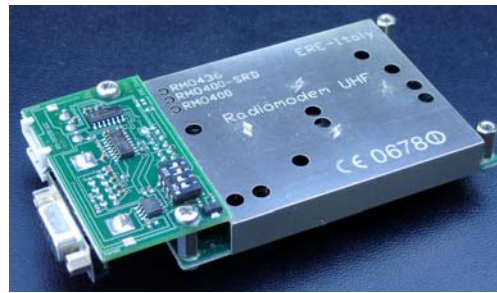


# RMO400, RMO400SRD e RMO436 - RADIOMODEMS UHF

RS 232-RS 485  
INTERFACE

Device certified under  
R&TTE 1999/5/CE  
Directive



CE 06780

## GENERAL INFORMATIONS

The **RMO400** is an high quality **UHF Radiomodem** in **simplex/half duplex mode** having a maximum R.F power of **2 W** in the **430-450 MHz** band. Others band are available and exactly the **RMO400-1: 390-410 MHz**, **RMO400-2:410-430 MHz** and **RMO400-3: 450-470 MHz**. For all available bands the device is **compliant with the national directives and rules on the radio spectrum utilisation**.

The **RMO400SRD** device is equal to RMO400 with the **R.F. output power reduced to 500 mW**. This device is utilisable under the **Short Range Device** directives applied in each country of the European Community.

The **RMO436** is an SRD with an **500 mW R.F. output power** working on the **Italian PMR Band** from **436,000 to 436,100 MHz**, containing **8 channels** with **12,5 kHz spacing**, that the Italian Communications Ministry allows to digital data communications for industrial, commercial and professional uses on payment of a **low cost fee**. This device is specified for the utilisation in **Italy**.

For all the above mentioned devices the functionality is **fully transparent** to the user and the configuration is simply feasible by the related **SW utility** to install on a **personal computer** with Windows '95→XP operative systems.

All devices are available both as single module with a **TTL UART Interface**, for a direct connection to a **µController** board, or as a complete device with the **RMO4IN Interface Board** for the **RS-232/RS-485** interfacing. In the single module version the **R/T485 criteria**, for the Transmit/Receive commutation of a RS-485 external interface unit, is available on main connector.

For all devices the **RMO4EM** outdoor mounting kit and the **RMO4Y3**, three-elements Yagi antenna, are available. Only for **SRD** apparatus the RMO4Y3 antenna **must be used** with a **10 m (10.933 yds)** of **RG-58 coaxial cable**.

### Specific characteristics:

- **Turning ON/OFF** by the **DTR criteria** with less than **100 nA** leakage current in DTR OFF condition
- **Low power consumption** both in RX than TX mode and **Power saving** utility settable by configuration software
- **Broadcasting or addresses management** by configuration software or directly by DTE
- **Digipeater mode** to allow communications between hidden units. In these events the direct communication is generally impossible
- **Remote configuration and channel change** directly from DTE
- **Others advanced configuration utilities** as **ACK and message resending, Echo**, utilisation of received addresses for the answer etc.

All devices are assembled in SMT technology with industrial temperature range components and are **specially designed** for **Low cost Radio Networks** where the contemporary necessities of low power consumption, e.g due to a battery or solar cells supply, and an high quality are fundamentals in the device choice.

General		Receiver	
Freq. range RMO436	436,006.25-436,093.75 kHz	Sensitivity	-118 dBm@ 12 dB SINAD
Freq. range RMO400	390-470 MHz in 4 sub-bands of 20 MHz each	Selectivity	-60 dB
Freq. range RMO400SRD	390-470 MHz in 4 sub-bands of 20 MHz each	IMD attenuation	-65 dB
Channels spacing	12.5 kHz (tuning spacing 6.25kHz)	Spurious radiation	-60 dBm
N° of channels RMO436	8	Interface	UART TTL + RT485
N° of channels RMO400	1600	Data rate interface	1200 → 38400 bps
N° of channels RMO400SRD	1600	Data format (standard)*	asynchronous 8,N,1
Modulation	F2D	Communication mode	simplex
Data rate radio	2400 - 3600 bps (4800 bps not certified)	RMO4IN general	
Frequency stability	+/- 1 kHz	Interface	RS 232 - RS 485
Operating voltage	11.5 / 13.5 VDC	Connector	D9F
DC RX current	about 60 mA	Data rate	1200 → 38400 bps
DC TX current	typ. 350 mA (typ. 700 mA for RMO400)	Operating voltage	11 - 13.5 VDC
DC current DTR OFF	< 100 nA		
Antenna	λ/4 or 3 elements Yagi (dedicated for SRDs)		
Size H x W x D	90 x 60 x 13 mm (3.55 x 2.36 x 0.512 inches)		
Operating temperature	-20 to +60 °C [-4 to +140 °F]		
Transmitter			
RF power	500 mW erp ( 2 W for RMO400 )		
Frequency deviation	+/-1.5 kHz		
RF power stability	+/-1.5 dB		
Spurious radiation	EN 300 113-2, EN 300 390-1, EN 300 296		
Adj. Channel power	-60 dB		
		* for other standards please contact factory	All stated specifications are subject to change without notice or obligation.

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## Circuit Description

The radiomodem is constituted by a synthesizer, a receiver, a transmitter a microcontroller ( $\mu\text{C}$ ) unit, a data interface and a supply unit.

The **Receiver** unit is a double conversion characterised by an high-dynamic MOSFET front-end with automatic tuning for the preselector. The 1<sup>st</sup> I.F. at 45,000 kHz is filtered by a four-poles crystal filter and the 2<sup>nd</sup> I.F at 455 kHz is filtered by a six-poles ceramic filter to ensure the requested selectivity. The received signal is send to a **quadrature detector** and, after the demodulation, to a **Slicer for data detection**. The integration of the demodulated signal is the source of the slicer comparison level and it's value may be **fixed** by the **FREEZE** command to avoid mistakes due to variation of duty cycle in the data stream. The receiver VCO, operating in down-conversion mode, is characterised by a low phase noise and a good mechanical vibration rejection.

The **Transmitter** section contains a VCO, controlled by synthesizer, followed by two amplifiers and the **Power MOSFET**. This output stage is characterised by high **Intermodulation** performance and reliability because it works quietly respect the normal operating condition of the power semiconductor. The **data signal** from  $\mu\text{C}$ , after a low-pass filtering with R-C and L-C cells, is sent to VCO and to the **reference VCTCXO** to obtain a excellent modulation. The **output power Rise/Fall times** are strictly controlled by the  $\mu\text{C}$  optimizing the behaviour during the Rx/Tx transients.

The **synthesizer** unit controls both the receiver and transmitter VCOs with PLL technique and the tuning of preselector resonant circuits in the receiver front-end.

The **microController ( $\mu\text{C}$ )** unit is configurable by the dedicated SW and manage the entire radiomodem and the communication protocol. The **DipSwitch Bank**, from **1 to 3**, is connected to  $\mu\text{C}$  to operate the **channel selection** between the eight available channels. The switch **n° 4 must be always in ON** to supply the  $\mu\text{C}$ . If this switch is in OFF the radiomodem is inactive. This condition is used **only** during the firmware implementation at factory.

The **Supply section** is switched by **ENRTX criteria** and is protected against polarity reversal and short circuits by a **0.75A SMT fast blow fuse**. After the power switch the voltage is stabilised to 8, 5 and 3.6 Vdc as requested from the various sections of the radiomodem.

If the **RMO4IN** board is used the switching on/off control is the **DTR criteria** of **RS-232 serial port**. The **dipswitch bank** on this board has the similar function of the one on the radiomodem board. The switches from 1 to 3 select the operative channels while the **4<sup>th</sup> switch is the DTR criteria**. This switch **must be always in ON** to turn-on the radiomodem. In this way the radiomodem is turned on also if the DTR criteria is not connected e.g. if RS-485 serial port is used. If DTR is connected, it operates correctly as the above switch is open.

It's important to remember that the Interface Board **reverse the data logic** both on Rx/D and Tx/D lines. If in a communication system one or more radiomodems are used **without RMO4IN board** the insertion, in these units, of a **inverting buffer** both in Rx/D and Tx/D lines is absolutely necessary to respect the correct logic. In absence of these inverters the communication is impossible or uncorrected.

<b>WARNING!</b> <b>CONNECTOR REVERSAL</b> <b>CAN DAMAGE THE</b> <b>CIRCUIT</b>		<b>S1</b> Dip1 – CH0 channel selector Dip2 - CH1 channel selector Dip3 - CH2 channel selector Dip4 - always in ON state  <b>Binary mode</b> <b>Dip selected in ON state</b>  Dip 1,2,3 are in parallel with homologous of RMO4IN
	<b>JP1</b> 1 - DC Supply 12.5 Vdc 2 - DC Supply 12.5 Vdc 3 - GND 4 - GND 5 - Rx/D TTL receive data to DTE 6 - Tx/D TTL transmit data by DTE 7 - CONFIG +Vdc in configuration modality	

**THE EMPLOYMENT OF THIS APPARATUS IS SUBJECTED TO A GOVERNMENT AUTHORISATION AND TO THE NATIONAL DIRECTIVES ON THE RADIO SPECTRUM UTILISATION**

**REFERENCE NORMATIVES : EN 300 113 , EN 300 390 , EN 300 296 , EN 60065 , EN 301 489-5 , EN 301 489-3**

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## Products and Accessories:

<p><b>RMO400SRD</b></p> <p>Power: <b>500 mW<sub>RMS</sub></b> with dedicated <math>\lambda/4</math> aerial, operating on 430-450 MHz band.</p> <p><b>Related products:</b></p> <p>RMO400SRD-1: 390-410 RMO400SRD-2: 410-430 RMO400SRD-3: 450-470</p>	<p><b>RMO436</b> <b>500mW out.</b></p> <p>with <math>\lambda/4</math> dedicated aerial developed for <b>Italian market</b> on the following authorized channels:</p> <p>1:436006,25 kHz 2:436018,75 kHz 3:436031,25 kHz 4:436043,75 kHz 5:436056,25 kHz 6:436068,75 kHz 7:436081,25 kHz 8:436093,75 kHz</p>	<p><b>RMO400</b></p> <p>Power: <b>2 W<sub>RMS</sub></b> More characteristics as <b>RMO400SRD</b></p> <p><b>Related products:</b></p> <p>RMO400-1- 390-410 RMO400-2 - 410-430 RMO400-3 - 450-470</p>	<p><b>RMO4IN</b></p> <p><b>RS232/RS485</b> Interface unit board for <b>all</b> the RMO4xxx series.</p>	<p><b>RMO4EM</b></p> <p>Outdoor mounting kit for <b>all</b> the RMO4xx series.</p>	<p><b>RMO4Y3</b></p> <p>Three elements Yagi directive aerial for all RMO4xx devices. For SRD devices a <b>10.93 yds (10 m) RG 58 A/U</b> cable <b>must</b> be used to compensate the aerial gain.</p>	<p><b>DRP-03</b> DIN rail locking system.</p>
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### CERTIFIED DEVICES

**RMO400** – Standard unit operating on 430-450 MHz Band

- Suffix 1** - Characterised on 390-410 MHz Band
- Suffix 2** - Characterised on 410-430 MHz Band
- Suffix 3** - Characterised on 450-470 MHz Band
- Suffix IN** - Open board unit with Interface Board RMO4IN
- Suffix B** - Unit with interface board RMO4IN in a stainless steel enclosure with BNC Aerial connector (TNC on request)

**RMO400SRD** – Standard unit operating on 430-450 MHz Band with dedicated  $\lambda/4$  aerial (ANT406).

- Suffix 1** - Characterised on 390-410 MHz Band
- Suffix 2** - Characterised on 410-430 MHz Band
- Suffix 3** - Characterised on 450-470 MHz Band
- Suffix IN** - Open board unit with Interface Board RMO4IN
- Suffix Y3** - Open board unit with three elements Yagi aerial plus 10.93 yds (10 m) RG 58 U coaxial cable
- Suffix EM** - Unit with outdoor mounting kit
- Suffix B** - Unit with interface board RMO4IN in a stainless steel enclosure with BNC Aerial connector (TNC on request)

**RMO436** – Designed for the **Italian Market** operates on the above specified eight channels with dedicated  $\lambda/4$  aerial (ANT406)

- Suffix IN** - Open board unit with Interface Board RMO4IN
- Suffix Y3** - Open board unit with three elements Yagi aerial plus 10.93 yds (10 m) RG 58 U coaxial cable
- Suffix EM** - Unit with outdoor mounting kit
- Suffix B** - Unit with interface board RMO4IN in a stainless steel enclosure with BNC Aerial connector (TNC on request)

**Ancillaries:** **DRP-03: DIN rail** locking system in extruded aluminium. Mounted on the box.

**AERIALS** – The Radiomodem unit is certified with the following dedicated aerials:

- 1 – ANT406/BNC** : Flexible aerial with  $\lambda/4$  length and male BNC connector. Designed for the insertion of the modem into a metallic or plastic box. Drill the upper side of the enclosure with a 0.512" (13 mm) hole and insert here the bulkhead female BNC connector of the radiomodem. If the enclosure is of plastic or other insulating material, glue the **adhesive radial** on the internal surface before insert the BNC female connector. This radial is 13.78"(350 mm) length and 0.787"(20 mm) wide. **Take care to the electrical contact** between the aluminised side of the radial and the bulkhead case (Ground): the rubber sealing ring may prevent the electrical contact. Verify the electrical connection with a multimeter.
- 2 – ANT Y3** – Three elements directive Yagi aerial for applications where an high interference immunity is required. In **Short Range** devices this aerial **must be used** in conjunction with its 10.93 yds (10 m) RG 58 A/U coaxial cable to respect the **maximum permissible radiating power (ERP)** specified by the SRD directives.
- 3 – ANT 413** – Ground Plane aerial with steel casting base for insertion on pole.
- 4 – ANT 229** – Vehicular  $\lambda/4$  aerial designed for outdoor installations over a metallic plane where a good impermeability is required. The metallic surface works as the aerial ground plane. 5 mt. low loss coaxial cable with BNC connector.
- 5 - MC 430 450** - Dipole vertical antenna with 5 mt. low loss coaxial cable and BNC connector.

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## RMO400 - RMO400SRD – RMO436 - CONFIGURATION

The Radiomodem setup is achieved by the **Configuration Software RMO400SW** dedicated to **all** devices. This software is releasable from our Internet website at URL: [www.ere-online.it](http://www.ere-online.it)

Is necessary the installation of the Interface Board RMO4IN, or equivalent RS-232→TTL interface unit, on the radiomodem board. The configuration procedure is following:

- 1 - Install the configuration software on your Personal computer. The required OS are Windows '95 → XP and the PC **must have** a RS-232 Port.
- 2 - Connect the radiomodem RS-232 port to the computer COM port with a **straight cable (NO Null Modem)**.
- 3 – Start the software, open the **Option menu** to select the **COM Port** and the **operating Band** of the radiomodem in according to the owned model
- 4 – Connect together the **CONFIG pin (No.1)** and the **Supply Pin (No. 2)** of the supply connector than turn-on the power supply. In this way the radiomodem is forced into **Configuration Mode**. If an other RS-232→TTL interface than RMO4IN is used, connect the pin **No. 7** of the radiomodem connector to a positive supply.
- 5 – Follow the online help of the configuration software to achieve the complete radiomodem setup.
- 6 – At the end of setup to exit from Configuration mode turn-off the power supply, remove the pin No.1 to pin No.2 link (or the positive supply to pin No.7 link if an other Interface Unit than RMO4IN is used).

The configuration software shows three pages: **BASIC**, **ADVANCED** and **LINK TEST** for the communication test after the setup.

### **BASIC:**

**SYSTEM CODE** – It defines univocally the radio network. Of course **all** radiomodems of the network **must have** the **same System code**.

**RX and TX Frequency** - The receiving or transmitting frequency. The frequency value is indicated in **kHz**.

**BROAD** - If selected, **all radiomodem release the received packet**. The **target address** is not considered but **necessary** to permit the usage as **digipeater** and the **remote configuration** if requested. Of course the target address must be different for each radiomodem. In Broadcasting Mode is possible the usage of **only one digipeater**. In order to use a greater number, up to 8, of digipeaters in a Broadcasting network is necessary to configure all the 8 available channels with the same parameters changing only the **digipeater address** and selecting the operating channel by remote configuration. If the Broad option is unselected **only the addressed modem release the packet** to the its DTE. The utilised addresses may be the set in configuration, see Advanced page, or given by DTE if Addr from DTE is chosen. In this case the address precede the sending message. Please see the Addr from DTE paragraph for more. If the **bit 7** of the **System Code** is set to **1**, a broadcasting message is sent.

**FLOW CONTROL** – In **RS-232** mode controls, via the **CTS criteria**, the buffer loading. If selected the buffer dimension is **slightly lower** than **256 byte**. Do not select for message of 256 bytes length or in **RS-485** mode. In **RS-485** mode the CTS criteria is employed as interface Rx/Tx switch.

**TIME DTX** – Configure the delay time between the end of the last character of the incoming packet and the start of the transmission cycle. If the DTE inserts a (variable) delay time between the bytes of a packet, the appropriate choice of this time avoids the cutting off of the message. An example of this phenomenon can be seen using Hyperterminal to send a packet.

**BAUD RATE DTE** – Set the **RS-232** or the **RS-485** serial port speed. The possible speed range is from 1,200 bps to 38,400 bps

**BAUD RATE RADIO** – Set the data transfer speed in the radio channel. Available speeds are **2,400** bps, **3,600** bps and, but only if the **SINAD** is high, **4,800** bps. The last one is **not certified**.

### **ADVANCED :**

**ITS ADDRESS** – Address of the radiomodem unit. Allowable values between **1** and **255**. The address defines univocally each radiomodem. The value **1** in a unit of a Point-Multipoint network operating in **Power Saving Mode** denotes the **Master Unit** that is **always powered**.

## RMO400 - RMO400SRD – RMO436 - CONFIGURATION

**TARGET** – Address of the destination unit. Allowable values from **1** to **255**. In all operating conditions this value **must be set** to permit the unit identification. In **Broadcasting** and **Addr from DTE** modes, although the address is not utilised, it must be present.

**DIGIP.** – Address of the unit used as **repeater**. Allowable values from **1** to **255**. If the value is **0** no one repeater is used. The digipeater may be a peripheral unit. In **Broadcasting mode** it first repeats the message afterwards discharges it to the serial port. In all operating modes with addresses the digipeater unit repeats the message without discharging it to the serial port. In the **Address from DTE** mode this field is not used and the correct addressing must be assigned from DTE.

**ACK** – Selecting this option the target radiomodem when receive a valid packet answers to the source modem an **ACK packet**. If the source modem don't receive the ACK, it continues to repeat the message until the receiving of an ACK. The option is available only for all addressed modes but **not** for **Broadcasting** mode. The acknowledge packet passes through the digipeaters units without repetitions.

**REPETITION** – Set the numbers of the message repetitions in absence of ACK packet. Allowable values from 1 to 255.

**NAK TO DTE** – Selecting this options the radiomodem sends a **NAK** character (ASCII 21=§ ) to the DTE if all the re-transmissions have been unsuccessful.

**ADDR TO DTE** – If selected , the receiving radiomodem sends the source unit address to the DTE. The address byte precedes the received data.

**RX ADDR FOR TX** – If selected, the receiving radiomodem holds in memory all the incoming addresses and uses them in the **reversed order** for the answer. An useful option for applications with “not intelligent” DTEs.

**ECHO** – If selected, the packet sent to the target radiomodem is re-transmitted to source radiomodem without releasing it to the serial port. It's an utility to check the radio link. This option is not available in **Broadcasting mode**. If the **bit No. 1** of the **System code Byte** is set at **1**, the Echo function is activated also in **Addr from DTE mode**.

**ADDR FROM DTE** – If selected, the DTE manage directly all the addresses. The addresses saved in configuration are not used. This option must be selected to manage the channel change in **Broadcasting mode**. The DTE sends some additional bytes before the message to obtain the correct addressing. These additional bytes are: **System Code** (from 1 to 63), **Number of Units** (target plus digipeaters, if present, **up to 9**), **Addresses of digipeaters** in the **exact order of utilisation**, **address of the target unit** and, finally, the **message**. This option is available **only** if the **Rx Addr for Tx** is **unselected**. In the System Code byte the bits Nos. **7** and **6** are the **Broadcasting** and the **Echo** switches respectively.

**PWSAVOFF** – It is the **Power OFF** time in the **Power Saving** cycle. This time is set with **steps of 10 millisecs** and the permissible values vary from **0** to **240**. Setting this time to **0** the power saving cycle is **inactive** and the unit is **always** operative. Of course **all units** in the network **must be set with the same PWSAVOFF time** to allow the communication because it is used to calculate the **preamble lenght**. The **Power ON** time is internally set to **70 milliseconds**. The maximum power off time may be of **2.40 seconds**.

**PWSAVA** – It is the delay time to **return** in Power saving Mode **after** the end of any transmitting or receiving operation. This time is set with **steps of 100 milliseconds** and the permissible values vary from **0** to **240**. This time may be set variously depending on the desired operating modality. For example in a Point-Multipoint network with Power Saving the value **255** set as **always operative** both the **Master** and the **Digipeater(s) unit (s)**.

## RMO400 - RMO400SRD – RMO436 - CONFIGURATION

### CHANNEL SELECTION

The channel selection may be executed in **Hardware Mode**, by using the Dip Switch bank or the **CH0**, **CH1** and **CH2** lines, or in **Software Mode** by using the linked DTE and the suitable procedure.

#### 1 – Hardware Channel Selection

The first three switches of the Dip Switch Bank **S1** on the radiomodem board are used to select manually the operative channel. The 4<sup>th</sup> switch is the  $\mu$ C power switch and **must be always in ON** to operate the radiomodem unit. An other method to change the operative channel utilises the CH0, CH1 and CH2 lines of the JP1 connector and **closes them to ground**. Three open collector/drain transistors/MOSFETs may be used to close each line to ground and in this case the channel switching may be executed by an external  $\mu$ C.

When the **Interface Board RMO4IN** is installed on the Radiomodem unit **only the manual selection** by the Dip Switch Bank is available. In this case the **4<sup>th</sup> switch** is the **power on switch** for the entire apparatus and **must always be in ON** position. The Interface channel dips are in parallel connection with the radiomodem board ones. When the interface board is installed the channel dips on the radiomodem board **must be set in OFF** position.

#### 2 – Channel Selection by DTE

An alternative technique to change/select the operative channel is the **software setting by the DTE**. In this case the **Addr from DTE mode must be selected** for all operative modes including **Broadcasting mode**.

If all the eight available channel are configured, the channel selection between them is made possible following this procedure:

Send **3 bytes** from DTE to Radiomodem in the following order: **New Channel Number – 09h – New Channel Number**. All bytes must be sent in **hexadecimal code**.

After the change, a waiting time of at least 1 millisecond is necessary before start of the normal utilisation. The string **00h – 09h – 00h restores the manual selection** via Dip Switches. Because the channel change via DTE is not stored in the radiomodem memory, whenever the supply line is disconnected the unit **resets itself in manual selection**.

### SENDING A “BROADCASTING PACKET” IN Addr from DTE Mode

It is possible to send a “Broadcasting packet” also in **Addr from DTE mode**. In fact in the **System Code Byte** the **bit No. 7** is the **Broadcasting switch**. This switch is enabled if the bit is **1**.

On the other hand in **Addr from DTE mode**, as explained above, it is necessary send to the radiomodem, before the message, a sequence of byte to obtain the correct addressing.

In this case the sequence of bytes includes the **System code byte**, with the bit No. **7** at **1**, and the required address bytes in according to the system specifications. For example for a **point to point** network the required string is: **System code – 01h – 01h**. The last byte is the target address. This value is not important because in broadcasting mode the target address is not considered.

For more complex networks the required string contains the **System code byte**, with the bit No. **7** at **1**, and the identical sequence shown for **Addr from DTE mode** with the difference on the **target address byte** that may take any values because it is not considered.

# RMO400 - RMO400SRD – RMO436 - CONFIGURATION

## *TYPICAL CONFIGURATIONS FOR MOST COMMON UTILISATIONS*

### COMMUNICATION BETWEEN TWO RADIOMODEMS (POINT TO POINT)

#### 1) **Broadcasting Mode.**

The most simple utilisation. For both radiomodems configure with the same values the **System Code**, the **RXFreq** and the **TXFreq** respectively and the **Baud Rate Radio** (2,400 or 3,600 bps as standard, using the 4,800 bps only in high SINAD networks). For each modem assign two different values in **It's Address** and **Target Address** fields and **0** in **Digip** field to exclude the presence of a digipeater unit. Select the **Broad** option to enable this mode while the **Baud Rate DTE**, the **Flow control** etc. etc may be set in according to the communication requirements. Some fields are **not active** because their activation is **not compatible** with other settings. The **active** fields are, usually, coloured in **white** while the others are in **grey**.

#### 2) **Broadcasting with Digipeater Mode.**

If a repetition is required a third radiomodem unit must be utilised as Digipeater. The new unit must be set with identical values of RX and TX Freq, and the same Baud Rate Radio of the other units to allow the communication. For the digipeater unit is necessary set the **Its Address** field with a **different value** from the others and **0** in the **Digip**. field. In the other units in the **Digip**. fields **must be set the Its Address value** of the digipeater unit. The digipeater unit, however, releases to its serial port the received message so this unit may be utilised also as a peripheral.

#### 3) **Configuration Addresses**

This mode allows some utilities denied in the Broadcasting mode. To operate in this mode is necessary **unselect the Broadcasting option** than configure both the **Its Address** and **Target Address** fields with two different values. Of course these two addresses **must be reversed** in the two units because the Target Address of the 1<sup>st</sup> unit is the Its Address of the 2<sup>nd</sup> unit and vice versa. If a digipeater unit is required, a third different **Its address** value must be assigned to the additional unit and this value must be set in the **Digip**. fields of the other two radiomodems. In the digipeater unit the **Digip**. fields must be **0**. In this configuration the **ACK**, **Repetition**, **NAK to DTE**, **Addr to DTE** and **ECHO** are available. Only for a **RS-232** communication is possible to select the **Hardware Flow Control RTS/CTS** to send messages longer than 256 bytes. The activation of ACK utility allows an high quality communication to avoid packets losses. If an **RS-485** serial port is used, this feature is not available because the communication port don't support the Flow control criteria.

### **POWER SAVING MODE**

If one or more units must be supplied by a battery or solar cells and the available energy is not sufficient to energise the system, is possible to activate the **Power Saving** utility. In this operating mode the unit will be supplied with a duty cycle equals to **70 / PwSavOFF** with all times in milliseconds.

The total cycle time is **70 + PwSavOFF** in milliseconds.

In this way the fixed power consumption of the receiver is reduced by the **duty cycle factor** to save energy increasing the battery life. For correct operation the **PwSavOFF** time **must be the same** in all units because the **preamble time** is equal to **PwSavOFF + 100** milliseconds. The correct choice of the **PwSavOFF** time is a compromise result between the achievable energy saving and the admissible speed slowing.

After a successful communication the radiomodem waits a **PwSava time** before return in the Power saving cycle. The choice of this value depends on the following considerations:

- 1 – All units, digipeaters included, in the power saving mode transmit with a **long preamble**.
- 2 – All units in the power saving mode **recognize only** messages having a **long preamble**.
- 3 – During the **PwSava time** all units, digipeaters included, transmit messages with a **standard (short) preamble**.  
At the same time they can recognise messages having any **preamble lenght**.
- 4 – As specified for the **PwSavOFF** also the **PwSava time must be the same in all units**.

## RMO400 - RMO400SRD – RMO436 - CONFIGURAZIONE

### TYPICAL CONFIGURATIONS FOR THE MOST COMMON UTILISATIONS

#### MULTIPOINT COMMUNICATIONS

##### 4) Broadcasting Mode.

The most simple utilisation. The communication protocol is completely managed by the network firmware. All units of the network, digipeater included, release the received message to their serial ports. Follow the instructions shown in the points **1** and **2** for the correct unit configuration. Any units may be chosen as digipeater. All the communications utilise this unit as “transit point” to reach their targets.

If a digipeater change or a direct transmission between two radiomodems is requested, is possible to configure the others channels with the same operating frequency but with different parameters, e.g a different System Code, and use the **Channel change by DTE** procedure. In this case the option **Addr from DTE must be selected** as formerly explained in page 6.

##### 5) Broadcasting Mode with Power Saving.

A typical network configuration shows a **Master unit**, normally connected to the ac line, one or more **Slave units** and, eventually, one or more **Digipeaters**. Although the majority of the peripherals are fed by the ac line, some of these may be supplied by a batteries system or solar cells. In these situations the available energy may be insufficient to allow a continuous service. The solution to the low energy availability is the **Power Saving Mode**. As explained in the specific paragraph, please refer to page 7, all units **must have the same PwSavOFF time** and his choice is a compromise between the required amount of energy saving and the maximum permissible slowing down of the communication speed. The **PwSava** time must be selected in according to the following consideration: when the peripheral unit is in the PwSava time it can decode a **short preamble** message while if this time is expired, a **long preamble** one is requested for the decoding. Of course the power consumption is higher for messages with a long preamble than a short one, so an operative status of the unit is preferable. Consequently the recommended configuration is the following:

- A) The **Master unit** must be always turned-on. Setting to **255** the **PwSava** time, this unit is always operative and can manage packet with **different preamble length**.
- B) All **Slave units** will be set with a **PwSava** time sufficient to allow the answers of their DTE to an incoming query, with an adequate time margin. It is essentially related to the answer times of the DTE.
- C) All **Digipeaters units**, if presents, will be set with a **PwSava** time slightly shorter than the answer time-out of the DTE linked to the **master unit**. In this way all the digipeaters are active during the answer.
- D) For **all units** the **PwSava** time counter **starts at the end** of any transmitting or receiving cycles.

#### NOTES

- 1) If the radio network is very busy or very big, the **Addr from DTE operating mode** is recommended rather than Broadcasting. In fact in Broadcasting mode **all units** decode and release on the serial port the received message independently from the message address. In this way the unused units are activated without necessity, causing an unnecessary loss of energy that may be a problem for the units powered by an autonomous energy source. The possible solutions are **the use of a different System Code**, one for the mains powered units and another for the remaining ones, otherwise **the channel change** to split the entire network in two, or more, smaller groups.  
In the first case all units exit from power saving cycle but only those receiving the correct System Code remain active while the others come back immediately to the power saving cycle.  
In the second case only the units of the specific group exit from power saving cycle while the others remain inactive.
- 2) The **Master unit** transmits **always** with a **long preamble**, depending on the PwSavOFF time, and can receive messages with both **short and long preamble**.  
The **peripherals** and the **digipeaters units** exit from power saving cycle when a **long preamble** message is detected and remain active for all the PwSava time. During this interval they transmit with a **short (standard) preamble** and can receive messages with both short and long preambles. After the end of this time interval they transmit with a **long preamble**.

## RMO400 - RMO400SRD – RMO436 - CONFIGURATION

### TYPICAL CONFIGURATIONS FOR THE MOST COMMON UTILISATION

#### MULTIPOINT COMMUNICATIONS

##### 6) Addresses from DTE Mode with Power Saving.

Is the most favourable operating mode to reduce the power consumption using all the utilities provided by the communication protocol. It's necessary to select the **Addr from DTE** and choose an appropriate value of the **System Code**. This value **must be the same** for all peripherals. In the **Master unit** this value is directly set by the **DTE** and, of course, must be the same of the peripherals. Each unit **must have** an **univocal It's Address, 1** for the **Master unit**, while both the Target and Digipeater addresses are not considered. In any case a generic values must be set in these fields. The default values of the configurations software may be an adequate choice.

The **ACK** options permits the repetition of the message but a repetition managed **directly by the application firmware** is recommended to minimise the time losses.

The **NAK to DTE** option is available only if the **ACK** is selected.

The **Addr to DTE** option, selectable **only** in the **Master unit**, send the **address byte** of an incoming message to the DTE.

The **Rx Addr for TX** option may be selected in the peripherals if they are not able to address the answer message. In the **Master unit** this choice is automatically stopped by the **Addr from DTE** enabling.

The **ECHO** option may be directly activated in the **System Code byte** sent by the DTE therefore don't select it in the configuration.

The **Repetition** option is not available if the **ACK** is unselected.

The **PwSavOFF time** will be a compromise between the required energy saving and the communication slowing down and **must be the same for all units**.

The **PwSava time** will be **255** for the **Master unit** while for the others will be related to the DTE answer delay time as formerly explained in page 8. For **all units** the **PwSava time counter** is cleared at every transmitting or receiving end.

##### Requested data stream from DTE.

To allow the correct addressing the DTE linked to the **Master unit must send** an adequate numbers of bytes before the message sending. The length of this "head" depends on the communication route and the bytes sequence is the following:

1<sup>st</sup> : The **System Code byte** (values from 1 to 63) in which the bits **Nos. 7 and 6** are the **Broadcasting** and **Echo switches** respectively.

2<sup>nd</sup> : The **Number of unit Byte** indicating the **total number** of unit in the route. It contains both all **digipeaters** and the **target**.

The maximum admissible value is **9** equivalent to maximum **8** digipeaters plus the target.

The successive bytes are **the addresses of each digipeater** in the **correct sequence of use** and finally the **last address byte** is the **target address**. It's possible to send a **Broadcasting message** also in this operative mode. Please refer to page 6 for more information.

#### NOTES

1 – If one or more peripherals are linked to the master directly or trough **only one digipeater**, is possible, in these units, to configure the addresses and disable the **Addr from DTE** option so that the DTE may send a message without any addressing. For more complex addressing it's useful the **Rx Addr for Tx** option. In this way, as explained at page 5, the received address string is reversed for the answer.

2 – In more complex networks, in which the power saving is essentially, it's possible to reduce the power consumption dividing the entire network into two or more groups having different operating frequencies. In this case only the units of a specific groups leave from the power saving cycle while the others remaining in this status. In the active group only the unit recognising his address remain active for the entire message time while the others return immediately to the power saving cycle. To allow this feature is necessary to use the **Channel change from DTE** procedure as explained on page 6.

3 – The **Master unit must be set** with **It's Address=1** so this unit is **always operative** and transmit with a **long preamble**, depending on **PwSavOFF** time, and can receive messages with both **short (standard)** and **long preamble**.

4 – All the **Slave** units (peripherals) and all the **Digipeaters** unit exit from power saving cycle by a **long preamble** message and remain operative for all the **PwSava** time. During this interval they answer with a **short (standard) preamble** and can receive messages with both short and long preambles. After the end of this time interval these units transmits with a **long preamble**.

5 - If the answer is longer than 255 Bytes, is possible to set, for this peripheral, both the **ACK** and the **Flow control** options. The feature, possible **only in absence** of any digipeaters, causes an appreciable slowing down of the communication speed. Because the **ACK** in any case causes a slowing down, the DTE management of the message is preferable. In this cases the message can be split into two or more shorter parts directly by the DTE.

# RMO400 - RMO400SRD – RMO436 - CONFIGURATION

## COMMUNICATION TIMING

The correct timing is fundamental for a successful communication. Because the radiomodem is a **Store & Forward** system the communication process contains three sequential phases.

In the **first** the **internal buffer is loaded** by the incoming data from a generic DTE. The buffer size is **256 bytes**.

In the **second** the stored message is managed by the firmware in according to the communication protocol and is **transmitted** to the target unit through the requested route. The route may contain one or more digipeaters.

In the **third** the received message, if and only if it is correctly decoded, will be released to the communication port of the target unit.

The answer, if present, follows the same steps of the query but in a reverse path.

### 1 – Buffer Loading Time.

The requested buffer loading time is the sum of the time of the sending message, depending on message length and serial port speed, and the fixed **Time DTX** can be set in configuration in according to the DTE timing characteristics.

The resultant time  $T_{BL}$  is given by the following formula:

$T_{BL} = N \times T_{SB} + \text{Time DTX}$  (1) where:

**N** is the number of the bytes in the sending message. Due to the buffer size limit this number is  $\leq 256$ .

$T_{SB}$  is the **Byte time length in milliseconds**. It depends on the selected **Baud rate DTE** and it's computable as:

$T_{SB} = 10,000 / \text{Baud Rate DTE}$ .

The **Time DTX**, in **milliseconds**, is the same set in the initial configuration process.

For example a 120 bytes message is sent by a DTE using a 9,600 bps communication speed with a Time DTX of 10 milliseconds. The resulting  $T_{BL}$  is  $T_{BL} = 120 \times (10,000 / 9,600) + 10 = 125 + 10 = 135$  milliseconds.

### 2 – Transmitting time.

After the buffer loading the communication protocol takes the stored data, adds the requested bytes for addressing, quality control etc. etc., inserts a preamble and, finally, send the resultant message on the air. To simplify the computation of the total time required to transmit the entire message the following consideration must be done:

**A** – The preamble is placed before the entire message.

**B** – The added bytes are, in the worst case, in number of **20** therefore the total message maximum length may be of **276 bytes**.

Consequently the **maximum Transmitting (On Air) time  $T_{OA}$**  is given by the following formula:

$T_{OA} = 35 + T_{pre} + (N+20) \times T_{RB}$  (2) where:

**35** is a **fixed time** in **milliseconds**.

**N** is the number of bytes of the sending message.

$T_{RB}$  is the time length of a byte in the radio transmission. It depends on the selected **Baud Rate Radio** in the configuration process and its value is computable as  $T_{RB} = 10,000 / \text{Baud Rate Radio}$  in **milliseconds**.

$T_{pre}$  is the **preamble time** and depends on the operating characteristics. If the operating mode **avoid** the **power saving cycle**, the preamble length is fixed and equal to **18 milliseconds**. If the power saving is used, the preamble length is:

$T_{pre} = 100 + \text{PwSavOFF}$  in **milliseconds**.

Of course the **PwSavOFF** time is the same set during the configuration process.

For example the above message of 120 bytes is sent by a Baud rate Radio of 3,600 bps without power saving. In this case the maximum Transmitting time  $T_{OA}$  is:

$T_{OA} = 35 + 18 + (120 + 20) \times (10,000 / 3,600) = 53 + 140 \times 2.778 = 53 + 388,92 = 441,92 = 442$  milliseconds.

If a power saving cycle with a **PwSavOFF** time of **500 milliseconds** is used, the transmitting time  $T_{OA}$  is:

$T_{OA} = 35 + (100 + 500) + (120 + 20) \times (10,000 / 3,600) = 35 + 600 + 389 = 635 + 389 = 1,024$  milliseconds.

As shown in the above examples, the employ of the power saving mode **increases** substantially the transmitting time.

The total number of added bytes depends on the operative mode selected. For example using the **Addr from DTE** mode in a complex network with more digipeaters the number of these bytes is higher than in a simple point to point communication.

# RMO400 - RMO400SRD – RMO436 - CONFIGURATION

## COMMUNICATION TIMING

### 3 – Releasing time.

After the correct decoding of the incoming message the radiomodem firmware release the original message to its communication ports. All the added bytes during the transmission are deleted and the released message is the original message to be sent. The total **Releasing Time**  $T_{REL}$ , depends on the message length and the serial port data rate. The following formula indicates the releasing time.

$$T_{REL} = N \times T_{SB} \quad (3) \text{ where:}$$

$N$  is the number of received bytes

$T_{SB}$  is the **Byte time length**. It depend on the selected **Baud Rate DTE** in the configuration and its value is computable as

$$T_{SB} = 10,000 / \text{Baud Rate DTE} \text{ in milliseconds.}$$

For example if the Baud Rate DTE is equal to 9,600 bps the above mentioned message of 120 bytes requires a releasing time  $T_{REL} = 120 \times (10,000 / 9,600) = 120 \times 1.0416 = 125 \text{ milliseconds}$  to be sent to the linked DTE.

Of course the Baud Rate Radio of the two radiomodems **must be the same** for both units otherwise no decoding is possible, while the Baud Rate DTE may be different and in this case in each calculation is necessary to choose the corresponding Baud Rate DTE.

### 4 – Total Communication Time and Notes.

The indicated process is referred to a simple unidirectional communication between the source and the target radiomodems. For the above mentioned example the **Total communication Time**  $T_{COMM}$  is the sum of the three partial times and its value is:

$$T_{COMM} = T_{BL} + T_{OA} + T_{REL} = 135 + 442 + 125 = 702 \text{ milliseconds at least.}$$

It's evident how the major delay time is imputable to the **ON AIR time** therefore the maximum allowable speed must be selected in according to the environmental conditions of the radio link. The choice of the Baud Rate DTE is forced by the DTE characteristics and, if possible, may be set to the highest allowable value for both units.

If an answer is requested, the related timing is computable with the same method, reversing the source and the target units.

### 5 – ACK message timing.

If the ACK option is selected, at the **end** of decoding and **before** of the message releasing the **ACK** message is transmitted from the target unit to the source unit. The **ACK message Time**  $T_{ACK}$  is the transmitting (On Air) time of a message of **20 bytes** and, in according to the formula No. 2, its value is  $T_{ACK} = 55 + 20 \times T_{RB}$  in which the  $T_{RB}$  time is the same defined in the formula No. 2. For example at 3,600 bps of Baud Rate Radio the ACK time is  $T_{ACK} = 55 + 55.6 = 110.6 = 111 \text{ milliseconds}$ .

### 6 – Waiting Time without Digipeaters.

At the end of the transmission cycle the **serial port** is re-activated and it is available for a new incoming message. At the same time the **target modem** is in the releasing mode and its  $\mu C$  is not able to receive a new message from the radio. In this time interval the eventual new message can't be decoded and therefore will be lost. To avoid this behaviour an adequate **Waiting Time**  $T_{WAIT}$  between the **end** of the previous message and the **start** of the following one **must** be inserted. The requested time is given by the following formula:

$$T_{WAIT} = T_{OA} + 5 + T_{REL} - T_{BL} \quad (4) \text{ in which:}$$

$5$  is a fixed time in millisecond necessary to compensate all the time losses due to both the internal switching and the radio link and the others are the same defined on pages 10 and 11.

It's important to notice that the  $T_{REL}$  is referred to the **Target unit** while the  $T_{BL}$  to the **Source unit** and depends on the Baud Rate DTE configured in each unit. This waiting time is **essential** if a very long message, beyond the buffer size limits, is sent **without** the **Flow Control** as for a **RS-485** link. In this case the entire message **must be split** into two or more parts lower than 256 bytes by the DTE. If the **Flow Control** is enabled, this time is internally calculated by the firmware and the **CTS** criteria drives correctly the communication port.

This waiting time is useful if **no answer is expected** by the DTE. If an answer is requested, the related timing calculations will be explained later in the dedicated paragraph.

### 7 - Waiting time with Digipeaters.

The insertion of one or more digipeaters in the message route increases the communication timing and, consequently, the waiting time. In fact each digipeater in the route repeats immediately the incoming message, if it is correctly decoded, and successively release it to its serial port.

# RMO400 - RMO400SRD – RMO436 - CONFIGURATION

## COMMUNICATION TIMING

If **D** is the **total number of the digipeaters units** the **total Waiting time**  $T_{WAIT}$ , in milliseconds, requested between the **end** of the previous message and the **start** of the next one on the **Master side** of the system is given by the following formula:

$$T_{WAIT} = (D + 1) \times (T_{OA} + 5) + T_{RELtarget} - T_{BL} \quad (5) \text{ where:}$$

$T_{RELtarget}$  is the **Releasing time** of the **Target unit**, **5** is the fixed time defined in the previous paragraph and  $T_{OA}$  and  $T_{BL}$  are the same defined on page 10.

The **target unit** is commonly a **peripheral** but may be also one of the **digipeaters** in the system because a digipeater unit **may be** a **peripheral unit** with its DTE. In these cases the **digipeaters unit number** comprehends **only the previous digipeaters** in the route and the  $T_{RELtarget}$  time is referred to the **digipeater unit used as target**.

For example a complete network contains one master unit, three digipeaters and seventy peripherals units splitted into four groups.

The first group of peripherals are linked using all the three digipeaters, the second using only two digipeaters, the third using only one digipeaters and the last one is directly linked with the master unit without any digipeaters. Of course the **D number** for the units of the first group is **3**, for the second is **2**, for the third is **1** and for the last one is **0**. In this case the Total Waiting time is different between the four groups therefore this time must be managed by the firmware of the DTE linked to the Master unit. An other way is using the higher of this waiting times for all the groups. This choice is not the most favourable for the system speed but is the simplest to manage. If an answer is requested the related timing calculations will be explained in a dedicated paragraph.

### 8 – Waiting times for ACK.

The ACK option permits an higher quality control of the communication but adds a further delay time in the process. If **R** is the **maximum Repetition number** of a single packet set in configuration, the **maximum total Waiting time** in milliseconds is given by the following formula:

$$T_{WAITack} = (R + 1) \times (T_{OA} + 5 + T_{ACK}) \quad (6) \text{ where all the parameters are defined as in pages 10 and 11. The formula is valid in the case of a system without digipeaters.}$$

If one or more digipeaters are used, the resulting waiting time, in milliseconds, is given by the next formula:

$$T_{WAITackdigip} = (D + 1) \times [(R + 1) \times (T_{OA} + 5 + T_{ACK})] \quad (7).$$

This is the maximum time if all the repetitions are unsuccessful and, of course, if a success happens with a lower number of repetitions, this time is proportionally reduced. The ACK is **always sent** with a **short preamble** in **any operating modes**.

### 9 – Timing of the Answers.

The most common application consists in a query from the master to the target unit with an answer in the reversed direction. Normally, after a query, the Master's DTE waits an adequate time interval before repeat the query or skip to an other peripheral. The answer is a packet, longer or shorter than query, depending on the requested applications. Because the modem configuration parameters are the same for both query and answer, the time calculation is the same in both directions. The unique difference is the **DTE answer delay time**  $T_{DTE}$  depending on its characteristics and, in many cases, it is configurable by the DTE firmware. Some DTE units are characterised by an immediate answer and the RMO400 can manage these situations. In the next formulas the **query timing** is in normal bold characters while the **answer timing** is in bold and **italics** characters to divide the specific timings. In a direct communication, without digipeaters, the requested **total waiting time** for answer  $T_{AWAIT}$ , in milliseconds, between the **end** of the previous query and the **start** of the next one is given by the following formula:

$$T_{AWAIT} = (T_{OA} + 5) + T_{REL} + T_{DTE} + T_{BL} + (T_{OA} + 5) + T_{REL} \quad (8)$$

If **D** digipeaters are used in the message route, the resulting waiting time  $T_{AWAITdigip}$ , between the **end** of the previous query and the **start** of the next one, will be given by the next formula:

$$T_{AWAITdigip} = (D + 1) \times (T_{OA} + 5) + T_{REL} + T_{DTE} + T_{BL} + (D + 1) \times (T_{OA} + 5) + T_{REL} \quad (9).$$

In this particular application it's important to remember that all the query timings are generally different from all answer timings due to the different packet length between query and answer.

Using the results of these calculations as answer time-out, the Master's DTE is properly configured for the communication.

# RMO400 - RMO400SRD – RMO436 - CONFIGURATION

## COMMUNICATION TIMING

### 10 – Power Saving Mode in a Point-Multipoint network.

This operating mode is specific for all the applications in which a supply by the ac mains is not available and the energy saving is requested. As previously explained to exit both the **digipeaters** and the **peripherals** from the power saving cycle it's necessary a **long preamble** message therefore all these units remain active for the PwSava time and successively they return in the power saving cycle. The **Master unit** must be configured with **255** as **Pwsava** as explained in page 8. In the most common applications the **query** starts from the Master when all the network is in Power saving cycle while the **answer** come back to the Master during the operative condition. In this conditions the answer is faster than the query and in this way the entire radio network is active for the minimum required time. If the radio network is in operative conditions, i.e. all the units are in the **PwSava** interval, the **total waiting time for answer**  $T_{WAIT}$  is the same calculated by the formula No. 9 in the previous page. If only a unit come back in the Power Saving mode during the answer cycle, this will be lost because the unit in the power saving mode requires a long preamble to decode the incoming message while the others transmit with a short preamble, since they are in the PwSava interval.

In the following formulas all the **query timings** are indicated in a normal bold characters while all the **answer timings** are indicated in **bold and italics** characters to divide the specific timings.

The requested PwSava time , in milliseconds, for the generic target unit depends on the DTE answer delay time  $T_{DTE}$  and may be set in according to the following formula:

$$PwSava_{TARGET} \geq 100 + T_{DTE} + T_{REL} + T_{BL} \quad (10) \text{ where:}$$

$T_{DTE}$  is the answer delay time, in milliseconds, of the DTE connected to the considered target modem and **100**, in milliseconds, is an additional fixed time necessary to ensure a safe margin. If a total number of **D** digipeaters are present, the **intermediate I digipeater** of the route, counted from the Master unit, requires a **minimum PwSava<sub>DIGIP</sub>** , in milliseconds, given by the following formula:

$$PwSava_{DIGIP-I} \geq 100 + (D - I + 1) \times T_{OA} + T_{REL} + T_{DTE} + T_{BL} + (D - I + 1) \times T_{OA} \quad (11) \text{ where:}$$

**D** is the number of the digipeaters in the network, **I** is the position of the intermediate digipeater to be configured counted from the master and **100**, in milliseconds, is an additional time necessary to ensure an adequate safe margin. This time may be increased by steps of 100 milliseconds if necessary.

For example in a network with four digipeaters the PwSava required in the second digipeaters from the master is:

$$PwSava_{DIGIP2} = 100 + (4-2+1) \times T_{OA} + T_{REL} + T_{DTE} + T_{BL} + (4-2+1) \times T_{OA}$$

The time  $T_{OA}$  contains the **PwSavOFF time** set during the configuration process and, as requested for the correct application of the Power Saving Mode, this time **must be the same** in **all units** of the network. Of course, the resulting time interval is much longer than the same used in the normal operative conditions. Because the answer starts during the PwSava time it is sent with a **short preamble**, therefore the  $T_{OA}$  time do not include the PwSavOFF.

### 11 – Master's DTE Time-out between queries.

In the Power Saving Mode the query travels much slower than the answer and this causes the lengthening of the time interval between two queries to permit the answer reception. It's a good practice to send the next query when **all units** are certainly returned in the Power Saving cycle. Because the last digipeater coming back in the power saving cycle is the **nearest** to the master unit, it's necessary to wait the coming back of this digipeater in the Power saving cycle. The resulting **Master's DTE time-out**  $T_{WAITMaster}$  between the **end** of the previous query and the **start** of the next one is given by the following formula:

$$T_{WAITMaster} = T_{OA} - T_{BLMaster} + 2 \times [ 100 + D \times T_{OA} + T_{REL} + T_{DTE} + T_{BL} + D \times T_{OA} ] \quad (12) \text{ where the time } T_{BLMaster}$$

is generally the shortest and, consequently, negligible.

In more complex networks alternating the queries between the sections having different digipeaters units is the best solution to reduce the Master's DTE time-out between the queries. In this case the section interested by the previous query can come back in the Power Saving cycle while the other sections are active. With an appropriate selection the  $T_{WAITMaster}$  may be substantially reduced and, in the best case, may be reduced to the value indicated by the formula No. 9 on page 12.

# RMO400 - RMO400SRD – RMO436 - CONFIGURATION

## COMMUNICATION TIMING

### 11 – Power Saving in an high acquisition speed network.

In a very complex network, using the Power Saving Mode, the acquisition speed may be very slowed down if the message route contains many digipeaters. As explained in the previous paragraph, the PwSava time of each digipeater must increase from the target to the master unit, therefore the first digipeater in the chain has got the maximum PwSava time. Moreover the time interval between two successive queries is, in practice, the double of the PwSava time set in the first digipeater unit.

In many cases the use of the Power Saving mode is imposed by a small part of the network that can't be fed by the ac mains.

The resulting PwSavOFF time is chosen to obtain the requested energy saving in the more critical unit, and, of course, the same value is set in all units of the network. As function of both this fixed value and the network complexity, all the other timings, PwSava included, are automatically derived by the calculations shown in the previous paragraphs and, consequently, the related time interval between the queries may be too long to allow the requested acquisition speed.

The most favourable solution is to configure the network with all digipeaters fed by the ac mains. If this condition is not possible, the less unfavourable is the utilisation of the units with autonomous feed **only** in the end of the digipeaters chain because the the acquisition speed slow down is due essentially to the initial ones.

To configure the network for this operating condition the following settings must be used:

#### A – Master Unit.

The master unit is normally placed in a location fed by the ac mains and although the network employ the Power Saving Mode this unit must be always operative. To obtain this operating condition the **PwSava must be set to 255**. The transmitted preamble length depends on the **Its Address** value in according with the following rules:

**Its Address = 1** → **long preamble**, suitable for communications with units in Power saving Mode (peripherals and digipeaters)

**Its Address > 1** → **short preamble**, suitable for communications with operating units (No Power Saving Mode)

#### B – Target Units.

All the target units **must have an Its Address higher than the Master one**, and transmit with a **long preamble** if they are in the Power Saving Mode while during the PwSava time they transmit with a **short preamble**.

#### C – Digipeater Unit.

Setting the **PwSava** of a digipeater to **255** the unit is configured as an always operative unit compatible with the Power Saving Mode. In this mode the digipeater unit is always active but can generate message with short or long preamble depending on the message route. In particular the messages directed to the **target unit** are transmitted with a **long preamble** while the messages directed to any other units are transmitted with a **short preamble**.

The **PwSavOFF** time **must be the same** for all the units. In this operating conditions the time interval between two queries, in the DTE linked to the master unit, is given by the following formula:

$$T_{WAIT} = T_{OAS} - T_{BLM} + 2 \times [100 + K \times T_{OAS} + (D - K + 1) \times T_{OAL} + T_{REL} + T_{DTE} + T_{BL} + (D + I) \times T_{OA} + T_{REL}] (13)$$

where:

$T_{WAIT}$  is the resulting time interval between two queries

$T_{OAS}$  is the transmitting time of the query with a **short preamble** (please refer to the formula No. 2 on page 10)

$T_{OAL}$  is the transmitting time of the query with a **long preamble** (please refer to the formula No. 2 on page 10)

$T_{BLM}$  is the buffer loading time of the query in the master unit (please refer to formula No. 1 on page 10)

**100** in **milliseconds** is the usual fixed time for a safe margin

**D** is the **total number** of digipeaters in the network

**K** is the number of digipeaters of the route **without** the **Power Saving Mode**, i.e. with **PwSava= 255**, counted from the Master unit, therefore **(D – K)** is the number of the digipeaters **with** the **Power Saving Mode**

$T_{REL}$  is the releasing time of the query in the **target unit** (please refer to the formula No. 3 on page 11)

$T_{DTE}$  is the delay time of the target DTE to answer

$T_{BL}$  is the **answer** buffer loading time in the **target unit** (please refer to the formula No. 1 on page 10)

$T_{OA}$  is the **answer transmitting time** with a **short preamble** (please refer to formula No. 2 on page 10)

$T_{REL}$  is the **answer releasing time** in the **master unit** (please refer to the formula No. 3 on page 11)

Between all these time intervals the shortest one is, generally, the  $T_{BLM}$  that may be neglected in the calculation.

In the digipeaters using the **Power Saving Mode** the related **PwSava** can be calculated by the formula No. 11 on page 13 with the following substitutions:

**D** becomes the **number of the digipeaters using the Power Saving**

**I** becomes the position of the generic digipeater **with the Power saving** counted from the **first digipeater that uses the Power saving**. For example in the network with four digipeater the first and the second **don't use** the power saving while the third and the fourth **use** it. In this network **D = 4** and **K = 2** for the time interval between the queries while for the PwSava calculation of the two last digipeaters **D = 2** and **I** may be 1 (for the third digipeater) or 2 for the last (the fourth).