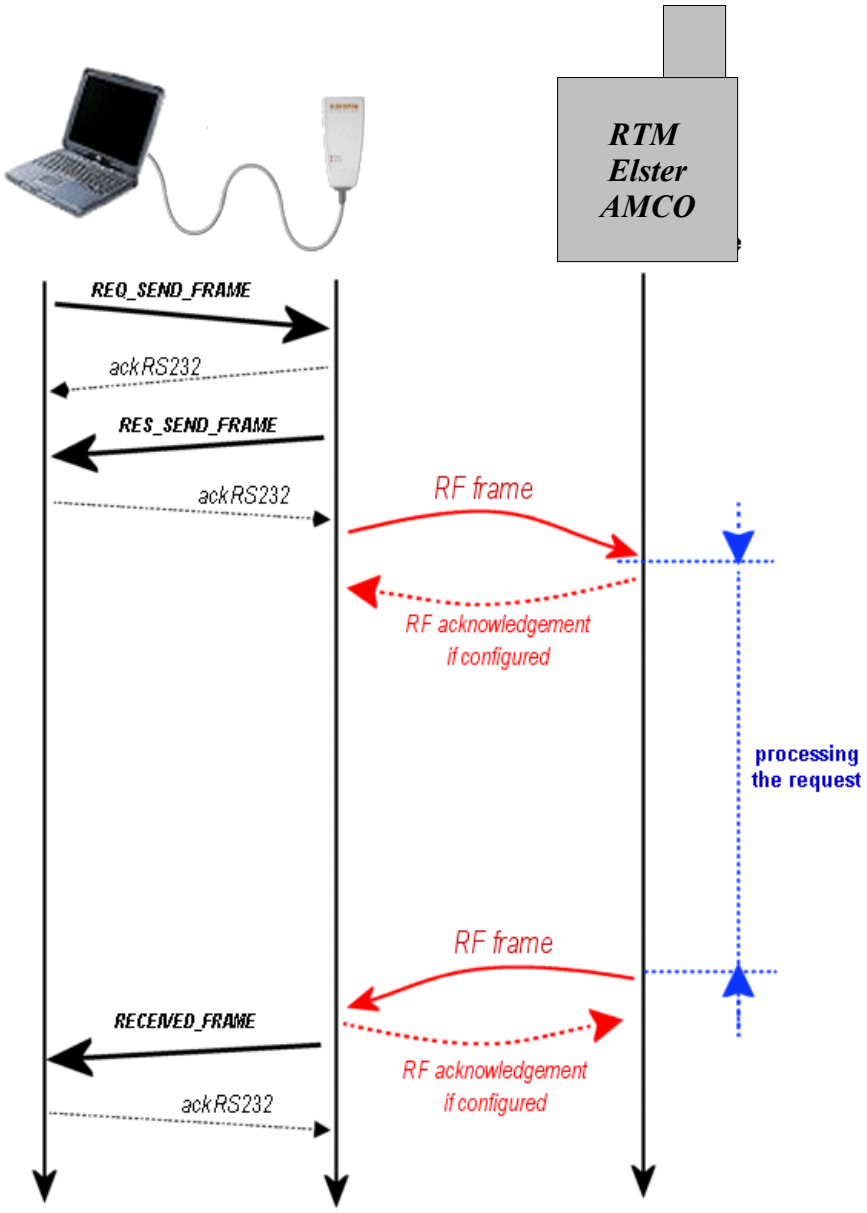


Figure 1

Note : *point-to-point exchange commands have the following format: (all exchanges modes are described in document DR[7])*

CMD	NAME	DESCRIPTION
0x20	REQ_SEND_FRAME	Request to send a radio frame with the waiting for the radio response.
0x30	RECEIVED_FRAME	Received radio frame by the radio board.

The data field of each command must be formatted according to the following table:

CMD	DATA	
	6 bytes	**variable (max : 174 bytes)**
0x20	Remote equipment "Radio Address"	Data to Transmit
0x30	Remote equipment "Radio Address"	Received Data

The first byte of the field ***"Data to Transmit"*** contains an *"applicative command"* that allows the recipient of the radio frame to identify the corresponding action to process.
The first byte of the field ***"Received Data"*** contains an *"applicative command acknowledgment"* indicating that the remote equipment has processed the requested action.

	1 byte	173 bytes max
Data to Transmit	Applicative command	Data relating to the request
Received Data	Applicative command Acknowledgment	Data relating to the response

ATTENTION :

Following sections of this document describe only ***"Data to Transmit"*** *and* ***"Received Data"*** *fields format. These fields are the only ones relevant when accessing to RTM Elster AMCO embedded features.*

Other fields of the radio frame depend on the exchange mode chosen, and are detailed in document DR [7].

4.2.Internal parameters access

This chapter details the applicative data field used for reading or writing **RTM Elster AMCO** internal parameters.
The complete list of accessible parameters is described in **Appendix A** at the end of this document.

*Commands to use for accessing **RTM Elster AMCO** internal parameters :*

Applicative Commands	*Description*
0x18	Request to read parameter(s)
0x98	Request to read parameter(s) acknowledgment
0x19	Request to write parameter(s)
0x99	Request to write parameter(s) Acknowledgment

It is possible to access up to 10 parameters simultaneously either in writing or reading access

4.2.1.Reading internal parameters

- ***Reading request data format***

Applicative command	*Number of param to read*	*1st param ID*	*1st param size*	*...*	*...*	*nnd param ID*	*nnd param size*
0x18	1 byte	1 byte	1 byte	...	...	1 byte	1 byte

n_{max} = 10

- ***Reading acknowledgment data format***

Applicative acknowledgment command	*Operating Mode (1)*	*Number of param read*	*1stparam ID*	*1st param size*	*1st param value*	*...*	*nth param ID*	*nth param size*	*nth param value*
0x98	2 bytes	1 byte	1 byte	1 byte	variable	...	1 byte	1 byte	variable

(1) Operating mode is systematically sent in the reading parameter request acknowledgment frame.

Remark :*When a parameter is not a valid parameter of RTM Elster AMCO, or the size is configured with a wrong value, the corresponding field "size" is set to "0x00" in the response frame and the corresponding parameter value is not significant in this case.*

4.2.2.Writing internal parameters

- ***Writing request data format***

Applicative command	*Operating Mode (1)*	*Mask on Operating mode (indicate the bits that must be updated) (1)*	*Number of param to write (2)*	*1st param ID*	*1st param size*	*1st param new value*	*...*	*nth param ID*	*nth param size*	*nth param new value*
0x19	2 bytes	2 bytes	1 byte	1 byte	1 byte	variable	...	1 byte	1 byte	variable

(1) These two fields has to be included in each writing command request. These 4 bytes are used to update partially or entirely the operating mode parameter fields ***(See section §4.3.2.)***.
Indeed, the operating mode mask is used in the **RTM Elster AMCO** embedded software to reinitialize the internal feature associated to these fields. With this method the application software don't need to take into account the previous value of operating mode parameter.

It is recommended to use the writing command to initialize all parameters relative to a functionality like datalogging in addition with positioning at "1" the concerned mask on operating mode. In this case the internal function will be initialized with the parameters included in the frame.

(2) the maximum number of parameters to write must not be higher than $\mathbf{n_{max} = 10}$

It is possible to write only the operation mode using the writing parameter command. In this case the frame format is as follows:

- ***Writing acknowledgment data format***

Applicative acknowledgment command	*Operating Mode*	*Number of param written*	*1st param ID*	**1st param update status (1)**	*...*	*...*	*nnd param ID*	*nnd param update status*
0x99	2 bytes	1 byte	1 byte	1 byte	...	...	1 byte	1 byte

***(1) 'Update Status'** possible value: **0x00** : param update ok*
***0xFF** : param update error*

***ATTENTION :** some of the parameters are limited, i.e. their values should not be written out of their limits.*

If a value is written out of the limits, the value will not be written and the parameter value will remain unchanged. The status of writing will be NOK.

Example: An hour parameter should be set up from 0 to 23. Thus if value 40 is set, the update status relative to this parameter will be equal to "0xFF".

- ***Writing request data format with only operating mode***

Applicative command	*Operating Mode*	*Mask on Operating mode (indicate the bits that must be updated)*	*Number of param to write*
1 byte	2 bytes	2 bytes	1 byte
0x19			0x00

- ***Writing acknowledgment data format in case of frame format error***

Applicative acknowledgment command	*Operating Mode*	*Status of writing*
1 byte	**2 bytes**	**1 byte**
0x99	Operating Mode current value	**0x00** --> update Operating Mode OK **0xFF** --> Syntax error (not enough bytes in the request)

4.3.Control bytes description

Some internal parameters are very useful to configure **RTM Elster AMCO** module and verify its state. These control bytes are:

- Profile selection (1 byte),
- Operating Mode (2 bytes),
- Alarm Configuration (1 byte),
- Application Status (1 byte),
- Leakage detection Status (1 byte),

Depending on the selected profile or the type of connected meter, the meaning of each field could be different. All these differences are defined below.

4.3.1.Profile selection

Profile selection (internal parameter ID = 0x05)	
Value	*RTM Elster AMCO profile*
0x01	1 to 4 Digital Ports
0x02	1 or 2 Encoder Ports

ATTENTION :

RTM Elster AMCO *initializes all the features on profile parameter programming. Also, programming the "Encoder" profile causes an encoder automatic detection.*

4.3.2.Operating Mode

The ***"Operating Mode"*** is used to activate/deactivate each **RTM Elster AMCO** feature. This parameter is accessible through the command write parameters (described in section 4.2.2).
"Operating Mode" parameter is systematically returned in generic header present in almost each response frame of the **RTM Elster AMCO**.

- ***RTM Elster AMCO pulse***

Operating Mode (no ID for this internal parameter)							
bit 15	***bit 14***	***bit 13***	***bit 12***	***bit 11***	***bit 10***	***bit 9***	***bit 8***
Not used	Not used	**Network configuration** **00:** Fixed Network **01:** Drive by/ Walk by **10:** Drive By (only) **11:** Walk By (only)		**Bubble-Up management** **0** : deactivated **1** : activated	**TOU Buckets management** **0** : deactivated **1** : activated	Not used	Not used

Operating Mode (no ID for this parameter)							
Bit 7	***Bit 6***	***Bit 5***	***Bit 4***	***Bit 3***	***Bit 2***	***Bit 1***	***Bit 0***
Not used	**Extreme leak detection** **0** : deactivated **1** : activated	**Residual leak detection** **0** : deactivated **1** : activated	**Tamper detection** **0** : deactivated **1** : activated	**Datalogging** **00** : deactivated **01** : time steps mngt **10** : once a week mngt **11** : once a month mngt		**Ports management** **00** : 1 Port (A) **01** : 2 Ports (A,B) **10** : 3 Ports (A, B, C) **11** : 4 Ports (A, B, C, D)	

- ***RTM Elster AMCO encoder***

Operating Mode (no ID for this internal parameter)							
bit 15	***bit 14***	***bit 13***	***bit 12***	***bit 11***	***bit 10***	***bit 9***	***bit 8***
Not used	Not used	**Network configuration** **00:** Fixed Network **01:** Drive by/ Walk by **10:** Drive By (only) **11:** Walk By (only)		**Bubble-Up management** **0** : deactivated **1** : activated	**TOU Buckets management** **0** : deactivated **1** : activated	**Encoder filtering algorithm management** **0** : deactivated **1** : activated	**Back flow detection** **0** : deactivated **1** : activated

Operating Mode (no ID for this internal parameter)							
Bit 7	***Bit 6***	***Bit 5***	***Bit 4***	***Bit 3***	***Bit 2***	***Bit 1***	***Bit 0***
Encoder misread detection **0** : deactivated **1** : activated	**Extreme leak detection** **0** : deactivated **1** : activated	**Residual leak detection** **0** : deactivated **1** : activated	**Encoder communication fault detection** **0** : deactivated **1** : activated	**Datalogging** **00** : deactivated **01** : time steps mngt **10** : once a week mngt **11** : once a month mngt		**Ports management** **00** : one Port (A) **01** :2 Ports (A & B)	

4.3.3. Alarm Configuration

"Alarm Configuration" parameter is used to enable automatically alarm transmission on fault or other anomaly independently.
Some internals features can be associated to an alarm configuration bit. To be sure that the Alarm frame will be sent after fault or problem detection, the user must take care that the corresponding ***"Operating Mode"*** bit is correctly set.
In case of manual network installation, Some other important information have to be configured in **RTM Elster AMCO** such as the path to reach the root of the network.

- ***RTM Elster AMCO pulse***

Alarm Configuration (internal parameter ID = 0x58)								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	Not used	Not used	Not used	Not used	High threshold (Extreme leak)	Low threshold (Residual leak)	Low Battery Warning	Cut cable
Pulse profile	**0**	**0**	**0**	**0**	**X**	**X**	**X**	**X**

***0** : alarm frames disabled*
***1** : alarm frames enabled*

- ***RTM Elster AMCO encoder***

Alarm Configuration (internal parameter ID = 0x58)								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	Not used	Not used	Back flow	Encoder misread	High threshold (Extreme leak)	Low threshold (Residual leak)	Low Battery Warning	Encoder communication failure
Encoder profile	**0**	**0**	**X**	**X**	**X**	**X**	**X**	**X**

***0** : alarm frames disabled*
***1** : alarm frames enabled*

ATTENTION :

*When RTM Elster AMCO is programmed to send information periodically using Pseudo bubble up feature, enabling alarm frames is not recommended. Indeed, in such a case alarm frame management can generate collisions on the radio medium . However, information returned in pseudo bubble up mode include **RTM Elster AMCO** Status bytes (Application Status & Leakage Detection Status) allowing the user software to monitor default detection on the **RTM** without any other necessary radio exchange.*

4.3.4.Application Status

" Application Status" parameter give at any time **RTM Elster AMCO** fault, or consumption-rate, status.

Each **RTM Elster AMCO** internal feature that can be activated or deactivated through its corresponding bit in ***"Operating Mode"*** has an associated status bit in ***"Application status"*** parameter.

User has to reset each bit by writing the **"*Application Status"*** parameter once the default has been handled. If a fault detection is not handled properly the corresponding bit in **"*Application Status"*** parameter will be set once again.

- ***RTM Elster AMCO pulse***

Application Status (internal parameter ID = 0x01)								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	Leak detection (extreme or residual)	Not used	Not used	Tamper detection on Port D	Tamper detection on Port C	Tamper detection on Port B	Tamper detection on Port A	Low Battery Warning
Pulse profile	**X**	**0**	**0**	**X**	**X**	**X**	**X**	**X**

*The coding is as follows : **0** : not detected*
***1** : detected*

- ***RTM Elster AMCO encoder***

Application Status (internal parameter ID = 0x01)								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	Leak detection (extreme or residual)	Back flow detection on Port B	Back flow detection on Port A	Encoder misread detection on Port B	Encoder misread detection on Port A	Encoder communication fault detection on Port B	Encoder communication fault detection on Port A	Low Battery Warning
encoder profile	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

*The coding is as follows : **0** : not detected*
***1** : detected*

4.3.5.Leakage Detection Status

This control byte is used to detect leakage in real time. Indeed, each bit is set to one when a leakage is detected and reset to zero automatically when it ended. This information can be read by the standard read parameter command. This parameter is in read access only.

- ***RTM Elster AMCO pulse***

Leakage Detection Status (internal parameter ID = 0x02)								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	High threshold (extreme leak) Port D	Low threshold (residual leak) Port D	High threshold (extreme leak) Port C	Low threshold (residual leak) Port C	High threshold (extreme leak) Port B	Low threshold (residual leak) Port B	High threshold (extreme leak) Port A	Low threshold (residual leak) Port A
Pulse profile	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

*The coding is as follows : **0** -> not detected*
***1** -> detected*

- ***RTM Elster AMCO encoder***

Leakage Detection Status (internal parameter ID = 0x02)								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	Not used	Not used	Not used	Not used	High threshold (extreme leak) Port B	Low threshold (residual leak) Port B	High threshold (extreme leak) Port A	Low threshold (residual leak) Port A
encoder profile	**0**	**0**	**0**	**0**	**X**	**X**	**X**	**X**

*The coding is as follows : **0** -> not detected*
***1** -> detected*

4.4.Writing RTC parameter

RTM Elster AMCO RTC can be updated using ***"Write Parameter"*** command.

RTC Structure :

RTC (internal parameter ID = 0x04)						
Day	**Month**	**Year (1)**	**Day of the week (2)**	**Hour**	**Minute**	**Seconds**
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

(1) *Year = 0x00 means that the current year is 2000*

(2) *Day of the week : value from 0 to 6:*

Day of Week	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
Value	0	1	2	3	4	5	6

ATTENTION :

1) *When configured in Fixed Network Mode, and when synchronized on the network, **RTM Elster AMCO** RTC is updated automatically through Radio Synchronization mechanism. In this case, it is not allowed to update RTC from the user software because it can disturb the Pseudo Bubble Up emission sequence.*
2) *When configured in Fixed Network Mode, **RTM Elster AMCO** Clock Synchronization accuracy is maintained below 2 seconds thanks to Coronis Synchronization scheme. When configured in Drive By (or Walk By) Mode, Clock drift is defined by the 32kHz used as a reference for **RTM Elster AMCO**. To reduce this clock drift, **RTM Elster AMCO** 32kHz reference clock is calibrated in manufacturing stage and an embedded feature will balance the clock temperature drift.*
3) *It is not advised to switch the network RTC from winter to summer time and conversely since it could have a transient impact on Pseudo Bubble Up emission sequence, Datalogging accuracy, TOU Buckets accuracy, and all applicative periodic events that could happen on **RTM Elster AMCO**.*
4) *Writing RTC parameter on an unsynchronized RTM will automatically deactivate the TOU Buckets functionnality*

4.5.Meter reading sampling period configuration

Several **RTM Elster AMCO** embedded features (datalogging in time steps, leakage detection, back flow detection) are based on periodic reading management. So, in order to synchronize these features **RTM Elster AMCO** offers the possibility to program a kind of *"Meter Reading Sampling Period"* principle that is shared between the features listed above in parenthesis.

4.5.1.Reading sampling period parameter

- ***For both RTM Elster AMCO profile (pulse or encoder)***

Reading sampling period (internal parameter ID = 0x07)							
Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
[b7:b2] : Sampling period expressed in time units minimum : once a minute maximum : 63 times 30 minutes = 31 h 30 min **[B7..B2] cannot be set to zero !**						**[b1:b0] : time unit** **00** : 1 minute **01** : 5 minutes **10** : 15 minutes **11** : 30 minutes	

ATTENTION :

1) *Meter sampling reading management starts only on associated feature activation (datalogging in time steps, back flow or leakage detection). This allows to avoid power consumption (especially when encoder profile is selected) while no periodic sampling is necessary. Once one of this associated feature is activated, the sampling will start on nex hour "on the dot".*
2) *Each meter reading sampling period parameter modification must be followed by a user initialization of all the associated features (datalogging in time steps, back flow or leakage detection).*

4.5.2.Sampling activation type parameter

- ***For both RTM Elster AMCO profile (pulse or encoder)***

Sampling activation type (internal parameter ID = 0x08)								
Bit Number	*Bit 7 (MSB)*	*bit 6*	*bit 5*	*bit 4*	*bit 3*	*bit 2*	*bit 1*	*Bit 0 (LSB)*
Bit Definition	Not used	Not used	Not used	Not used	Not used	Not used	**00 : Immediate Start** **01 : Start on next hour "on the dot"** **10 : Not used** **11 : Not used**	

This parameter allows to program the way the user wants the **RTM Elster AMCO** to start reading sampling mechanism on associated feature activation.

- **Immediate Start**: using this activation type, user wants the **RTM Elster AMCO** to start the meter reading sampling immediately after associated feature activation (datalogging in time steps, back flow, or leakage detection).
- **Start on next hour on the dot:** using this activation type, user wants the **RTM Elster AMCO** to start the meter reading sampling on next hour on the dot after associated feature activation (datalogging in time steps, back flow, or leakage detection).

ELIMINATED

ATTENTION:
*If the user wants the meter reading sampling to be synchronized on each **RTM Elster AMCO** which is part of a Fixed Network System, it is advised to use **"start on next hour on the dot"** since RTC in each RTM is updated automatically through radio synchronization mechanism.*

5.RTM Elster AMCO functionalities

5.1.Fixed Network/Walk By/ Drive By switching method

(Refers to DR[5] Section 1.0.1)

According to **§4.3.2** *(Operating mode parameter description)*, **RTM Elster AMCO** is able to operate in “Fixed” network, “Walk By”, and “Drive By” installations. The operation in “Walk By” and “Drive By” is exactly the same.

RTM Elster AMCO operating in “Fixed” network mode just needs a setting command coming from a hand-held computer to switch in “Drive By” mode operation. Conversely, once operating in “Drive By” (or in “Walk By”), only a new setting command is required to make it switching in “Fixed” Network mode operation.

5.2.Datalogging management

(Refers to DR[3] Section 1.0.16 and 1.0.21; DR[4,5] Section 1.0.15 and 1.0.18)

The datalogging mode enables periodic logging of meter readings for each Port. The frequency of these readings can be set in three different ways :

- data logging in time steps (selectable from 1 minute to 31 ½ hours),
- data logging once a week (day and hour of the day selectable),
- data logging once a month(date* and hour of the day selectable).

**when datalogging once a month is selected, date can be selected from the 1st to the 28th of each month.*

Datalogging feature allows to store up to :

- 2100 readings when one Port is connected,
- 1050 readings when two Ports are connected,
- 700 readings when three Ports are connected,
- 525 readings when four Ports are connected.

Each Port has its own datalogging table. When the storage table is full, most recent logs overwrite oldest ones.
Each time the datalogging settings are modified, storage tables are reset.

Datalogging table structure for one Port (A) connected:

RTC value on last logged reading	Last logged reading on Port A Log 0	Last but one logged reading on Port A Log 1	Port A Log 2	Port A Log 3	...	Port A Log n-1	First log Port A Log (n-1)
7 bytes	4 bytes	4 bytes	4 bytes	4 bytes		4 bytes	4 bytes
	2100 logged readings maximum whatever the number of Ports connected						

n= 2100 readings max.

Datalogging table structure for two Ports (A & B) connected:

RTC value on last logged readings on each Port	Last logged reading on Port A Log 0	...	Port A Log (m-2)	Port A Log (m-1)	Last logged reading on Port B Log 0	...	Port B Log (m-2)	Port B Log (m-1)
7 bytes	4 bytes			4 bytes	4 bytes		4 bytes	4 bytes
	2100 logged readings maximum whatever the number of Ports connected							

m= 1050 readings max.

Depending on the number of Ports configured, **RTM Elster AMCO** knows exactly where to store each Port readings, and so, where to recover them. This is done thanks to a pointer on the table and dynamic offsets, depending on the number of Ports configured in the **RTM Elster AMCO**.

ATTENTION :

*Only the last logged reading is time stamped. It is necessary to know the datalogging configuration to compute others logged reading time stamps. That's why **RTM Elster AMCO** sends back datalogging configuration every time a request to return logged reading is addressed to it.*

5.2.1.Datalogging parameters access

The table below gives the list of parameters used for datalogging initialization.

N°	Description	Size in bytes	Access Right (Pulse Profile)	Access Right (encoder Profile)	Default value (Hexa)	Restriction on parameters
Datalogging feature parameters						
0x07	Reading Sampling Period	1	R/W	R/W	**0x0B**	-
0x08	Sampling activation type	1	R/W	R/W	**0x01**	**0x01 only**
0x10	Measurement Period (datalogging in time steps) expressed in multiple of *"Reading Sampling Period"*	1	R/W	R/W	**0x01**	-
0x12	Day of the week, or of the month (datalogging)	1	R/W	R/W	**0x01**	Conform day needed
0x13	Hour of measurement (datalogging once a week, or once a month)	1	R/W	R/W	**0x08**	Conform hour needed
0x14	number of records in the datalogging table (all ports records cumulated)	2	R	R	**0x0000**	Read only

5.2.2.Datalogging mode activation

Datalogging mode is activated (or deactivated) by setting bits 3 and 4 in ***"Operating Mode"*** parameter.

ATTENTION :

Stopping then restarting the datalogging mode implies the re-initialization of the storage table. In this case, all the logged readings will be lost.

It is advised to configure and activate the datalogging at the same time (with a single radio frame).

How to manage datalogging feature in RTM Elster AMCO "Operating Mode" parameter ?

- ***Writing request data format with only operating mode***

Applicative command	*Operating Mode*	*Mask on Operating Mode (indicate the bits that must be updated)*	*Number of param to write*
1 byte	2 bytes	2 bytes	1 byte
0x19	'0000000000000**00**00' : deactivate '0000000000000**01**00' : time steps '0000000000000**10**00' : once a week '0000000000000**11**00' : once a month	'0000000000000**11**00' (0x000**C**) Mask value to write only the Datalogging Field in Operating Mode	0x00

5.2.3.Datalogging in time steps

This type of datalogging is used to log the readings for each port at periods ranging from one minute to over thirty hours.

Parameter :

- **measurement period of the datalogging in time steps :** expressed as a multiple of the reading sampling period (parameter 0x07). *(from 1 minute to 31h30minutes)*

5.2.4.Datalogging once a week

This type of datalogging is used to log the readings for each Port once a week. The time, and day of the week, logging is carried out, may be set with a parameter.

Parameters :

- **Time of measurement (datalogging once a week) :** this parameter allows to synchronize the periodic measurement on **RTM Elster AMCO** RTC. It is expressed in multiple of hour, and its value must be set from 0 to 23.

- **Day of the week (datalogging once a week) :** this parameter allows to select the day of week according to the table below.

Value	Day of the week
0	Sunday
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday

5.2.5.Datalogging once a month

This type of datalogging is used to log the readings for each Port once a month. The time and day (from 1 to 28) logging is carried out may be set with a parameter.

Parameters :

- **Time of measurement (datalogging once a month) :** this parameter allows to synchronize the periodic measurement. It is expressed in multiple of hour, and its value must set from 0 to 23.

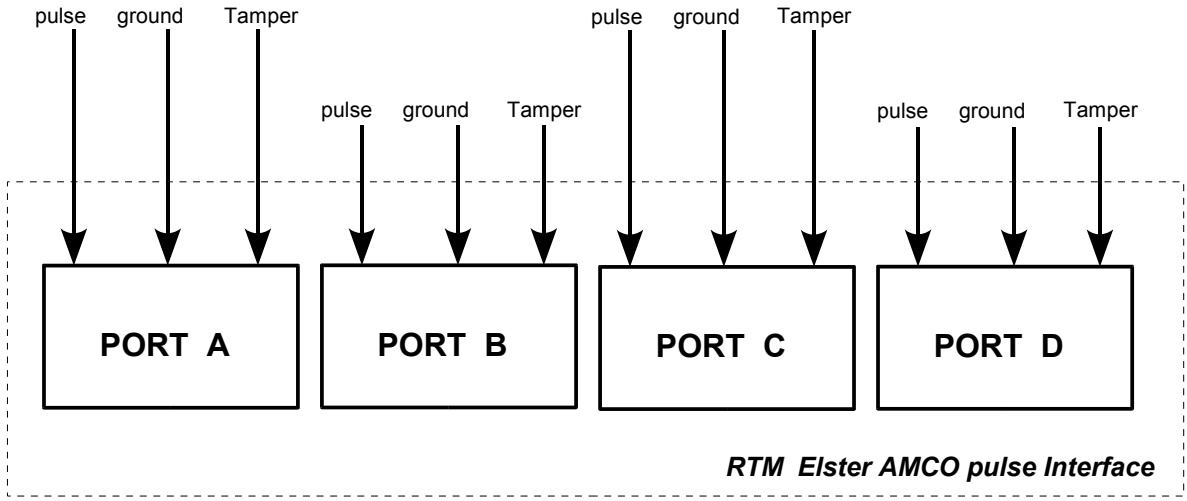
- **Day of the month (datalogging once a month) :** the format is different from the datalogging once a week. Indeed, the day of measurement is set from 1 to 28. And, the system does not manage changes in the number of days depending on the month (day of the month setting cannot exceed the 28th).

5.3.RTM-Register interface

(Refers to DR[3] Section 1.0.17 to 1.0.19; DR[4,5] Section 1.0.16 and 1.0.17)

RTM Elster AMCO radio module is able to manage up to four Ports connected to pulse registers or up to two Ports connected to encoders.
Register interface selection (pulse or encoder) is made by parameter configuration. So, there is only one embedded software reference to manage. Nevertheless, the wiring connections on the PCB are different between pulse and encoder interface. So, this means that Elster AMCO will have to manage two hardware references. One for pulse registers interface and the second for encoder interface.

5.3.1.Pulse register three wire interface



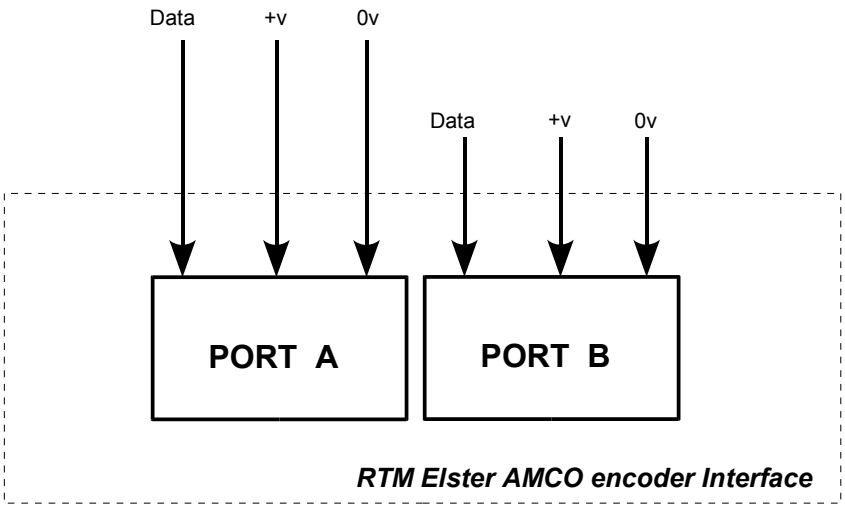
RTM Elster AMCO pulse profile list :

- **RTM – 1 to 4 ports** : Ports *A to D are used for measurement of pulses coming from pulse registers.*

Note:

Since wiring connections on PCB are different between pulse and encoder RTM, the profile configuration has to be made by Coronis during manufacturing stage. Depending on the product reference ordered by Elster AMCO, Coronis needs to manage each specific wiring and profile configuration at the same time to avoid problems in the field during installation. Two different product references will be managed depending on the expected register to connect (Pulse register or Encoder).

5.3.2.Encoder three wire interface



Encoder compatibility list :

RTM Elster AMCO first release is compatible with the encoders below :

- Elster AMCO Scancoder
  - Specs : 6170 M 1009
- Elster AMCO Invision 11Class
  - Specs : 6170 m 1042
- Elster AMCO Invision 21Class
  - Specs : 6170 Q 0009
- SENSUS ECR II and III encoders:
  - Specs : ui1203r19.pdf
  - V frame R field supported only,

A future release of **RTM Elster AMCO**, with no additional development fee to pay on Elster AMCO side, will have to manage additional encoders that are listed below :

- NEPTUNE Pro E49N, ARB V, eCoder,
- BADGER RTR, ADE,
- HERSEY Translator.

RTM Elster AMCO encoder profile list :

- **RTM – Single or Dual Port(s)** **:** Ports *A & B are used for encoders reading.*

Note:

Since wiring connections on PCB are different between pulse and encoder RTM, the profile configuration has to be made by Coronis during manufacturing stage. Depending on the product reference ordered by Elster AMCO, Coronis needs to manage each specific wiring and profile configuration at the same time to avoid problems in the field during installation. Two different product references will be managed depending on the expected register to connect (Pulse register or Encoder).

5.4.RTM-register pairing

5.4.1.Programming current register reading (pulse register only)

This feature allows to initialize the current reading of each Port.

RTM Elster AMCO measures, and count pulses coming from the pulse register. It is thus necessary to establish the link between the reading of the meter given in volume unit (gallon, for example), and **RTM Elster AMCO** current reading accessible through radio link.

Example : *if the water meter indicates 1000 gallons.*

- if the pulse register is from type ***k = 1*** *(1 pulse per gallon)*
1000 pulses represent 1000 gallons, so the value to be programmed into the RTM current reading will be 1000.

- if the pulse register is from type ***k = 10*** *(1 pulse per 10 gallons)*
100 pulses represent 1000 gallons, so the value to be programmed into the RTM current reading will be 100.

- if the pulse register is from type ***k = 100*** *(1 pulse per 100 gallons)*
10 pulses represent 1000 gallons, so the value to be programmed into the RTM current reading will be 10.

- ***Request data format***

Applicative command	*Writing type*	*Current reading A*	*Current reading B*	*Current reading C*	*Current reading D*
1 byte	1 byte	4 bytes (MSB first)	4 bytes (MSB first)	4 bytes (MSB first)	4 bytes (MSB first)
0x02	(*)				

(*)***Writing type :*** *indicates which current readings have to be written or not.*

Writing type byte							
b7	*b6*	*b5*	*b4*	*b3*	*b2*	*b1*	*b0*
Not used	Not used	Not used	Not used	**Port D** 0: skip 1: write	**Port C** 0: skip 1: write	**Port B** 0: skip 1: write	**Port A** 0: skip 1: write

- ***Response data format***

Applicative acknowledgment command	*Writing status*
1 byte	1 byte
0x82	**0x00** : writing OK **0xFF** : writing error

5.4.2.Programming pulse value (pulse register only)

In order to know through a radio command the pulse value of the meter connected to the **RTM Elster AMCO**, specific parameters for each Port allows to store the corresponding pulse value.

The pulse value is used to convert the water consumption read in number of pulses, in volume unit (gallon for example).

RTM Elster AMCO provides up to 4 parameters to store the pulse value of each wired water meter.

ATTENTION:
*the pulse value will only be stored for informative purpose. **RTM Elster AMCO** does not use it to convert automatically the readings. Because of the wide range of pulse value, all operations are processed in number of pulses, it is up to the user software to convert the information in volume unit.*

Applicative command	*Associated internal parameters*	*Description*
0x18	0x19 ; 0x1A ; 0x1B ; 0x1C	Request to read the pulse value parameters
0x98	0x19 ; 0x1A ; 0x1B ; 0x1C	pulse value reading response
0x19	0x19 ; 0x1A ; 0x1B ; 0x1C	Request to set the pulse value
0x99	0x19 ; 0x1A ; 0x1B ; 0x1C	pulse value configuration acknowledgment

The pulse value parameters are reached by standard reading, and writing parameters commands (*described in **§4.2.***).

- **0x19** *pulse value on Port A,*
- **0x1A** *pulse value on Port B,*
- **0x1B** *pulse value on Port C,*
- **0x1C** *pulse value on Port D.*

5.4.3.Definition of the pulse value parameters

MSB							***LSB***
b7	***b6***	***b5***	***b4***	***b3***	***b2***	***b1***	***b0***
Volume Unit				**pulse value**			

- ***pulse value :*** The range is from 1 to 15. ZERO value will be rejected.
- ***Volume Unit :*** this unit is **U** (where **U** is the value contained in bits ***[b7:b4]***.
  In order to standardize the information, the minimum unit is the liter.

The table below gives the different possible unit:

Unit used (hexadecimal) [b7:b4]	*Unit*
0	liters
1	kilo-liters
2	US gallons
3	US gallons x 1000
4	Imperial gallons
5	cubic feet x 100
6	cubic meters
7	cubic meters x10
8	cubic meters x 100
9 to F	Reserved for future use

5.4.4.Programming meter model (pulse register only)

"meter model" parameters gives an indication on the digital register type connected on each Port. It can be initialized during *"RTM-Register pairing"* phase but it is not mandatory. Default value is 0 and corresponds to unknown type. This field is just for informative purpose.

Applicative command	*Associated internal parameters*	*Description*
0x18	0x15 ; 0x16 ; 0x17 ; 0x18	Request to read the meter model parameters
0x98	0x15 ; 0x16 ; 0x17 ; 0x18	Meter model reading response
0x19	0x15 ; 0x16 ; 0x17 ; 0x18	Request to program the meter model
0x99	0x15 ; 0x16 ; 0x17 ; 0x18	Meter model programming acknowledgment

"meter model" parameters are reached by standard reading, and writing parameters commands (*described in **§4.2.***).

- **0x15** *meter model on Port A,*
- **0x16** *meter model on Port B,*
- **0x17** *meter model on Port C,*
- **0x18** *meter model on Port D.*

The table below gives the correspondence between the meter type parameter value and the physical digital register connected:

Meter type value	*Corresponding Meter model*
0x00	Unknown (default)
0x01	TBD by Elster AMCO (ex : C700 5/8”)
0x02	TBD by Elster AMCO (ex : C700 1”)
0x03	TBD by Elster AMCO (ex : C700 1.5”)
0x04	TBD by Elster AMCO (ex : C700 2”)
0x05	TBD by Elster AMCO
0x06	TBD by Elster AMCO
0x07	TBD by Elster AMCO
0x08	TBD by Elster AMCO
...	TBD by Elster AMCO

ATTENTION:
the meter model will only be given for informative purpose. ***RTM Elster AMCO*** *does not use it. This parameter could be useful for user software to ensure proper register reading interpretation for billing purposes for example. It's up to user software to define the correspondence between meter model parameter value and digital register type connected.*

5.4.5.Encoder model detection

(Refers to DR[3] Section 1.0.17; DR[4,5] Section 1.0.16)

RTM Elster AMCO embeds a feature allowing to recognize the encoder model connected.
This feature is performed either when profile selection parameter is programmed with encoder profile value, or using a dedicated radio command.
RTM Elster AMCO run all encoders drivers and recognizes the connected encoders models.
Once the initialization is completed, **RTM Elster AMCO** sends back to the command initiator the encoder model.

Note :
This command has to be performed once the RTM is connected to the encoder, either in the field during installation phase or during manufacturing phase of the RTM.

- ***Request data format***

Applicative command
1 byte
0x0C

- ***Response data format***

The total length is 7 Bytes

Applicative acknowledgment command	*Status Encoder A*	*Encoder A model*	*Status Encoder B*	**Encoder B model**
1 byte	1 byte	2 bytes	1 byte	2 byte
0x8C	0x00 = OK 0xFF = sensor error	**(1)**	0x00 = OK 0xFF = sensor error	

(1) : Encoder model description:

Encoder model is 2 bytes long with the **MSByte** indicating the encoder manufacturer (ELSTER or SENSUS) and the **LSByte** indicating the encoder model (example: Scancoder or Invision for Elster AMCO) and this value takes different meaning depending on the brand.

The table below describes the different encoder models written in field "Encoder model":

Manufacturer	**Elster AMCO**	**SENSUS**
Encoder Manufacturer **(MSB)**	0x01	0x02
Adapter Code **(LSB)**	0x00 (Scan_Coder) 010 (Dual Scan) 0x2x (Multi Scan) 0x30 (Q100) 0x40 (Scan_Counter) 0x50 (Aqua Master) 0x60 (Invision 11C) 0x70.(Invision 21C)	MANUFACTURER_ID (First byte of the serial code)

Encoder model is then stored in an internal parameter which is in read access only.

Applicative command	*Associated internal parameters*	*Description*
0x18	0x1D ; 0x1E	Request to read the encoder model parameters
0x98	0x1D ; 0x1E	Encoder model reading response

"encoder model" parameters are accessible by standard reading parameters command (*described in* ***§4.2.***).

- **0x1D** *encoder model on Port A,*
- **0x1E** *encoder model on Port B,*

5.4.6.Encoder Unit (Encoder register only)

Each encoder embeds its unit in an internal parameter and the **RTM Elster AMCO** reads out this information after encoder model detection. It stores the unit inside a *read only parameter.*
The unit parameter contains two important information that are the position of the decimal point and the unit.

ATTENTION:
the unit value will only be given for informative purpose. RTM Elster AMCO does not convert the current unit to a standard GALLON unit and all operations are processed without taking into account the unit and the decimal point position, it is up to the user software to convert the information in desired unit.

Applicative command	*Associated internal parameters*	*Description*
0x18	0x1F ; 0x20	Request to read the unit parameters
0x98	0x1F ; 0x20	Encoder Unit reading response

The **MSByte** indicates the unit.
The **LSByte** indicates the number of digits **before** the decimal point.
Default value is assigned to 0xFFFF.

The table below gives the different possible unit (MSB byte) :

MSB unit value (hexadecimal)	Unit definition	Elster AMCO encoder	SENSUS encoder
0x01	Cubic meters (m^3)	X	X
0x11	Cubic meters * 10	X	
0x21	Cubic meters * 100	X	
0x02	US Gallons * 1000	X	
0x03	Imperial gallons	X	X
0x04	liters	X	X
0x05	Cubic feet * 100	X	
0x06	US gallons	X	X
0x07	-"K" Multiplier (*1000)	X	
0x08	Kilo liters	X	X
0x30	Cubic feet		X
0x31	Cubic Inches		X
0x32	Cubic Yards		X
0x33	Acre feet		X
TBD	**TBD**	**TBD**	**TBD**

5.4.7.Reading encoder internal data (Encoder only)

This feature allows to access directly to the information returned by the encoder(s) connected to **RTM Elster AMCO**.

ATTENTION:
Data returned could be different according to the encoder model connected.

- ***Reading encoder internal data request data format***

Applicative command
1 byte
0x0B

- ***Reading encoder internal data acknowledgment data format***

The total length depends on encoder returned data length

Applicative acknowledgment command	*Encoder model on Port A*	*Encoder model on Port B*	*Size of the returned data on Port A*	*Size of the returned data on Port B*	*Encoder data different according to encoder connected on Port A*	*Encoder data different according to encoder connected on Port B*
1 byte	2 bytes	2 bytes	1 byte	1 byte	N bytes	N bytes
0x8B	0xFFFF if no encoder connected	0xFFFF if no encoder connected	0x00 if no encoder connected	0x00 if no encoder connected	**(*)**	**(*)**

(*) Information returned by encoders: if any problem occurred during the communication with the encoder, then the information returned in the encoder data field is set to 0xFF *(N= 1 byte)*.

"Encoder data" returned in case of Elster AMCO encoder connected (N = 29 bytes) :

Information	*Size (in bytes)*	*Description*
AMCO/ELSTER company identifier	1	0x4B
Value of meter wheels	6	Provide the meter value in ASCII characters
User serial number	10	10 ASCII characters
Registration units code	2	registration units
Encoded wheel digits	1	4,5 or 6 active digits
Digits before decimal point	1	Counted from the first "V" digit (most significant) Example: if d=4 & VVVVVV = 654321 then the value = 6573.21
Option	2	Indicates major software version
Manufacture adapter code	2	Example : **0x3730** = "Invision 21C"
Error code	2	
Checksum	2	

5.5.RTM reading management

(Refers to DR[3] Section 1.0.22; DR[4,5] Section 1.0.19)

RTM Elster AMCO offers the possibility to recover different types of readings listed below:

- Current reading,
- Daily consumption profile readings,
- Datalogging table,
- TOU buckets.

These different way to recover reading from **RTM Elster AMCO** are described in details in this section. Furthermore, **RTM Elster AMCO** sends back on each of these requests, control information formatted as a generic header described below. This one is useful to manage network supervision.

5.5.1.Generic header structure

The total length of the generic header is 23 Bytes

Profile Selection (1)	*Operating mode*	*Application Status*	*Leakage Detection Status*	*current RTC*	*QoS (2)*	*Life counter (3)*	*Meters/Encoders connected information (4)*
1 byte	2 bytes	1 byte	1 byte	7 bytes	1 byte	2 bytes	8 bytes

(1) *"Profile selection"* parameter is useful to inform the user software on current profile selected on **RTM Elster AMCO**. Indeed, user software needs to use this parameter to be able to handle correctly the data received format.

(2) The **QoS** value gives an image of the previous radio reception signal strength.

(3) The *"life counter"* value gives an estimated quantity of energy that remains in **RTM Elster AMCO** battery. User software has to take into account the default value of this counter to compute an estimated remaining lifetime.

(4) This field has different meaning and format depending on **RTM Elster AMCO** profile selected:

	Byte 1	*Byte 2*	*Byte 3*	*Byte 4*	*Byte 5*	*Byte 6*	*Byte 7*	*Byte 8*
pulse profile	pulse value Port A	pulse value Port B	pulse value Port C	pulse value Port D	Meter model on Port A	Meter model on Port B	Meter model on Port C	Meter model on Port D
Encoder profile	Encoder unit on Port A		Encoder unit on Port B		Encoder model on Port A		Encoder model on Port B	

5.5.2.Current register reading

When current index reading is expected, **RTM Elster AMCO** sends back through a radio frame the current readings on each Port connected. If a Port has no meter connected to it, then the corresponding current reading is set to 0x7FFFFFFF.

- ***Request data format***

Applicative command
1 byte
0x01

- ***Response data format (pulse registers connected)***

The total length is 40 Bytes

Applicative acknowledgment command	*Generic Header*	*Current reading Port A*	*Current reading Port B*	*Current reading Port C*	*Current reading Port D*
0x81	23 bytes	4 bytes (MSB first)	4 bytes (MSB first)	4 bytes (MSB first) **(1)**	4 bytes (MSB first) **(1)**

- ***Response data format (encoders connected)***

The total length is 32 Bytes

Applicative acknowledgment command	*Generic Header*	*Current Reading on Port A*	*Current Reading on Port B*
0x81	23 bytes	4 bytes (MSB first)	4 bytes (MSB first)

5.5.3.Daily consumption profile reading

Daily consumption profile reading request allows to recover:

- generic header,
- current readings,
- logged readings 4th, 8th, 12th, 16th, and 20th positions in the datalogging table (if datalogging is set).

ATTENTION:
Daily consumption profile is accurate only when datalogging every hour is programmed. All other datalogging configuration will not provide daily information using this particular command.

- ***Request data format***

Applicative command
1 byte
0x03

- ***Response data format***

The total length for 1 Port managed is 62 Bytes
The total length for 2 Ports managed is 86 Bytes
The total length for 3 Ports managed is 110 Bytes
The total length for 4 Ports managed is 134 Bytes

Applicative acknowledgment command	*Generic Header*	*RTC on last logged reading*	*Datalogging Parameters*	*Current readings area*	*4th, 8th, 12th, 16th, 20th, position logged readings area*
0x83	23 bytes	7 bytes	7 bytes **(See section §5.2.1 for field description)**	Variable **(2)**	Variable **(2)**

(1) *Datalogging parameters field:*

	Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**
Parameter ID	**0x07**	**0x08**	**0x10**	**0x12**	**0x13**	**0x14**	
Parameter description	Reading Sampling Period	Sampling activation type	Measurement Period (datalogging in time steps)	Day of the week, or of the month (datalogging)	Hour of measurement (datalogging once a week, or once a month)	number of records in the datalogging table (all ports records cumulated)	

(2) format and size of the fields *"current readings area"*, *"4th, 8th, 12th, 16th, 20th, position logged readings area"* depend on the number of ports managed. The tables below describes the format and the size of these fields.

- ***Pulse profile selected***

Number of Ports	*Current readings area (byte order : [Bxx..B0])*	*4th, 8th, 12th, 16th, 20th, position logged readings area (byte order : [Bxx..B0])*
1	Size : 4 bytes **[B3:B0]** : current reading on Port A	Size : 20 bytes **[B19:B0]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port A
2	Size : 8 bytes **[B7:B4]** : current reading on Port A **[B3:B0]** : current reading on Port B	Size : 40 bytes **[B39:B20]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port A **[B19:B0]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port B
3	Size : 12 bytes **[B11:B8]** : current reading on Port A **[B7:B4]** : current reading on Port B **[B3:B0]** : current reading on Port C	Size : 60 bytes **[B59:B40]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port A **[B39:B20]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port B **[B19:B0]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port C
4	Size : 16 bytes **[B15:B12]** : current reading on Port A **[B11:B8]** : current reading on Port B **[B7:B4]** : current reading on Port C **[B3:B0]** : current reading on Port D	Size : 80 bytes **[B79:B60]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port A **[B59:B40]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port B **[B39:B20]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port C **[B19:B0]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port D

- ***Encoder profile selected***

Number of Ports	*Current readings area (byte order : [Bxx..B0])*	*4th, 8th, 12th, 16th, 20th position logged readings area (byte order : [Bxx..B0])*
1	Size : 4 bytes **[B3:B0]** : Current reading on Port A	Size : 20 bytes **[B19:B0]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port A
2	Size : 8 bytes **[B7:B4]** : Current reading on Port A **[B3:B0]** : Current reading on Port B	Size : 40 bytes **[B39:B20]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port A **[B19:B0]** : 4th, 8th, 12th, 16th, 20th, logged readings on Port B

5.5.4.Datalogging table reading

First of all, it is important to note that only the last logged reading is time stamped. So, CORONIS advises to read datalogging table from the last logged reading in order to be able to compute the time stamp of each log.

- ***Request data format***

Applicative command	*Requested ports logged readings*	*Expected Logged Readings by Port*	*Offset in records table*
1 byte	1 byte	2 bytes (MSB first)	2 bytes
0x07	(*)		**0** : request to read datalogging table from the most recent logged reading **n** : request to read datalogging table from the most recent logged reading **+ n**.

(*)***Requested index :*** *indicates which logging table is expected,*

Requested ports logged readings							
b7	*b6*	*b5*	*b4*	*b3*	*b2*	*b1*	*b0*
Not used	Not used	Not used	Not used	**Port D readings** **0**: skip **1**: requested	**Port C readings** **0**: skip **1**: requested	**Port B readings** **0**: skip **1**: requested	**Port A readings** **0**: skip **1**: requested

- ***Response data format***

If the amount of logs requested is too large to be returned with a single radio frame, **RTM Elster AMCO** automatically uses *"CORONIS multiframe"* process, which is useful to decrease consumption and response time. This process successively transmits several frames containing the recordings from the most recent to the oldest one.

- ***First frame applicative data format***

Applicative acknowledgment command	*Generic header*	*Datalogging Parameters*	*RTC on last logged reading*	*Frame counter*	*Data zone*
1 byte	23 bytes	7 bytes	7 bytes	1 byte	Variable
0x87		**(See section §5.2.1 for field description)**		**n**	(*)

(1) Frame counter starts with the number of frame that will be transmitted : ***n***

- ***Next frame applicative data format***

Acknowledgment command	*Frame counter (decreased on each frame)*	*Data zone*
1 byte	1 byte	Variable
0x87	**m (< n)**	(*)

- ***Last frame applicative data format***

Acknowledgment command	*Frame counter (decreased on each frame)*	*Data zone*
1 byte	1 byte	Variable
0x87	**0x01**	(*)

(*) Data zone description

Data zone							
Port A number of logged reading in frame (**J** logs)	Port B number of logged reading in frame (**K** logs)	Port C number of logged reading in frame (**M** logs) **(1)**	Port D number of logged reading in frame (**N** logs) **(1)**	**J** logs of Port A from the most recent requested to the oldest one	**K** logs of Port B from the most recent requested to the oldest one	**M** logs of Port C from the most recent requested to the oldest one **(1)**	**N** logs of Port D from the most recent requested to the oldest one **(1)**
1 bytes	1 bytes	1 bytes	1 bytes	(J x 4) bytes	(K x 4) bytes	(M x 4) bytes	(N x 4) bytes

(1) *Always equal to zero when encoder profile is selected.*

Note:

When the number of requested logged reading is higher than the number of reading effectively logged, then **RTM Elster AMCO** returns the whole datalogging table.
This behavior is always true excepted in case of “Drive By/Walk By” mode, in this case only 36 logged readings per port can be read out.

When datalogging reading request is not conform the response frame has the following format:

Applicative acknowledgment command	*Generic header*	*Error code*
1 byte	23 bytes	1 byte
0x87		**0xFF**

Maximum number of logged reading per Port depending on Frame position:

Frame Position	Number of Ports configured	maximum logged reading
First Frame	4 Ports	**6**
	3 Ports	**8**
	2 Ports	**12**
	1 Port	**24**
Following Frames	4 Ports	**9**
	3 Ports	**12**
	2 Ports	**18**
	1 Port	**32**

ATTENTION:

1) *When RTM Elster AMCO is programmed in Fixed Network mode operation and datalogging reading in pseudo bubble-up is parametrized, it is advised to use the table above to select the appropriate number of expected logged reading per port. Indeed, if the number of expected logged reading is too large and so multiframe radio process is used, the behavior of the pseudo bubble-up mechanism in the whole network will be affected and will lead to a loss of information coming from th RTM.*
2) *When RTM Elster AMCO is configured in Drive By / Walk By mode, Datalogging table reading is limited to the last 36 logs per port.*

5.5.5.Time Of Use (TOU) buckets configuration and readings

RTM Elster AMCO offers the possibility to manage up to 6 TOU buckets. This means that each port has 7 totalizers, one for current reading and the 6 others corresponding to TOU Buckets.

ATTENTION:
Activating TOU Buckets on an unsynchronized RTM is not recommended. Indeed, this feature highly depends on RTM RTC parameter which is automatically updated only when the RTM is synchronized.

➔ **TOU Buckets configuration**

The parametrization can be done by using the standard reading and writing command (**See section §4.2**). The parameter to read or write is the parameter 0x60.

Param ID	Description	Size (in bytes)
0x60	TOU buckets configuration parameter	7

Description of the 7 bytes of the TOU buckets parameter:

TOU buckets configuration parameter						
Byte 1	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**
Number of TOU buckets	Start hour of the 1st TOU bucket	Start hour of the 2st TOU bucket	Start hour of the 3st TOU bucket	Start hour of the 4st TOU bucket	Start hour of the 5st TOU bucket	Start hour of the 6st TOU bucket

ATTENTION:
RTM Elster AMCO *check for coherence in the TOU buckets programming when user access to the configuration parameter:*

- *If the number of TOU Buckets is lower than 2, then TOU buckets management will be rejected (update status = error) even if it is activated.*
- *If starting hour list is not coherent, i.e. there are windows overlaps,* ***RTM Elster AMCO*** *sends back to the initiator of the request an error status for parameter writing access.*
- *When less than 6 TOU Buckets are expected, fields relative to not used TOU buckets will not be treated by the* ***RTM Elster AMCO*** *for coherence. Parameter length is always seven bytes.*

- ***Request to read TOU Buckets data format***

Applicative command
1 byte
0x06

- ***Response data format***

The total length for 1 port managed is 66 Bytes
The total length for 2 ports managed is 94 Bytes
The total length for 3 ports managed is 122 Bytes
The total length for 4 ports managed is 150 Bytes

Applicative acknowledgment command	*Generic Header*	*RTC on TOU Buckets mngt initialization*	*TOU Buckets Parameters*	*Port A totalizers (1)*	*Port B totalizers*	*Port C totalizers*	*Port D totalizers*
1 byte	23 bytes	7 bytes	7 bytes **(1)**	28 bytes	28 bytes	28 bytes	28 bytes
0x86	-	-	-	-	-	-	-

(1) Structure of a TOU buckets totalizers:

The total length is 28 bytes

Current Reading	*First TOU buckets totalizer*	*2nd TOU buckets totalizer*	*3rd TOU buckets totalizer*	*4rd TOU buckets totalizer*	*5rd TOU buckets totalizer*	*6rd TOU buckets totalizer*
4 bytes	4 bytes	4 bytes	4 bytes	4 bytes	4 bytes	4 bytes

ATTENTION:
If TOU Buckets configuration parameter is modified, it is in charge of the user to initialize the feature. The only way to reset the TOU buckets totalizers is to modify the TOU buckets activation bit in Operating Mode parameter.

Each totalizer return by the RTM are complete totalizer means that the current totalizer isn't taken into account. In other words, at the end of each TOU bucket the current totalizer is stored into a memory and the user can only access this memory zone through this reading command.

ATTENTION:
*When **RTM Elster AMCO** is configured in Drive By/Walk By mode, TOU buckets are automatically turned off. So reading TOU Buckets in this case will not be relevant.*

5.6.Automatic Radio transmission (pseudo bubble up mode - Fixed Network Only)

(Refer to DR[3] Section 1.0.20)

RTM Elster AMCO is able to send periodically some of its information through the network. This feature is fully configurable. Pseudo bubble up like system configuration and activation is made with a single radio frame.

5.6.1.Pseudo bubble up parameters list

Param ID	Description	Size in bytes	Access Right (Pulse Profile)	Access Right (encoder Profile)	Default value (Hexa)	Restriction on parameters
Pseudo bubble up feature						
0x68	Starting hour, minute and second of the pseudo bubble up mechanism	3	R/W	R/W	**0x080000**	An erroneous date will be rejected
0x69	pseudo bubble up transmission period	1	R/W	R/W	**0x06**	See Section **§5.6**
0x6A	**First byte :** Data length of bubble up command buffer **Other bytes :** bubble up command buffer (use to write request command)	7	R/W	R/W	**0x01030000000000**	The first byte should not be higher than 6 and the command should be correctly written
0x6B	Maximum cancellation Timeout (in seconds): this time is needed when a process take a too long time and shift the current RTC compare to the computed RTC of bubble up emission.	1	R/W	R/W	**0x05**	From 0x01 to 0x0A

pseudo bubble up transmission period definition:

step time for automatic transmission (parameter 0x69)							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
[b7:b2] : measurement period expressed in time units min : once a minute max : every 63 days						**[b1:b0] : time unit** 00 : 1 minute 01 : 1 hour 1x : 1 day	

5.6.2.Pseudo bubble up allowed commands list

Applicative Command	Command Function
0x01	Current reading
0x03	Daily consumption profile reading
0x06	TOU buckets reading
0x07	Datalogging table reading ***(rejected in case of multi frame answer)***

5.6.3.Example

Daily consumption profile reading is expected on the first RTM installed on the network with the following parameters:

- Starting hour : 9AM,
- Step time : 5 hours (means number of transmission per day is not constant),
- Command buffer : Daily consumption profile *(applicative command 0x03)*
- Cancellation Timeout : 5 seconds (default value)

In this example the current hour is 8.58AM.

Applicative command	*Operating Mode*	*Mask on Operating mode (indicate the bits that must be updated)*	*Number of param to write*	*1st param ID*	*1st param size*	*1st param new value*	*2nd param ID*	*2nd param size*	*2nd param new value*
0x19	**0x0800**	**0x0800**	**0x04**	**0x68**	**0x03**	**0x090000**	**0x69**	**0x01**	**0x15**

3rd param ID	*3rd param size*	*3rd param new value*	*4th param ID*	*4th param size*	*4th param new value*
0x6A	**0x07**	**0x01030000000000**	**0x6B**	**0x01**	**0x05**

ATTENTION:
In this case, the first pseudo bubble up transmission will occur at 9AM.

Daily consumption profile reading is also expected on the second RTM installed on the network. The Wavebox computes a time shift between each RTM pseudo bubble up transmission. In this example the time shift between the first RTM transmission and the second RTM transmission is 2 minutes.

The second RTM will be configured with the following parameters :

- Starting hour : 9: 02AM,
- Step time : 5 hours (means number of transmission per day is not constant),
- Command buffer : Daily consumption profile *(applicative command 0x03)*
- Cancellation Timeout : 5 seconds (default value)

In this example the current hour is 9:04AM.

Applicative command	*Operating Mode*	*Mask on Operating mode (indicate the bits that must be updated)*	*Number of param to write*	*1st param ID*	*1st param size*	*1st param new value*	*2nd param ID*	*2nd param size*	*2nd param new value*
0x19	**0x0800**	**0x0800**	**0x04**	**0x68**	**0x03**	**0x090200**	**0x69**	**0x01**	**0x15**

3rd param ID	*3rd param size*	*3rd param new value*	*4th param ID*	*4th param size*	*4th param new value*
0x6A	**0x07**	**0x01030000000000**	**0x6B**	**0x01**	**0x05**

ATTENTION:
In this case, the first pseudo bubble up transmission will occur at 2:02PM. Indeed, the second RTM computes next pseudo bubble up transmission time in order to respect the time shift that was defined by the Wavebox between the first RTM and itself. In this case, Starting hour is not respected since it will induce a time shift of 58 minutes between the first RTM and the second one.

5.7.Leak detection management

(Refer to DR[3] Section 1.0.23*; DR[4,5] Section 1.0.20)*

5.7.1.Residual leak detection

Residual leak is detected when the module measures a consumption-rate (by default calculated every hour) systematically higher than that set by the user (parameter *residual leak threshold*) for a given detection period (parameter *residual leak detection period*).

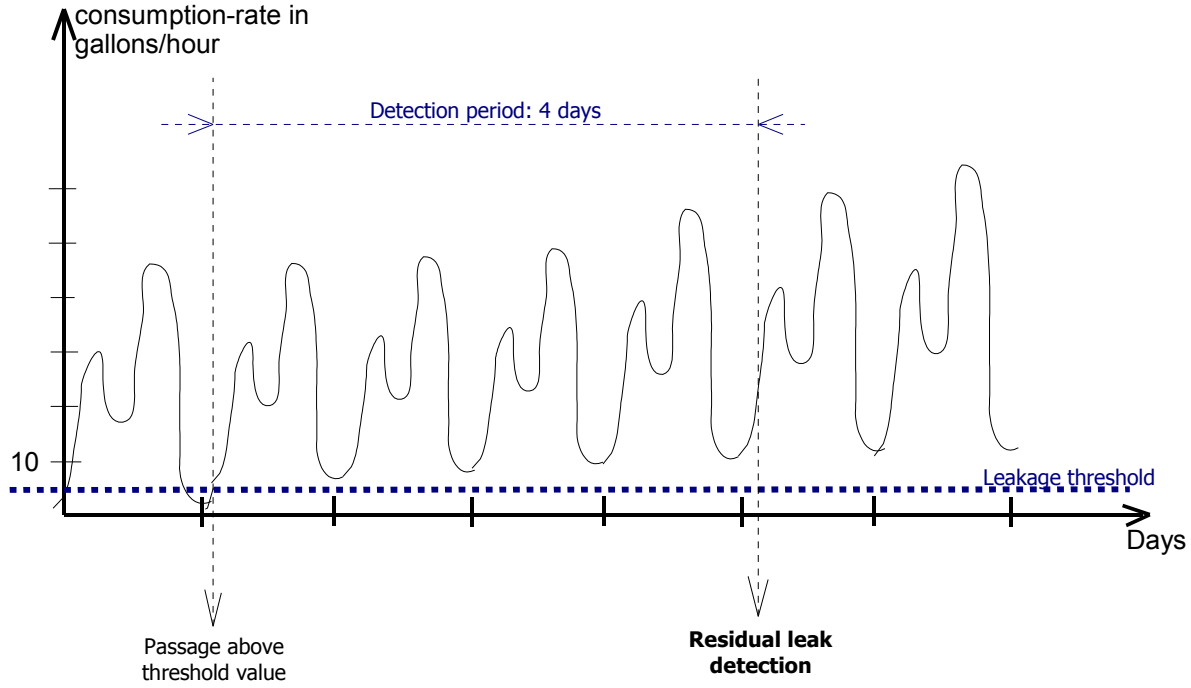
- ***Residual leak threshold*** : Detection threshold, expressed in number of pulses per sample period (pulse register) or absolute volume per sample period (encoder). It is necessary to link this value with the right pulse value or encoder unit.
- ***Residual leak detection period*** : minimum time during which the threshold value must be exceeded before leak detection is detected (expressed in multiple of sample period).

The parameters relative to this detection, has to be configured before activating the detection.
Residual leak detection is activated by setting bit 5 in '*Operating Mode'* parameter.

➢ **Example :** The measurement step is set to measure the consumption-rate in gallons/hour and the residual leakage detection parameter is then set as follows:

- ***Residual leak threshold :*** *5 gallons per hour*

  the value of the parameter depends of the pulse value or on encoder unit
- ***Residual leak detection period :*** 4 days.



ATTENTION : *it is advised to configure the detection period value to several days (or a week) in order to avoid alarms when opening a tap.*

5.7.2.Extreme leak detection

Extreme leak is detected when the module measures a consumption-rate higher than that set by the user in the *Extreme Leak Threshold* parameter for a given detection period (parameter *Extreme Leak Detection Period*).

The parameters relative to this detection, has to be configured before activating the detection functionality. Extreme leak detection is activated by setting bit 6 in the "*Operating Mode"* parameter.

- **Extreme Leak Threshold** : Detection threshold. Expressed in number of pulses per sample period (pulse register) or absolute flow per sample period (encoder).
- **Extreme Leak Detection Period** : minimum time during which the threshold value must be exceeded before leak detection is validated. Expressed in multiple of sample period.

RTM Elster AMCO stores in an internal table, the pieces of information relative to the occurrence, or the disappearance of the leaks. The table is a circular buffer which can store up to 5 events which is accessible through a radio signal.

5.7.3.Leak detection parameters list

Param ID	Description	Size in bytes	Access Right (Pulse register)	Access Right (encoder register)	Default value (Hexa)	Restriction on parameters
Leakage detection function						
0x07	Reading Sampling Period	1	R/W	R/W	**0x0B**	-
0x08	Sampling Activation Type	1	R/W	R/W	**0x01**	Must not exceed value **0x01**
0x21	Residual leakage consumption-rate (low threshold) on **Port A** *(The unit is the same as the reading unit)*	1	R/W	R/W	**0x0F**	If 0x00 error
0x22	Residual leakage detection period on **Port A** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0xA8**	If 0x00 error
0x23	Extreme leakage consumption-rate (high threshold) on **Port A** *(The unit is the same as the reading unit)*	2	R/W	R/W	**0x03E8**	If 0x0000 error
0x24	Extreme leakage detection period on **Port A** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0x03**	If 0x00 error
0x28	Residual leakage consumption-rate (low threshold) on **Port B** *(The unit is the same as the reading unit)*	1	R/W	R/W	**0x0F**	If 0x00 error
0x29	Residual leakage detection period on **Port B** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0xA8**	If 0x00 error
0x2A	Extreme leakage consumption-rate (high threshold) on **Port B** *(The unit is the same as the reading unit)*	2	R/W	R/W	**0x03E8**	If 0x0000 error
0x2B	Extreme leakage detection period on **Port B** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0x03**	If 0x00 error
0x30	Residual leakage consumption-rate (low threshold) on **Port C** *(The unit is the same as the reading unit)*	1	R/W	-	**0x0F**	If 0x00 error
0x31	Residual leakage detection period on **Port C** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0xA8**	If 0x00 error
0x32	Extreme leakage consumption-rate (high threshold) on **Port C** *(The unit is the same as the reading unit)*	2	R/W	-	**0x03E8**	If 0x0000 error
0x33	Extreme leakage detection period on **Port C** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0x03**	If 0x00 error
0x38	Residual leakage consumption-rate (low threshold) on **Port D** *(The unit is the same as the reading unit)*	1	R/W	-	**0x0F**	If 0x00 error
0x39	Residual leakage detection period on **Port D** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0xA8**	If 0x00 error
0x3A	Extreme leakage consumption-rate (high threshold) on **Port D** *(The unit is the same as the reading unit)*	2	R/W	-	**0x03E8**	If 0x0000 error
0x3B	Extreme leakage detection period on **Port D** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0x03**	If 0x00 error

5.7.4.“leak event table” reading management

RTM Elster AMCO stores in an internal table, the pieces of information relative to the occurrence, or the disappearance of the leaks.

- ***Reading request data format***

Applicative command
1 byte
0x04

- ***Reading acknowledgment data format***

The total length is 74 Bytes

Applicative acknowledgment command	*Generic header*	*Leak Event 0 (most recent)*	*Leak Event 1*	*Leak Event 2*	*Leak Event 3*	**Leak Event 4**
1 byte	23 bytes	10 bytes	10 bytes	10 bytes	10 bytes	10 bytes
0x84		**(*)**	**(*)**	**(*)**	**(*)**	**(*)**

(*) : when no event has been detected, the table is filled with **0x00**.
when only one event has been detected, only “*Leak Event 0”* field is filled with the corresponding leak detected event.
If a second leak is detected, then the previous one moved in *“Leak Event 1”* field and the second one filled *“Leak Event 0”* field.

The table is a circular buffer which can store up to 5 events, and has the following structure:

	Status	*Consumption-rate*	*Date*
	1 byte	**2 bytes**	**7 bytes**
Leak Event 0	Status_Evt 0	ConsRate_Evt 0	Date_Evt 0
Leak Event 1	Status_Evt 1	ConsRate_Evt 1	Date_Evt 1
Leak Event 2	Status_Evt 2	ConsRate_Evt 2	Date_Evt 2
Leak Event 3	Status_Evt 3	ConsRate_Evt 3	Date_Evt 3
Leak Event 4	Status_Evt 4	ConsRate_Evt 4	Date_Evt 4

✔ **Status :** indicates the event type (occurrence or disappearance) and the corresponding Port.

Status							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Corresponding Port **00** : Port A **01** : Port B **10** : Port C **11** : Port D		-	-	-	-	**Leak type** **0** : Extreme leak **1** : Residual leak	**Event Type** **0** : disappearance **1** : occurence

✔ **Consumption-rate :** according to the event type described above in status byte, the consumption-rate has different meaning:

- ➔ ***Occurrence of a residual leak :*** *minimum consumption-rate value which is higher than the specified threshold, for the given Residual Leak Detection Period;*
- ➔ ***Disappearance of a residual leak :*** *minimum consumption-rate value higher than the threshold, logged just before the disappearance of the leak;*
- ➔ ***Occurrence of an extreme leak :*** *maximal consumption-rate value logged on the specified Extreme Leak Detection Period.*
- ➔ ***Disappearance of an extreme leak :*** *the value is not significant.*

✔ **Date :** the format of the date is strictly identical to the format of the RTC parameter ***(See section §4.4).***

5.8.back flow detection management (encoder only)

5.8.1.back flow detection parameters list

Param ID	Description	Size in bytes	Access Right (Pulse profile)	Access Right (encoder profile)	Default value (Hexa)	Restriction on parameters
Back flow detection function						
0x07	Reading Sampling Period	1	R/W	R/W	**0x0B**	See Section **§4.5** for parameter description
0x08	Sampling Activation Type	1	R/W	R/W	**0x01**	**0x01 only**
0x3E	Back flow detection date on **Port A**	7	-	R	**0x01010101 010101**	An erroneous RTC Format will be rejected
0x3F	Back flow detection date on **Port B**	7	-	R	**0x01010101 010101**	An erroneous RTC Format will be rejected
0x40	Back flow detection period on **Port A** *expressed in multiple of "Reading Sampling Period"*	1	-	R/W	**0x01**	If 0x00 error
0x41	back flow detection before indication on **Port A**	1		R/W	**0x02**	If 0x00 error
0x42	Back flow threshold on **Port A** *(same unit as encoder)*	1	-	R/W	**0x0A**	If 0x0000 error
0x43	Back flow detection flags on **Port A** *(rotate every month)*	2	-	R/W	**0x0000**	No restriction
0x44	Back flow detection period on **Port B** *expressed in multiple of "Reading Sampling Period"*	1	-	R/W	**0x01**	If 0x00 error
0x45	back flow detection before indication on **Port B**	1	-	R/W	**0x02**	If 0x00 error
0x46	Back flow threshold on **Port B** *(same unit as encoder)*	1		R/W	**0x0A**	If 0x00 error
0x47	Back flow detection flags on **Port B** *(rotate every month)*	2	-	R/W	**0x0000**	No restriction

- **Back flow detection period:** this period is a multiple of the *"Reading Sampling Period"* parameter. Indicates the water back flow measurement granularity.
- **Back flow Threshold :** water back flow rate (same unit as encoder).
- **Number of back flow presence before detection:** this parameter is used to filter the number of back flow presence before real detection.
- **Back flow detection flags** : this word contains 12 relevant bits that express back flow detection in the month.

5.8.2.Reading back flow detection

- ***Reading request data format***

Applicative command	*Number of parameters to read*	*First parameter ID (back flow detection on Port A)*	*first parameter length*	*Second parameter ID (back flow detection on Port B)*	*second parameter length*
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
0x18	**0x02**	**0x43**	**0x02**	**0x47**	**0x02**

- ***Reading acknowledgment data format***

The total length is 10 Bytes

Applicative Acknowledgment command	*Number of parameters returned*	*first parameter ID*	*first parameter length*	*first parameter value*	*second parameter ID*	*second parameter length*	*second parameter value*
1 byte	1 byte	1 byte	1 byte	2 bytes	1 byte	1 byte	2 bytes
0x98	**0x02**	**0x43**	**0x02**	**(*)**	**0x47**	**0x02**	**(*)**

(*) once a back flow is detected (according to the parameters settings), the least significant bit of the "**Back flow detection flags"** is set to 1.
When month changes all the bits of this parameter are shifted left (from LSB to MSB).

Flag indicating back flow detection in month															
Most Significant Byte								***Least Significant Byte***							
b7	b6	b5	b4	b3	b2	b1	b0	b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	Month -12	Month -11	Month -10	Month -9	Month -8	Month -7	Month -6	Month -5	Month -4	Month -3	Month -2	Month -1	Current month

Clearing back flow detection flags can be done using Standard writing parameter command.

5.9.Tamper detection (pulse register only)

Tamper detection is possible if the cable sensor is 3-wire type. In such a case, the 3rd wire is connected to a module input in the same way as the metering input.
Tamper detection is activated by setting bit 4 in the "*Operating Mode"* parameter.
When Tamper detection is activated, **RTM Elster AMCO** checks periodically (every second) the state of this input (0 means no tamper , 1 means tamper). Once a tamper has been detected (input level = 1), RTM Elster AMCO sets bit 4 in the "Application Status" parameter.

5.9.1.Tamper detection parameters list

Param ID	Description	Size in bytes	Access Right (Pulse profile)	Access Right (encoder profile)	Default value (Hexa)	Restriction on parameters
Tamper detection function						
0x48	tamper detection date on **Port A**	7	R	-	**0x010101 01010101**	-
0x49	tamper detection date on **Port B**	7	R	-	**0x010101 01010101**	**-**
0x4A	tamper detection date on **Port C**	7	R	-	**0x010101 01010101**	-
0x4B	tamper detection date on **Port D**	7	R	-	**0x010101 01010101**	**-**

5.9.2.Reading Tamper detection date

- ***Reading request data format***

Applicative command	Number of parameters to read	parameter ID (Tamper detection date on Port A)	parameter length
1 byte	1 byte	1 byte	1 byte
0x18	**0x01**	**0x48**	**0x07**

- ***Reading acknowledgment data format***

The total length is 11 Bytes

Applicative Acknowledgment command	*Number of parameters returned*	Parameter ID (Tamper detection date on Port A)	Parameter length	Parameter value
1 byte	1 byte	1 byte	1 byte	7 bytes
0x98	**0x01**	**0x48**	**0x07**	

5.10.Communication and reading error detection (encoder only)

Definitions :

- **Communication error :** what CORONIS calls a communication error is when **RTM Elster AMCO** observed no data on data wire after a certain period of time, when attempting to read the encoder.
- **Reading error :** what CORONIS calls a reading error is when an error is detected in one of the fields of the data frame returned by the encoder (**?** or **:** in the *"value"* field for example).

5.10.1.Encoder communication error

The encoder communication error can be detected either following a radio request or when a periodic action is processed (datalogging for example).Once the communication error has been detected, it is pointed out through bit 1 and bit 2 in ***"Application Status"*** parameter and the detection date (RTC) is recorded.

5.10.2.Encoder reading error detection

On another hand, there could be a misread due to the encoder itself (interdigit, ...).

- ***Filtering algorithm deactivated***

RTM Elster AMCO handles these misreads in order to give more precision on the fault detected. Since these reading errors could happen in a daily basis, RTM Elster AMCO will not handle each reading error separately but on a 24 hours period. Assuming that the encoder is read every hour, if during 24 consecutive readings, **RTM Elster AMCO** is unable to read an error-free frame from the encoder, a reading error is detected and pointed out through bit 3 and bit 4 in ***"Application Status"*** parameter and the reading error detection date (RTC) is recorded.

- ***Filtering algorithm activated***

If filtering algorithm is activated, then the **RTM Elster AMCO** reads three times the encoder every ***"Reading Sampling period"*** *(internal parameter 0x07)*. The algorithm used is the one provided by *Elster AMCO*. This one is a majority function computed on the three readings performed. Even if the filtering algorithm is activated, **RTM Elster AMCO** will not handle each reading error separately but on a 24 hours period.

ATTENTION :

1) *Each time a reading attempt is unsuccessful, **RTM Elster AMCO** logs the previous valid reading if datalogging is set.*
2) *It is important to notice that the filtering algorithm is power consuming and will lead to a decrease of the **RTM Elster AMCO** life duration of 3 to 4 years when it is activated.*

5.10.3.Communication and reading error detection parameters list

Param ID	Description	Size in bytes	Access Right (Pulse profile)	Access Right (encoder profile)	Default value (Hexa)	Restriction on parameters
Encoder communication and reading error function						
0x4C	Communication error detection date on **Port A**	7	-	R/W	**0x010101 01010101**	-
0x4D	Communication error detection date on **Port B**	7	-	R/W	**0x010101 01010101**	**-**
0x4E	Reading error detection date on **Port A**	7	-	R/W	**0x010101 01010101**	-
0x4F	Reading error detection date on **Port B**	7	-	R/W	**0x010101 01010101**	**-**

5.11.Low Battery Warning detection

(Refer to DR[3] Section 1.0.28)

To detect a *"Low Battery Warning"*, **RTM Elster AMCO** uses power metering principle rather than battery voltage measurement. Lithium batteries are, in particular during passivation, unsuitable for the voltage measurement method to determine the remaining capacity.
RTM Elster AMCO records and evaluates all occurrences (measurements, radio emissions and receptions, ...) to decrement the power meter according to the battery used. When the meter passes below a predefined threshold, the ***"Low Battery Warning"*** is pointed out through ***bit 0*** in ***"Application Status"*** parameter. The threshold is factory-set and indicates that remaining battery capacity is about 10% of the practical capacity (60% of the theoretical one) depending on product usage (number of emissions per day, output power,...).
The initial value of the end-of-life meter is factory-set. It depends on the type and number of batteries used.
When the end of battery life is detected, the detection date is recorded and may be read with a radio command.
Some occurrence counters useful for "Low Battery Warning" calculation are stored in non-volatile memory. These counters are accessible through a radio request.

List of accessible counters :

- Number of radio transmissions,
- Number of radio receptions.

5.11.1.Low Battery Warning detection parameters list

Param ID	Description	Size in bytes	Access Right (Pulse profile)	Access Right (encoder profile)	Default value (Hexa)	Restriction on parameters
Low Battery Warning detection						
0x50	Low Battery Warning meter	3	R	R	**TBD**	
0x51	Low Battery Warning detection date	7	R	R	**0x010101 01010101**	

5.12.Faults or Flow Problems automatic transmission

(Refer to DR[3] Section 1.0.25 to 1.0.27; DR[4,5] Section 1.0.22 to 1.0.24)

RTM Elster AMCO module offers the possibility to automatically transmit radio frames when an occurrence is detected. The following occurrences may provoke an automatic alarm :

- Extreme Leak detection (High threshold)
- Residual Leak detection (Low threshold)
- Encoder Communication fault detections (encoder register only)
- encoder reading error detection (encoder register only)
- Tamper detection (pulse register only)
- Low Battery warning detection
- Back flow detection (encoder only)

It is possible to select for each type of occurrence whether or not an alarm frame is to be sent.

5.12.1.Time windows dedicated to alarm sending

Activating alarm in a system already configured to send information using pseudo bubble up mechanism can lead to collisions. To avoid as much as possible these collisions **RTM Elster AMCO** embeds a parameter that allows to configure time windows dedicated to alarm. These time windows will then not be used for Pseudo Bubble Up time slot attribution. This mechanism allows to mix either Pseudo Bubble Up mechanism and Alarm frame management without affecting system accuracy.

5.12.2.Parameter list

Param ID	Description	Size in bytes	Access Right	Profile	Default value (Hexa)	Restriction on parameters
Time affectation for alarm						
0x57	Alarm Window configuration parameter	1	R/W	All	**0x09**	-

- ***Alarm Window configuration parameter description***

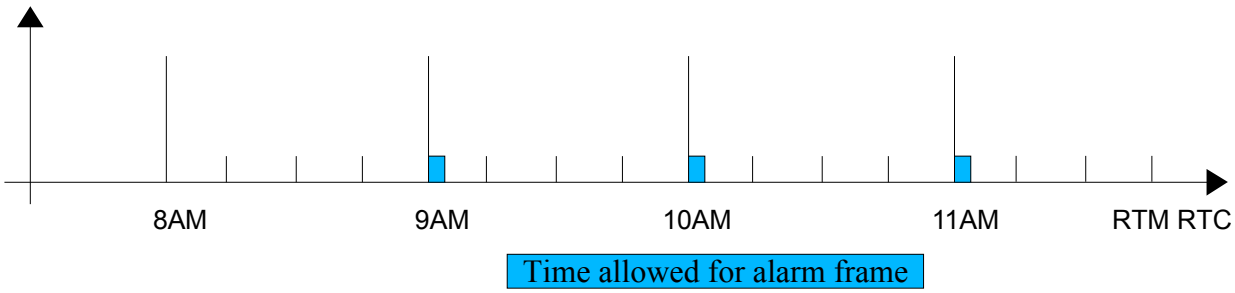
Alarm Window configuration parameter (0x57)							
bit 7	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***bit 0***
Time Slot Granularity: **"000" =** every **quart hour** (start on hour on dot of RTC) **"001" =** every **30 minutes** (start on hour on dot of RTC) **"010" =** every **hour** (start on hour on dot of RTC)			**Time slot duration:** **"000" =** 30 secs **"001" =** 45 secs **"010" =** 60 secs **"011" =** 90 secs **"100" =** 120 secs			**Time Slot mechanism activation:** **"00"** = Disable **"01"** = Enable	

Example of Alarm Windows activation

In this example, to activate alarm windows every hour during 60 seconds, the parameter "Alarm Window configuration" (**0x57**) must be set to **0x69.**

By using this configuration the **RTM Elster AMCO** will allow alarm frame during 30 seconds every hour and will start the first time on hour on dot taking into account its internal RTC.

In this example the request to configure alarm windows activation is done between 8:01AM and 8:59AM.



5.12.3. Automatic configuration of the destination route (via SDP)

RTM Elster AMCO integrates the CORONIS SDP feature *"Self Discovery Protocol"* used to identify the path to reach the root of the network. **RTM Elster AMCO** uses this parameter to transmit its alarm frames.
When no path to reach the root is found, **RTM Elster AMCO** will erase the route contained inside its parameters. The destination address will be equal to **0xFFFFFFFFFFFF**. In such a case, **RTM Elster AMCO** does not manage alarm frame since it has no idea of distant equipment radio address to send it to.

5.12.4.Radio command for the configuration of the route

The route can be configured by a standard write command of the concerned parameters, or in an automatic way.

Indeed when a distant module send the Alarm Configuration command (0x0A), the **Waveflow AMCO** module stores the radio address of the transmitter, and the relay route (if used) as the recipient of alarm frames.

- ***Configuration request data format***

Applicative command	Alarms Configuration byte parameter 0x58 (*)
1 byte	1 byte
0x0A	

(*) By configuring the route this command can also parametrize automatically the parameter 0x58 that enable the alarm transmission frame on a given functionality.

- ***Configuration acknowledgment data format***

Applicative Acknowledgment command	Configuration status
1 byte	1 byte
0x8A	**(1)**

(1) ***'Configuration Status'*** *possible value:* ***0x00*** *: configuration update ok*
0xFF *: configuration update error*

5.12.5.Triggering an alarm frame

- ***Automatic transmission alarm frame format***

Applicative Command	Generic header	Alarm Status	RTC on Alarm detection	Alarm Data field
1 byte	23 bytes	3 bytes	7 bytes	2 bytes
0x40				

ATTENTION:
an alarm frame only has one type of detection. When several alarms are detected, ***RTM Elster AMCO*** *emits the frames one after the other.*
Next alarm frame will be transmitted after the previous frame has been acknowledged.

- ***Alarm Status for RTM Elster AMCO pulse profile***

Alarm Status MSB Byte								
Bit Number	***Bit 23 (MSB)***	***Bit 22***	***Bit 21***	***Bit 20***	***Bit 19***	***Bit 18***	***Bit17***	***Bit 16 (LSB)***
Bit Definition	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
Alarm Status Middle Byte								
Bit Number	***Bit 15 (MSB)***	***Bit 14***	***Bit 13***	***Bit 12***	***Bit 11***	***Bit 10***	***Bit 9***	***Bit 8 (LSB)***
Bit Definition	Not used	Not used	Not used	Tamper detection on Port D	Tamper detection on Port C	Tamper detection on Port B	Tamper detection on Port A	Low Battery Warning
Alarm Status LSB Byte								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	extreme leak detection on Port D	residual leak detection on Port D	extreme leak detection on Port C	residual leak detection on Port C	extreme leak detection on Port B	residual leak detection on Port B	extreme leak detection on Port A	residual leak detection on Port A

The coding is as follows : ***1*** *: Alarm detected*

- ***Alarm Status for RTM Elster AMCO encoder profile***

Alarm Status MSB Byte								
Bit Number	***Bit 23 (MSB)***	***Bit 22***	***Bit 21***	***Bit 20***	***Bit 19***	***Bit 18***	***Bit17***	***Bit 16 (LSB)***
Bit Definition	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
Alarm Status Middle Byte								
Bit Number	***Bit 15 (MSB)***	***bit 14***	***bit 13***	***bit 12***	***bit 11***	***bit 10***	***bit 9***	***Bit 8 (LSB)***
Bit Definition	Not used	Back flow detection on Port B	Back flow detection on Port A	Encoder reading error detection on Port B	Encoder reading error detection on Port A	Encoder communication error detection on Port B	Encoder communication error detection on Port A	Low Battery Warning
Alarm Status LSB Byte								
Bit Number	***Bit 7 (MSB)***	***bit 6***	***bit 5***	***bit 4***	***bit 3***	***bit 2***	***bit 1***	***Bit 0 (LSB)***
Bit Definition	Not used	Not used	Not used	Not used	extreme leak detection on Port B	residual leak detection on Port B	extreme leak detection on Port A	residual leak detection on Port A

*The coding is as follows : **1** : Alarm detected*

- **Alarm Data Field:** the signification of this field depends on the alarm type.

When the alarm is a leakage (extreme or residual) detection, this field corresponds to the ***consumption-rate*** value. When the alarm is a sensor default, this field represents the type of default detected.

	Alarm Data Field	
Alarm Type	MSB byte	LSB Byte
High Threshold (Extreme leak)	*Leak flow value measured*	
Low threshold (Residual leak)	*Leak flow value measured*	
Low Battery Warning	*current life counter (Parameter 0x50)*	
Back flow	*parameter “Back flow detection flags”*	

- **Date** : Standard RTC format

5.12.6.alarm frame acknowledgment

The remote device must send an acknowledgment frame (command 0xC0) to confirm reception of the alarm frame and end dialog.

- ***Acknowledge request data format***

Applicative command	Alarm Status
1 byte	3 bytes
0xC0	**Same as received in the alarm frame**

If the **RTM Elster AMCO** does not receive this acknowledgment, it re-transmits the alarm frame several time, with a delay between each retransmission. The delay, and the number of retries depend on the equipment type used.

Number of retries of alarm sending	7 times
Delay between each retransmission	1st retry :1 minutes, 2nd retry : 15 minutes, 3rd retry : 45 minutes, 4th retry : 90 minutes, 5th retry : 180 minutes, 6th retry : 360 minutes, 7th retry : 720 minutes

ATTENTION:
*As mentioned above in this document, it is not recommended to enable alarm frames when **RTM Elster AMCO** is programmed to send periodically its information. This could cause collision on the radio medium and so lead to a loss of information coming from the RTM.*

6.Radio address description

Each Coronis product has its own radio address in order to achieve bidirectional communications.

A bar code label is applied to each product, indicating the **RTM Elster AMCO** radio address. This address may be given in two forms:

- either with direct display of the radio address: 12 digits indicating the hexadecimal radio address of the module;
- or in the form of a serial number: in this case, the radio address is coded in the first 15 digits of the serial number; the other digits represent the CRC (algorithm available on request).
  To find the radio address in a serial number, proceed as follows:

Serial number indicated on the bar code (without CRC): **16662-06-06291457**		
The chain of characters is split into 3 sections (as indicated below)		
16662	06	06291457
Conversion Decimal to Hexadecimal (on 2 bytes)	Conversion Decimal to Hexadecimal (on 1 byte)	Conversion Decimal to Hexadecimal (on 3 bytes)
4116	06	600001
A combination of these 3 parts provides the radio address (hexadecimal) of the module: **411606600001**		

- ***Radio Address description***

In hexadecimal format, radio address is composed of 6 bytes. The signification of radio address fields is described below:

Field Signification	*Test Bench Identifier*	*Product Identifier*	*Year of production*	*Wavenis physical layer*	*Product serial number*
Field size	**1 byte**	**1 byte**	**1 byte**	**4 bits**	**20bits**
RTM Elster AMCO	-	50	-	6	xxxxx
sRTM Elster AMCO	-	51	-	6	xxxxx

Note : First byte of radio address is the *"Test Bench Identifier" that allows to trace the*

sRTM : same specifications as RTM but able to repeat 10 to 15 RTMs.

7.APPENDIX A : RTM Elster AMCO internal parameters list

Param ID	Description	Size in bytes	Access Right (Pulse register)	Access Right (encoder register)	Default value (Hexa)	Restriction on parameters
NO ID	Operating Mode	2	R/W	R/W	**TBD with Elster AMCO**	-
General status						
0x01	Application Status	1	R/W	R/W	**0x00** if no default at start	
0x02	Leakage Detection Status	1	R	R	**0x00** if no default at start	Read only no limit
Current date						
0x04	Current RTC parameter	7	R/W	R/W	**0x01010101010101**	An erroneous RTC Format will be rejected
Profile						
0x05	profile parameter	1	R/W	R/W	**0x02**	Between 0x01 and 0x02
Meter Sampling Management						
0x07	Reading Sampling Period	1	R/W	R/W	**0x0B**	See section **§4.5.1**
0x08	Sampling activation type	1	R/W	R/W	**0x01**	**0x01 only**
Radio configuration						
0x0A	Group number to use in polling mode	1	R/W	R/W	**0x00**	-
0x0B	Group number in Multicast mode	1	R/W	R/W	**0x00**	-
Datalogging feature parameters						
0x10	Measurement Period (datalogging in time steps) expressed in multiple of *"Reading Sampling Period"*	1	R/W	R/W	**0x01**	-
0x12	Day of the week, or of the month (datalogging)	1	R/W	R/W	**0x01**	Conform day needed
0x13	Hour of measurement (datalogging once a week, or once a month)	1	R/W	R/W	**0x08**	Conform hour needed
0x14	number of records in the datalogging table (all ports records cumulated)	2	R	R	**0x0000**	Read only
Pulse Register Unit & Model parameters						
0x15	Meter Model on **Port A** (pulse only)	1	R/W	-	**0x00**	
0x16	Meter Model on **Port B** (pulse only)	1	R/W	-	**0x00**	
0x17	Meter Model on **Port C** (pulse only)	1	R/W	-	**0x00**	
0x18	Meter Model on **Port D** (pulse only)	1	R/W	-	**0x00**	
0x19	Pulse value on **Port A** (pulse only)	1	R/W	-	**0x21**	
0x1A	Pulse value on **Port B** (pulse only)	1	R/W	-	**0x21**	
0x1B	Pulse value on **Port C** (pulse only)	1	R/W	-	**0x21**	
0x1C	Pulse value on **Port D** (pulse only)	1	R/W	-	**0x21**	

Param ID	Description	Size in bytes	Access Right (Pulse register)	Access Right (encoder register)	Default value (Hexa)	Restriction on parameters
Encoder Unit & Model parameters						
0x1D	Encoder Model on **Port A** (encoder only)	2	-	R	**0xFFFF**	
0x1E	Encoder Model on **Port B** (encoder only)	2	-	R	**0xFFFF**	
0x1F	Encoder Unit on **Port A** (encoder only)	2	-	R	**0xFFFF**	
0x20	Encoder Unit on **Port B** (encoder only)	2	-	R	**0xFFFF**	
Leakage detection function						
0x21	Residual leakage consumption-rate (low threshold) on **Port A** *(The unit is the same as the reading unit)*	1	R/W	R/W	**0x0F**	If 0x00 error
0x22	Residual leakage detection period on **Port A** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0xA8**	If 0x00 error
0x23	Extreme leakage consumption-rate (high threshold) on **Port A** *(The unit is the same as the reading unit)*	2	R/W	R/W	**0x03E8**	If 0x0000 error
0x24	Extreme leakage detection period on **Port A** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0x03**	If 0x00 error
0x28	Residual leakage consumption-rate (low threshold) on **Port B** *(The unit is the same as the reading unit)*	1	R/W	R/W	**0x0F**	If 0x00 error
0x29	Residual leakage detection period on **Port B** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0xA8**	If 0x00 error
0x2A	Extreme leakage consumption-rate (high threshold) on **Port B** *(The unit is the same as the reading unit)*	2	R/W	R/W	**0x03E8**	If 0x0000 error
0x2B	Extreme leakage detection period on **Port B** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	R/W	**0x03**	If 0x00 error
0x30	Residual leakage consumption-rate (low threshold) on **Port C** *(The unit is the same as the reading unit)*	1	R/W	-	**0x0F**	If 0x00 error
0x31	Residual leakage detection period on **Port C** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0xA8**	If 0x00 error
0x32	Extreme leakage consumption-rate (high threshold) on **Port C** *(The unit is the same as the reading unit)*	2	R/W	-	**0x03E8**	If 0x0000 error
0x33	Extreme leakage detection period on **Port C** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0x03**	If 0x00 error
0x38	Residual leakage consumption-rate (low threshold) on **Port D** *(The unit is the same as the reading unit)*	1	R/W	-	**0x0F**	If 0x00 error
0x39	Residual leakage detection period on **Port D** *(expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0xA8**	If 0x00 error
0x3A	Extreme leakage consumption-rate (high threshold) on **Port D** *(The unit is the same as the reading unit)*	2	R/W	-	**0x03E8**	If 0x0000 error
0x3B	Extreme leakage detection period on **Port D** *expressed in multiple of 'Reading Sampling Period')*	1	R/W	-	**0x03**	If 0x00 error

Param ID	Description	Size in bytes	Access Right (Pulse register)	Access Right (encoder register)	Default value (Hexa)	Restriction on parameters
Back flow detection function (encoder only)						
0x3E	Back flow detection date on **Port A**	7	-	R	**0x01010101010101**	An erroneous RTC Format will be rejected
0x3F	Back flow detection date on **Port B**	7	-	R	**0x01010101010101**	An erroneous RTC Format will be rejected
0x40	Back flow detection period on **Port A** *expressed in multiple of "Reading Sampling Period"*	1	-	R/W	**0x01**	If 0x00 error
0x41	back flow detection before indication on **Port A**	1		R/W	**0x02**	If 0x00 error
0x42	Back flow threshold on **Port A** *(same unit as encoder)*	1	-	R/W	**0x0A**	If 0x0000 error
0x43	Back flow detection flags on **Port A** *(rotate every month)*	2	-	R/W	**0x0000**	No restriction
0x44	Back flow detection period on **Port B** *expressed in multiple of "Reading Sampling Period"*	1	-	R/W	**0x01**	If 0x00 error
0x45	back flow detection before indication on **Port B**	1	-	R/W	**0x02**	If 0x00 error
0x46	Back flow threshold on **Port B** *(same unit as encoder)*	1		R/W	**0x0A**	If 0x00 error
0x47	Back flow detection flags on **Port B** *(rotate every month)*	2	-	R/W	**0x0000**	No restriction
Pulse Register error detection						
0x48	Tamper detection date (RTC) on **Port A**	7	R	-	**0x01010101010101**	An erroneous date must be rejected
0x49	Tamper detection date (RTC) on **Port B**	7	R	-	**0x01010101010101**	An erroneous date must be rejected
0x4A	Tamper detection date (RTC) on **Port C**	7	R	-	**0x01010101010101**	An erroneous date must be rejected
0x4B	Tamper detection date (RTC) on **Port D**	7	R	-	**0x01010101010101**	An erroneous date must be rejected
Encoder error detection						
0x4C	Communication error for encoder on **Port A**	7	-	R	**0x01010101010101**	An erroneous date must be rejected
0x4D	Communication error for encoder on **Port B**	7	-	R	**0x01010101010101**	An erroneous date must be rejected
0x4E	encoder misread on **Port A**	7	-	R	**0x01010101010101**	An erroneous date must be rejected
0x4F	encoder misread on **Port B**	7	-	R	**0x01010101010101**	An erroneous date must be rejected

Param ID	Description	Size in bytes	Access Right (Pulse register)	Access Right (encoder register)	Default value (Hexa)	Restriction on parameters
Battery life						
0x50	Battery life duration counter	3	R	R	**TBD by CORONIS**	**-**
0x51	Date end of battery life detection	7	R	R	**0x01010101010101**	An erroneous date must be rejected
Configuration of alarm						
0x57	Alarm Window configuration parameter	**1**	R/W	R/W	**0x00**	See Section **§xxx**
0x58	Alarm Configuration parameter	**1**	R/W	R/W	**0x00**	From 0x00 to 0x3F
0x59	Number of repeaters *(used only with manual network construction)*	**1**	R/W	R/W	**0x00**	From 0x00 to 0x03
0x5A	Address of the 1st repeater *(used only with manual network construction)*	**6**	R/W	R/W	**0x000000000000**	
0x5B	Address of the 2nd repeater *(used only with manual network construction)*	**6**	R/W	R/W	**0x000000000000**	
0x5C	Address of the 3rd repeater *(used only with manual network construction)*	**6**	R/W	R/W	**0x000000000000**	
0x5D	Address of the recipient of the alarm frame *(used only with manual network construction)*	**6**	R/W	R/W	**0x000000000000**	
TOU buckets						
0x60	TOU buckets configuration parameter	7	R/W	R/W	**0x00000000000000**	See Section ***§5.6***
Pseudo bubble up feature						
0x68	Starting hour, minute and second of the pseudo bubble up mechanism	3	R/W	R/W	**0x080000**	An erroneous date will be rejected
0x69	Step time of pseudo bubble up transmission	1	R/W	R/W	**0x06**	See Section **§5.6**
0x6A	**First byte :** Data length of bubble up command buffer **Other bytes :** bubble up command buffer (use to write request command)	7	R/W	R/W	**0x01030000000000**	The first byte should not be higher than 6 and the command should be correctly written
0x6B	Maximum cancellation Timeout (in seconds): this time is needed when a process take a too long time and shift the current RTC compare to the computed RTC of bubble up emission.	1	R/W	R/W	**0x05**	From 0x01 to 0x0A

8.APPENDIX B : RTM Elster AMCO Radio commands list

Applicative command	*Direction*	*Description*	*Accessibility*	*Applicative Command Parameter field*
RTM Elster AMCO Configuration Access				
0x0B	**Host → RTM**	Request to read encoder internal data	Encoder profile only	No parameter field
0x8B	**RTM → Host**	Request to read encoder internal data acknowledgment	Encoder profile only	See Section ***§5.4.7*** for detailed description
0x0C	**Host → RTM**	Request to detect encoder model	Encoder profile only	No parameter field
0x8C	**RTM → Host**	Request to detect encoder model acknowledgment	Encoder profile only	See Section ***§5.4.5*** for detailed description
0x18	**Host → RTM**	Request to read parameter(s)	Pulse and Encoder	See Section ***§4.2*** for detailed description
0x98	**RTM → Host**	Request to read parameter(s) acknowledgment	Pulse and Encoder	See Section ***§4.2*** for detailed description
0x19	**Host → RTM**	Request to write parameter(s)	Pulse and Encoder	See Section ***§4.2*** for detailed description
0x99	**RTM → Host**	Request to write parameter(s) Acknowledgment	Pulse and Encoder	See Section ***§4.2*** for detailed description
RTM Elster AMCO Meter Reading Access				
0x01	**Host → RTM**	Request to read current reading	Pulse and Encoder	No parameter field
0x81	**RTM → Host**	Request to read current reading acknowledgment	Pulse and Encoder	See Section ***§5.5.2*** for detailed description
0x02	**Host → RTM**	Request to program current register reading	Pulse profile only	See Section ***§5.4.1*** for detailed description
0x82	**RTM → Host**	Request to program current register reading acknowledgment	Pulse profile only	See Section ***§5.4.1*** for detailed description
0x03	**Host → RTM**	Request to read Daily consumption profile	Pulse and Encoder	No parameter field
0x83	**RTM → Host**	Request to read Daily consumption profile acknowledgment	Pulse and Encoder	See Section ***§5.5.3*** for detailed description
0x06	**Host → RTM**	Request to read TOU buckets	Pulse and Encoder	No Parameter field
0x86	**RTM → Host**	Request to read TOU buckets acknowledgment	Pulse and Encoder	See Section ***§5.5.5*** for detailed description
0x07	**Host → RTM**	Request to read Datalogging table	Pulse and Encoder	See Section ***§5.5.4*** for detailed description
0x87	**RTM → Host**	Request to read Datalogging table acknowledgment	Pulse and Encoder	See Section ***§5.5.4*** for detailed description
0x0A	**Host → RTM**	Request to configure the route to use on alarm frame transmission	Pulse and Encoder	See Section ***§5.12.2*** for detailed description
0x8A	**RTM → Host**	Request to configure the route acknowledgment	Pulse and Encoder	See Section ***§5.12.2*** for detailed description
RTM Elster AMCO Miscellaneous commands				
0x04	**Host → RTM**	Request to read leakage event table	Pulse and Encoder	No parameter field
0x84	**RTM → Host**	Request to read leakage event table acknowledgment	Pulse and Encoder	See Section ***§5.7.4*** for detailed description
0x40	**RTM → Host**	Alarm to indicate default detected	Pulse and Encoder	See Section ***§5.12.3*** for detailed description
0xC0	**Host → RTM**	Alarm to indicate default detected acknowledgment	Pulse and Encoder	See Section ***§5.12.4*** for detailed description

9.APPENDIX C : SERVICE COMMANDS

Services commands are used to configure Wavecard modules or to read radio parameters independently of the connected host equipment. No data sent to the connected host when a Wavecard recognizes a service command.

These commands are mainly used to handle:

- Link budgets with remote modules (RSSI levels)
- Verifying products firmware version remotely
- Setting or reading parameters via RF (not described here)

9.1.Wavecard Serial Link Service Request Command description

CMD	NAME	DESCRIPTION
0x80	REQ_SEND_SERVICE	Request to send a service frame (and wait for response)
0x81	RES_SEND_SERVICE	REQ_SEND_SERVICE response
0x82	SERVICE_RESPONSE	Frame received following REQ_SEND_SERVICE transmission

- Service request

REQ_SEND_SERVICE						
HEADER	**CMD**	**DATA**			**CRC**	**ETX**
3 bytes	1 byte	6 bytes	1 byte	variable	2 bytes	1 byte
0xFF ; 0x02 ; 0xXX	0x80	Radio address of remote radio module	Service request type	Parameter(s) related to request type		0x03

- Service request acknowledgment

RES_SEND_SERVICE				
HEADER	**CMD**	**DATA**	**CRC**	**ETX**
3 bytes	1 byte	1 byte	2 bytes	1 byte
0xFF ; 0x02 ; 0x05	0x81	Status 0x00: Frame transmission OK 0x01: Frame transmission error		0x03

- Service request response

SERVICE_RESPONSE						
HEADER	**CMD**	**DATA**			**CRC**	**ETX**
3 bytes	1 byte	6 bytes	1 byte	variable	2 bytes	1 byte
0xFF ; 0x02 ; 0xXX	0x82	Radio address of remote radio module	Service response type	Parameter(s) related to response type		0x03

9.2.

9.3.Request types

The transmitting module sends a service command that includes a *request type*. Each *request type* has an associated *response type* which is included in the SERVICE_RESPONSE command.

In command byte coding, response frames reuse the request command with the LSB bit set to 1.

- Request type

REQUEST TYPE		DESCRIPTION	PARAMETER(S)
NAME	VALUE		
GET_TYPE	**0x20**	Command used to read equipment type and RSSI level from remote equipment.	n/a
GET_FW_VERSION	**0x28**	Command used to read firmware version in remote module.	n/a

- Response type

RESPONSE TYPE		DESCRIPTION	PARAMETER(S)
NAME	VALUE		
RESP_GET_TYPE	**0xA0**	Response to GET_TYPE command.	Byte 1: module type Byte 2: RSSI level Byte 3: Wake-up period Byte 4: module type
RESP_GET_FW_VERSION	**0xA8**	Response to GET_FW_VERSION command.	Byte 1: 'V' in ASCII code (0x56) Byte 2: Default Radio Protocol (MSB byte) Byte 3: Default Radio Protocol (LSB byte) Byte 4: Firmware version (MSB byte) Byte 5: Firmware version (LSB byte)