coronis
SYSTEMS

sEVO RTM Elster AMCO
User Manual

Coronis Systems
RTM Elster AMCO Products,

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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	05/03/05
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	10/02/06
DR[5]	Coronis Conformance Doc - Drive By - 10.1.06 v4 revised by AMCO.xls	4	10/01/06
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.

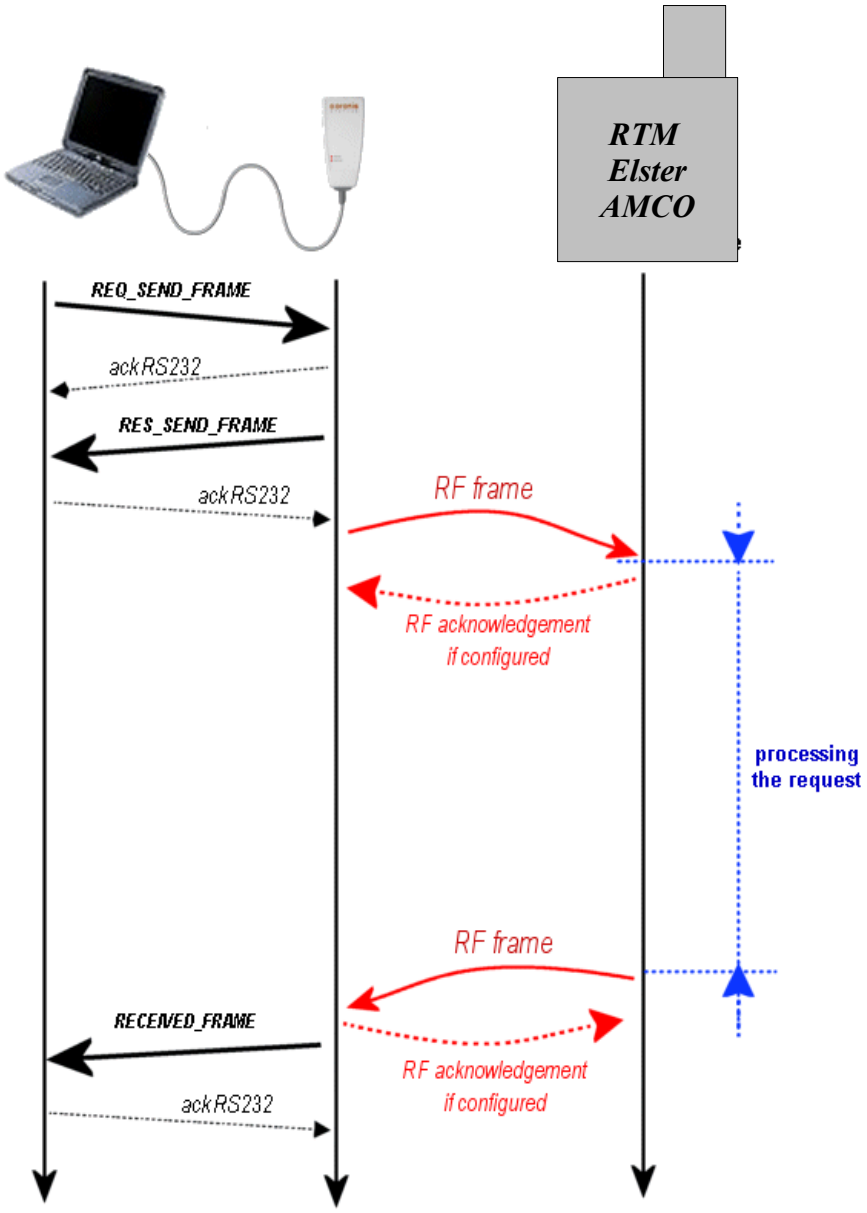


Figure 1

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

4.2.Control bytes

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

- Operating Mode,
- Alarm Configuration,
- Application Status,
- Leakage detection Status,

4.2.1.Operating Mode

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

4.2.2. 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.

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.*

4.2.3.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.

4.2.4.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.

ATTENTION :

Leakage detection is not available in ***evoHop Elster AMCO*** *profile.*

4.3.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.

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).*

ATTENTION :

Meter reading sampling period is not available in ***evoHop Elster AMCO*** *profile.*

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 in WalkBy is required to make it switching in “Fixed” Network mode operation.

Parameters details :

WakeUp Channel :

This parameter allows to define the channel number used by the RTM to receive in DriveBy/WalkBy mode.

Emission Number :

This parameter allows to define the number of emissions made by the RTM in response to a DriveBy WakeupTone reception.

Inter-Answer Delay :

This parameter allows to define the delay the RTM should wait between 2 answers to a DriveBy WakeupTone.
The format is : 0xhhmmss : hh = hours number, mm = minutes number, ss = seconds number.
The maximum allowed delay is 255 hours + 255 minutes + 255 seconds and the minimum is 1 second.
This delay include the frames sending.

Minimum RSSI :

This parameter defines the minimum RSSI Level required on a DriveBy WakeupTone to answer.

ATTENTION :

DriveBy/WalkBy mode is not available in ***evoHop Elster AMCO*** *profile.*

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.

ATTENTION :

*Datalogging management is not available in **evoHop Elster AMCO** profile.*

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 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).

5.2.2.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)*

5.2.3.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.

5.2.4.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.

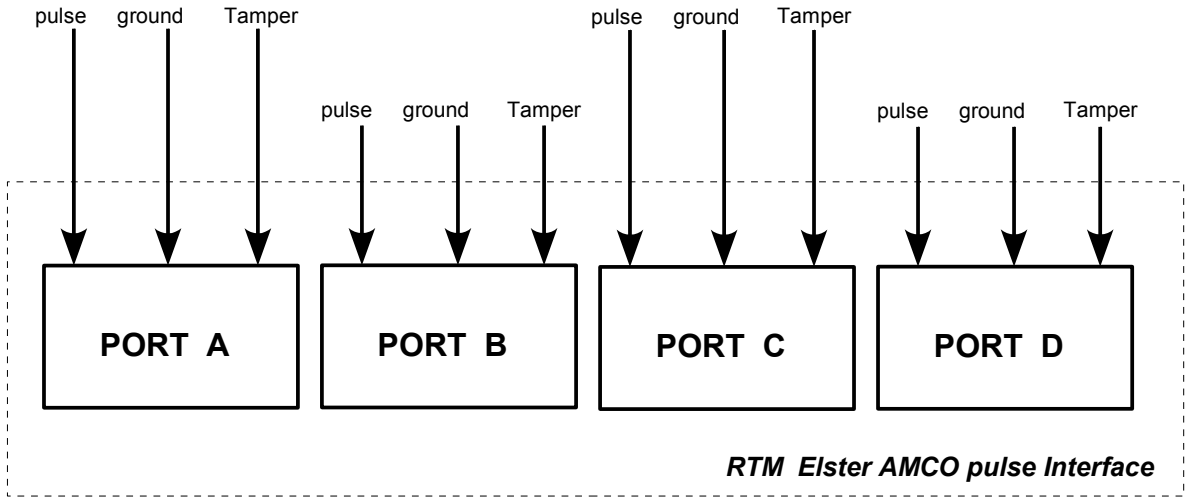
- **Day of the month (datalogging once a month) :** the format is different from the datalogging once a week. Indeed, the day of measurement is set from 1 to 28. And, the system does not manage changes in the number of days depending on the month (day of the month setting cannot exceed the 28th).

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



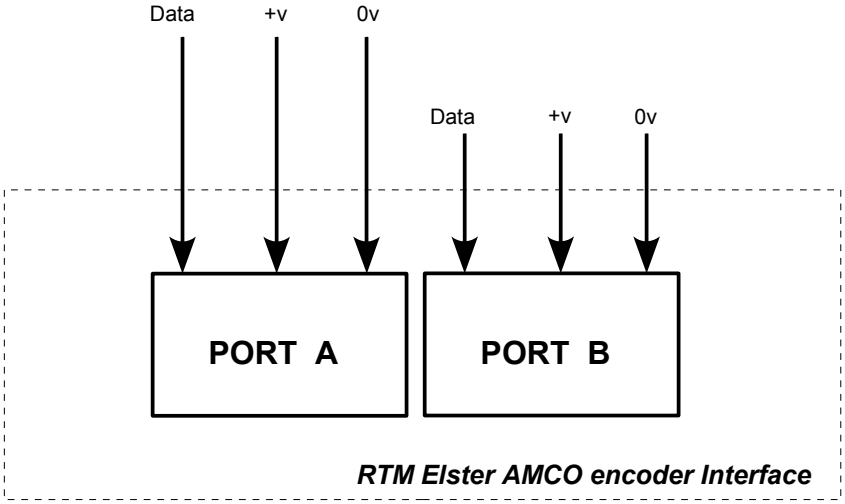
RTM Elster AMCO pulse profile list :

- **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.

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.*

5.4.3.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.

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.*

5.4.4.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.

5.4.5.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.

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.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.

5.5.2.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 reading is not available in **evoHop Elster AMCO** profile.*

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.

5.5.3.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.

ATTENTION :

*Datalogging table reading is not available in **evoHop Elster AMCO** profile.*

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.

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.*

5.5.4. 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.

ATTENTION :

*Time Of Use buckets is not available in **evoHop Elster AMCO** profile.*

➔ **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.

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.*

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.

ATTENTION:

*In evoHop profile case, the only allowed command is **0x01**. It allows to get generic header informations.*

5.7.Leak detection management

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

ATTENTION:

Leak Detection Management is not available in evoHop Elster AMCO profile.

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*).

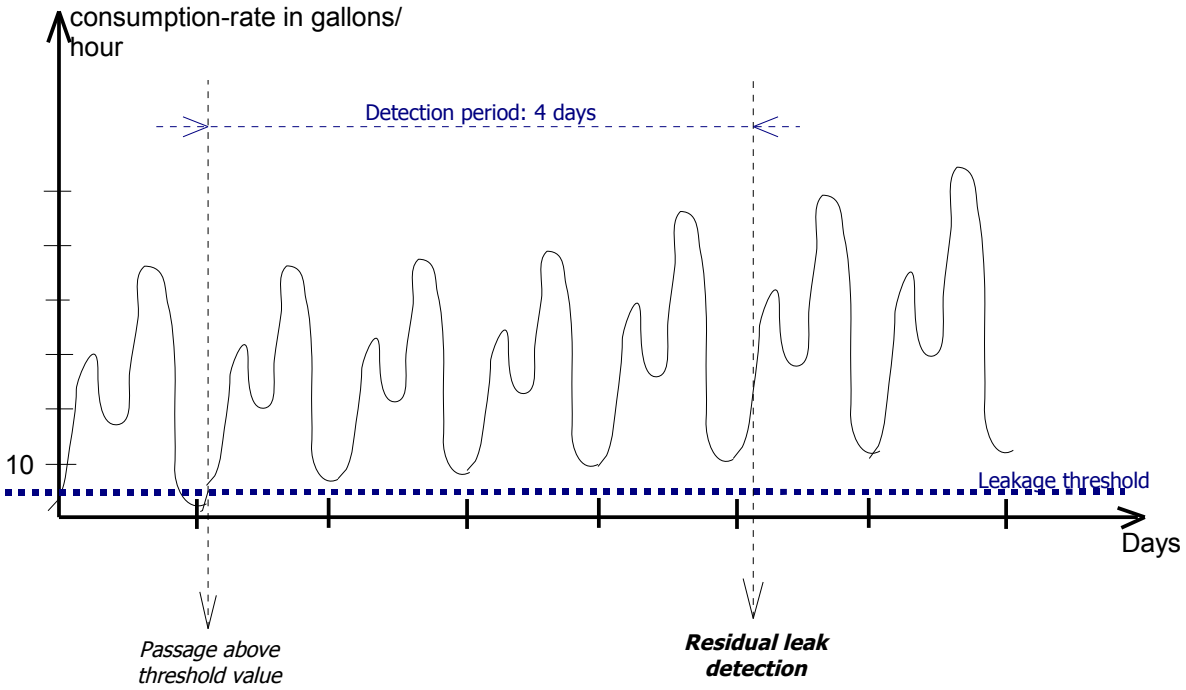
- ***Residual leak threshold*** : Detection threshold, expressed in number of pulses per sample period (pulse register) or absolute volume per sample period (encoder). It is necessary to link this value with the right pulse value or encoder unit.
- ***Residual leak detection period*** : minimum time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

5.8.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.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).

5.9.1.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.

5.9.2.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.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.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) (encoder and pulse register only)
- Residual Leak detection (Low threshold) (encoder and pulse register only)
- 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.

5.11.1.Time windows dedicated to alarm sending

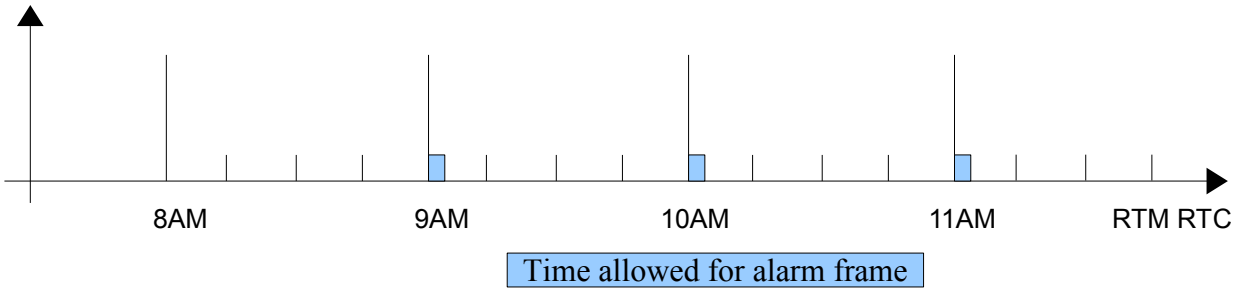
Activating alarm in a system already configured to send information using pseudo bubble up mechanism can lead to collisions. To avoid as much as possible these collisions **RTM Elster AMCO** embeds a parameter that allows to configure time windows dedicated to alarm. These time windows will then not 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.

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.



5.11.2. 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.

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	-	4	xxxxx
sRTM Elster AMCO	-	51	-	4	xxxxx
evoHop	-	56	-	4	xxxxx

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

sRTM : same specifications as RTM but able to repeat 10 RTMs.
evoHop : not connected to a meter and able to repeat 10 RTMs.

APPENDIX : SERVICE COMMANDS

Services commands are used to configure Wavecard modules or to read radio parameters independently of the connected host equipment. No data is 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)

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 acknowledgement

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

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)

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 could void the user's authority to operate the equipment.