ProMATIC

RC4
Digital Ripple Control Receiver
-Time Switch

TECHNICAL MANUAL

RC4, DIGITAL RIPPLE CONTROL RECEIVER-TIME SWITCH
TECHNICAL MANUAL

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1. Overall Description

RC4 Digital Ripple Control Receiver-Time Switch operates according to DIN43861-301 transmission protocol, complies with IEC 62054-11 (IEC61037) standard for ripple control receivers, and with IEC 62054-21 (IEC61038) standard for time switches.

Polycarbonate plastic housing is heat, flame and UV-rays resistive. Three screws on flat surface can do device mounting. Sealing can be made at two levels: for guarding parameters only and the whole device with terminal cover. Terminals are for two wires of 2,5 mm^2 each, or single 6 mm^2 wire. Penetrating through to electronic components is prevented, and wire is not damaged while screwing.

RC4 is a single chip electronic device using temperature compensated quartz crystal time base, 12-bits A/D converters and digital signal processing. All elements are rated for industrial grade (-25 do +70 C) and life expectance longer than 30 years. Its firmware and parameters are reprogrammable at any time.

Programming firmware is possible on the place, for fast upgrading of all features.

Programming parameters can be made using PC or portable programmer.

1.1 Name Plate, Terminals, Displays

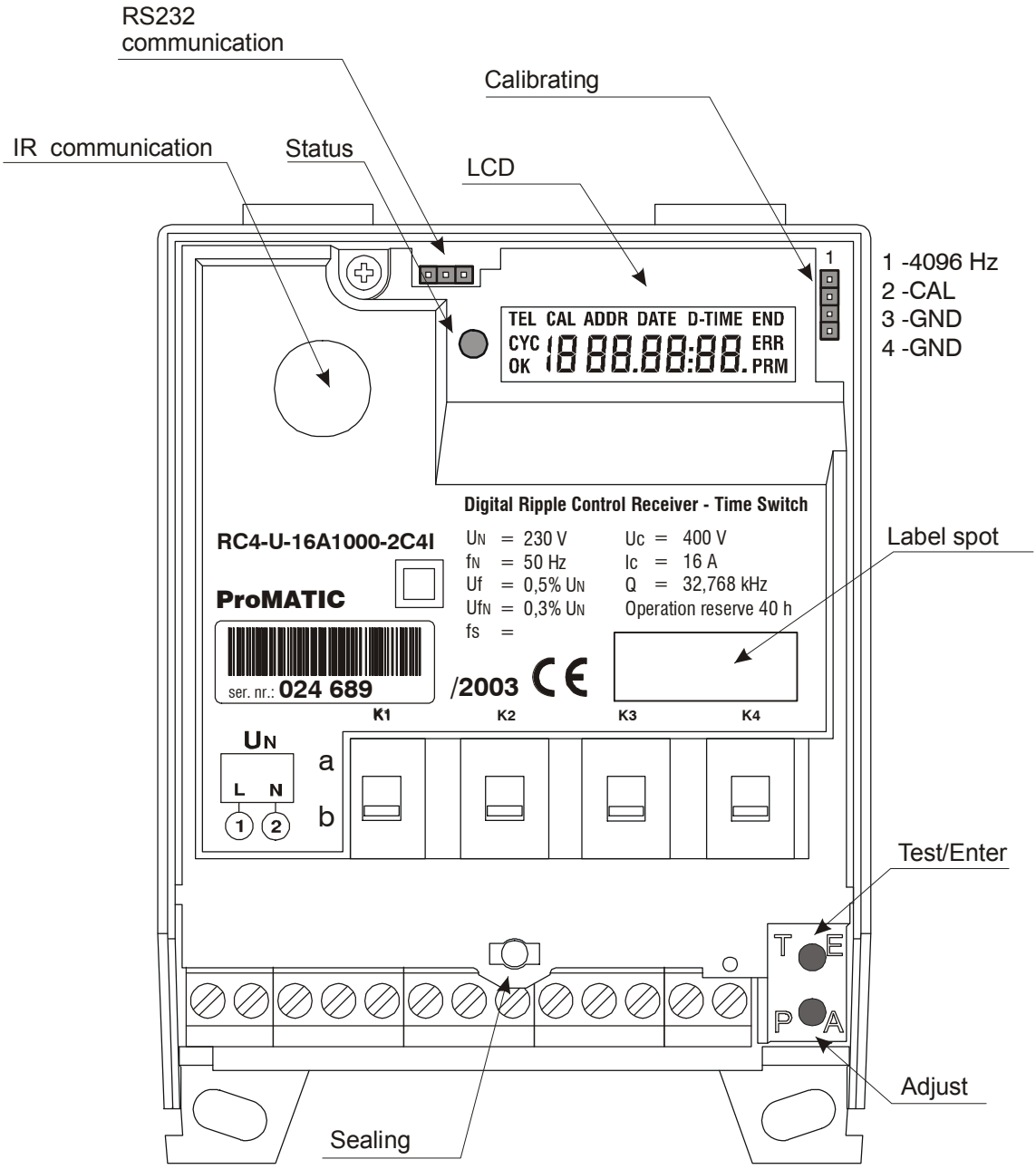


Figure 1. Name plate, terminals and buttons

Operation status indicator, LCD, relays states and all data proposed by standards are visible through the transparent cover.

1.2 Subtypes of RC4 Devices

According to implemented functions, RC4 can be made in a few subtypes.

1. P Conventional receiver without LCD.
   It operates only with conventional ripple control telegrams.
2. T Time switch with LCD.
   It operates as time switch device only, but still using DIN43861-301 parameters. No remote changing of parameters is possible. Real time clock is temperature compensated; local adjusting and calibration are possible.

3. U Conventional ripple control receiver + time switch with LCD.
   It operates as P and T subtype simultaneously. No remote changing of parameters is possible. Real time clock is temperature compensated; local adjusting and calibration are possible. Activation / deactivation of time switch functions, and time synchronization are possible using conventional ripple control telegrams.
4. D DIN43861-301 ripple control receiver without LCD.
   It operates as P subtype and according to DIN43861-301 protocol. Remote parameters changing and activation/deactivation of conventional telegram commands are possible using DIN43861-301 telegrams.
5. L DIN43861-301 ripple control receiver + time switch with LCD.
   It operates as D and T subtypes simultaneously.

Subtype-functions				**Subtype**				
				P	T	U	D	L
Functions	Conventional teleg. commands	Standard: relay ON/OFF and cyclic switching		√		√	√	√
		Special	DS (switching to DIN43861-301 protocol)				√	√
			UE (activate time switch program)			√		
			UD (deactivate time switch program)			√		
			MS (store conventional command to day cycle memory)	√		√	√	√
			ME (activate day cycle memory)	√		√	√	√
			MD (deactivate day cycle memory)	√		√	√	√
			MC (clear day cycle memory)	√		√	√	√
			TS (time synchronization to 00:00:00)	√		√	√	√
	Time switch program				√	√		√
	DIN43861-301 protocol						√	√

1.3 Operation Reserve

Operation reserve is realized by GOLD capacitor (for 40 or 100h) or 3V Li COIN battery. Battery is mounted in holder and easy replaceable without soldering.

1.4 Replacing the battery

Battery type: 3V Li COIN batery-CR1220.

Replacing procedure:

- Disconnect RC4 from main power supply.
- Remove plastic nameplate.
- Remove battery from its holder.
- Put new battery into holder.
- Return plastic nameplate.
- Connect RC4 on main power supply to ensure proper initialization. This step is ABSOLUTELY NECESSARY, even if RC4 will be held on stock after replacing the

battery. Otherwise the new battery can discharge in next few hours. Date and time should be checked and set if not OK.

1.5 Output Relays

Output relays are bistable, magnetic latching type. Two types are available:

1. Soldered
   Up to 4 relays can be installed. Later installation of relays is possible only by soldering.
2. Plug in
   Up to 3 plug-in relays can be installed. Later installation of relays is possible without soldering.

1.6 Mounting and Wiring

RC4 is assumed to be mounted on a flat surface by three screws. Mounting holes are arranged according to DIN43861-2. Figure 2 shows all dimensions required for mounting.

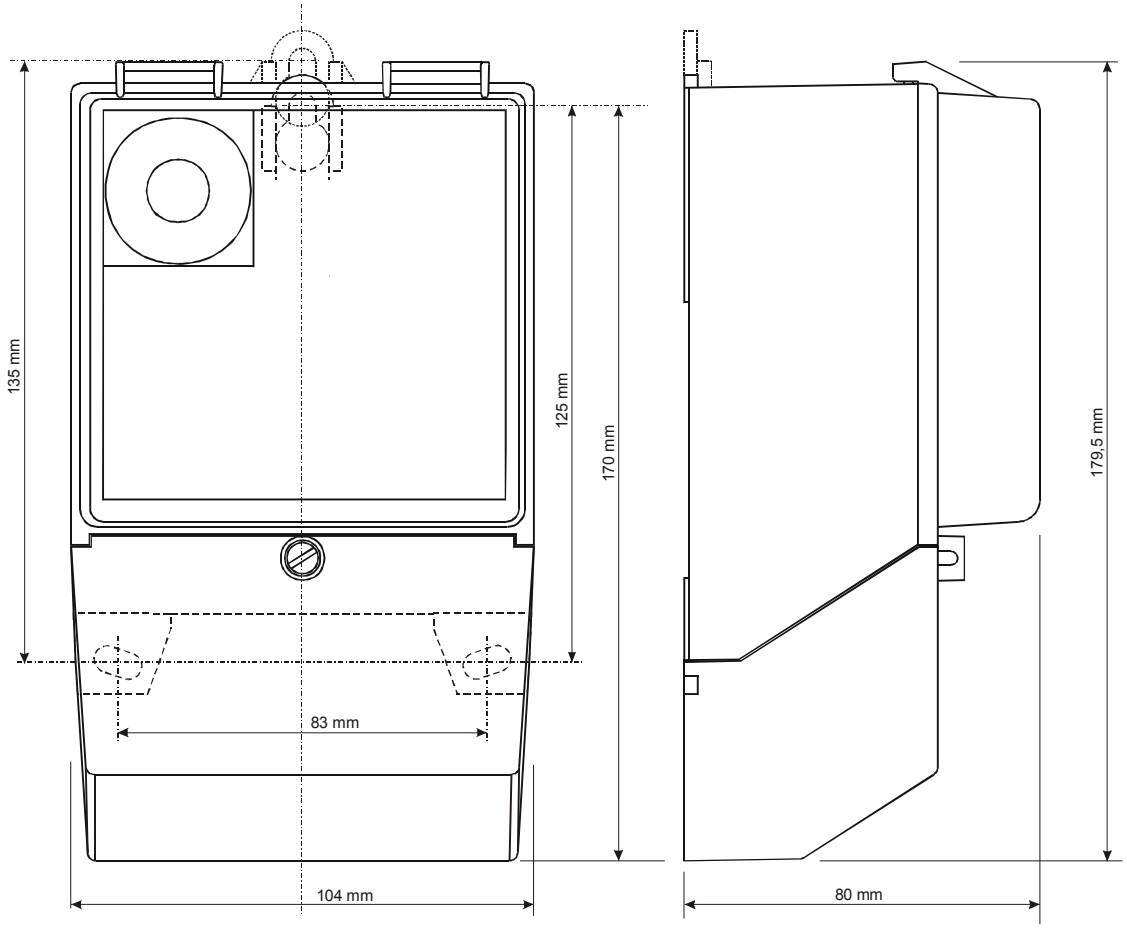


Figure 2. Mounting dimensions

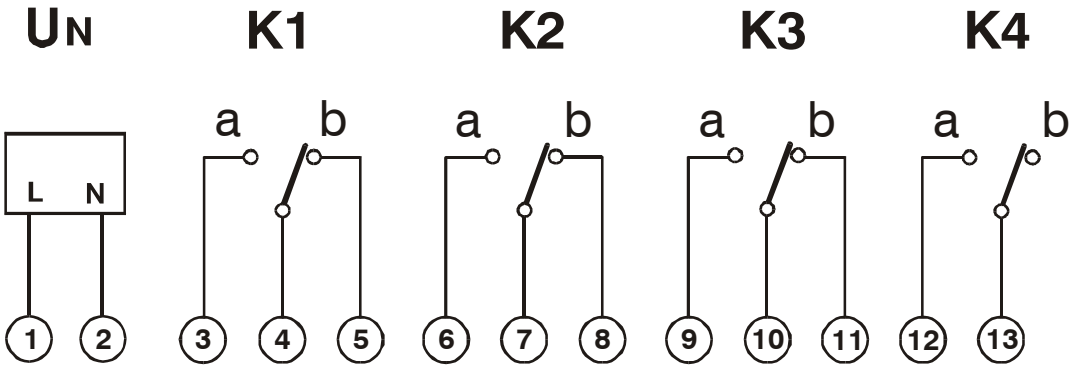


Figure 3 Wiring diagram-16A change over contacts

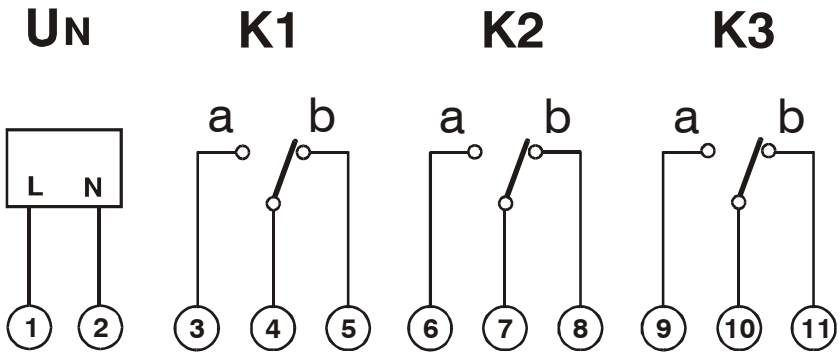


Figure 4 Wiring diagram-25A change over contacts

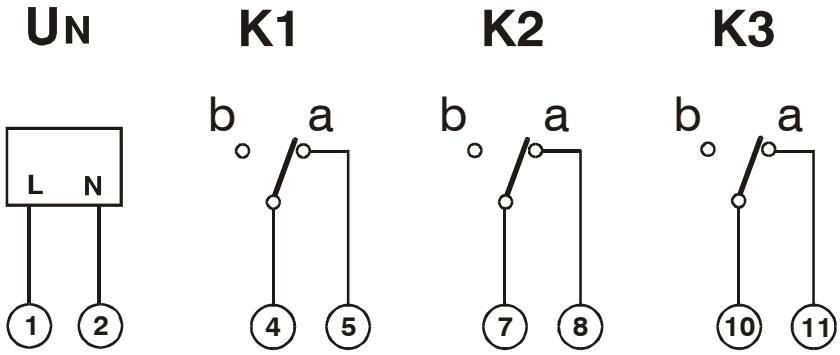


Figure 5. Wiring diagram-40A make contacts

TERMINAL		DESCRIPTION
1	**L**	PHASE-phase voltage
2	**N**	NULL-common voltage

1.7 Operation Status, Date and Time

STATUS LED displays operation status:

1. Blinking at rate 30/minute (0,5 Hz)/ OFF (programmable)
   - Correct operation of the receiver and time switch
2. Blinking according to active pulses in telegram
   - Receiving telegram
3. Blinking with 2 Hz
   - Supply voltage for relays operation is too low

4. Blinking with 5 Hz
   - Incorrect operating parameters, all relays are switched to 'b' position
5. ON continuously
   – Programming mode, waiting for parameters

RC4 device with LCD additionally displays:

1. Date ("DATE" + day, month, year), and time ("D-TIME"+ weekday-hours: minutes)
2. "OK/ERROR"-hardware failure
3. "TEL"-receiving telegram in progress
4. "CYC"-active cyclic function
5. "PRM"- incorrect parameters

1.8 Local Adjusting of Date, Time and Receiver Address

Only RC4 devices with LCD are allowed for adjusting by local buttons. Device has to be powered while adjusting takes place. Date and time adjusting are allowed for all subtypes. Additionally, receiver address (defined in DIN43861-301) local adjusting is allowed for L subtype.

1.8.1 Date and Time Adjusting (Devices with LCD)

Date and Time adjust mode is entered by holding P/A button longer than 4 seconds: DATE (blinks), D-TIME (ON), END (ON).

P/A button is used for selection of DATE / TIME / END; selected item blinks. Using T/E button, blinking item can be activated. If END is activated, adjusting is finished. If DATE or TIME is chosen, 1st digit to be edited starts blinking. Using P/A button blinking digit can be edited, while T/E button moves editing to next digit. When last digit is adjusted, blinking is moved to DATE / TIME / END.

Adjustment has to be finished correctly by activating END item. If it is not the case, device will discard newly entered data and exit adjust mode. PON procedure is always performed on exiting adjust mode.

1.8.2 Receiver Address Adjusting (subtype L only)

This mode is entered by holding P/A button longer than 8 seconds: ADR (blinks), END (ON).

P/A button is used for selection of ADR / END; selected item blinks. Using T/E button, blinking item can be activated. If END is activated, adjusting is finished. If DATE or TIME is chosen, 1st digit to be edited starts blinking. Using P/A button blinking digit can be edited, while T/E button moves editing to next digit. When last digit is adjusted, blinking is moved to DATE / TIME / END.

Adjustment has to be finished correctly by activating END item. If it is not the case, device will discard newly entered data and exit adjust mode. PON procedure is always performed on exiting adjust mode.

1.9 Device Correct Operation Check

Device correct operation check can be done using T/E button. Device parameters, STATUS LED and relays will be checked:

- ***STATUS*** LED lights continuously for about 4 sec

- Relays change their position 2 or 3 times (depending on start position)

1.10 Performance Adjusting and Servicing

There is no classic adjusting of device performance (using trimmers, etc.). All device parameters, like control frequency, telegram timing, min. operate voltage and max. non-operate voltage, and other functional parameters are completely programmable. Filter stability (temperature and aging) is achieved by temperature compensated quartz time base, A/D converter and digital signal processing. Choosing appropriate components high performance is achieved:

1. No trimmer adjustments required
2. No preventive and periodical servicing required
3. Declared performance retained for longer than 30 years
4. Filter stability against temperature and aging

1.11 Local Programming of Device Parameters

All functional parameters of RC4 devices are completely programmable, and can be preprogrammed before installation. Some parameters are fixed, while most proposed by DIN43861-301 standard are remote programmable. Programmed parameters retention is longer than 100 years. Local programming of RC4 devices can be done in two ways:

1. Using PC computer
2. Using Pocket PC

No programming of device parameters is possible before enabling it by P/A button. STATUS LED will light continuously. If no programming is done, after 2 minutes, device will exit programming mode and start operating using old parameters.

1.11.1 Local Programming Using PC Computer

For programming RC4 devices following equipment is required:

1. PC computer
2. RC4-IR probe or RC4-232 probe
3. Application for PC computer (ACE PULSE configurator)

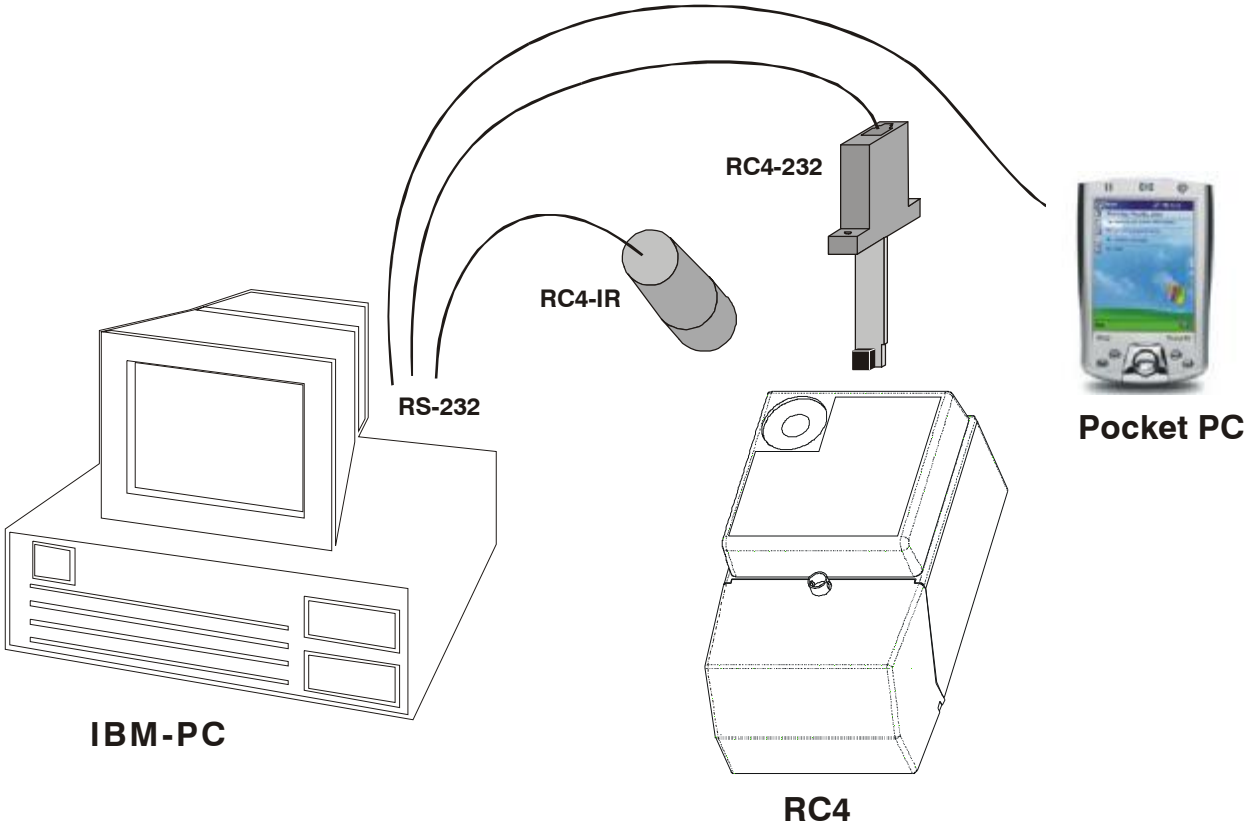


Figure 6. Programming RC4 using PC computer

User guides and helps are parts of software application for editing and programming RC4 parameters on PC computers.

RC4 parameters are to be prepared on PC computer, and transferred to RC4 device or Pocket PC.

RC4 has to be powered while programming.

RC4-IR or RC4-232 probe can be used for data transferring to RC4 devices.

Programming with RC4-IR probe is possible without removing transparent cover.

Before programming with RC4-232 probe, removing transparent cover is required. Optical insulation is implemented as well as with RC4-IR.

1.11.2 Local Programming Using Pocket PC

For programming RC4 devices following equipment is required:

1. Pocket PC with RS232C interface
2. RC4-232 adapter or RC4-IR probe

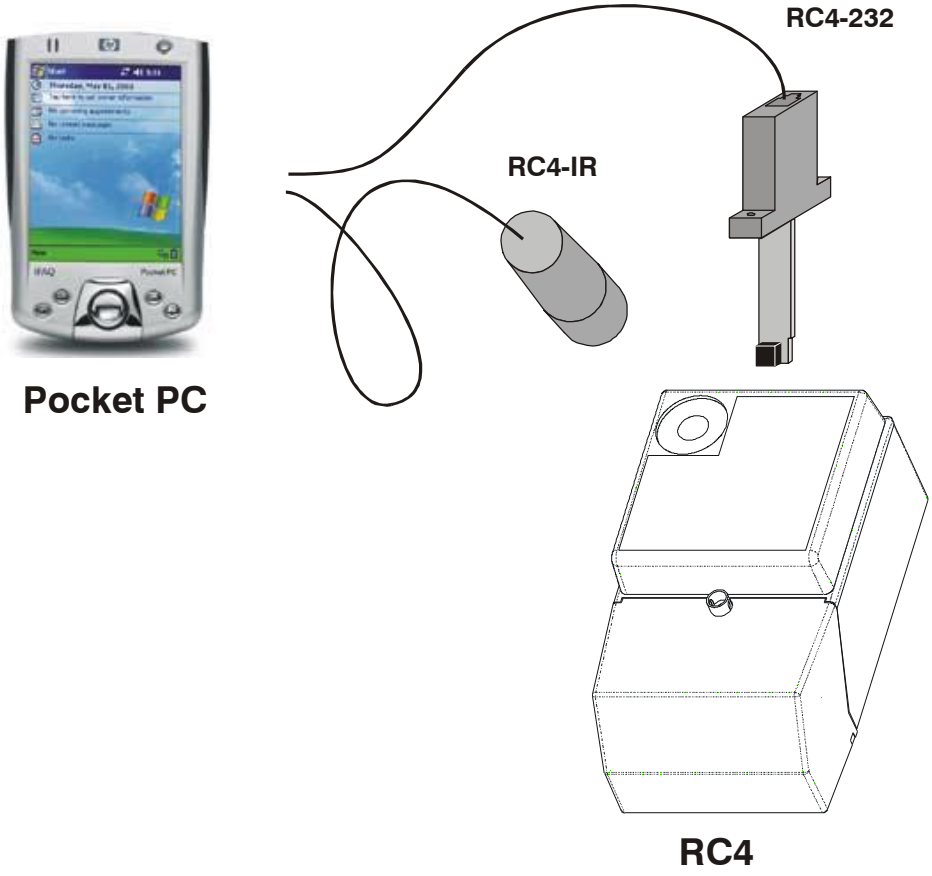


Figure 7. Programming RC4 using Pocket PC

Using Pocket PC as RC4 programmer is described in separate document.

RC4 has to be powered while programming.

RC4-IR or RC4-232 probe can be used for data transferring to RC4 devices.

Programming with RC4-IR probe is possible without removing transparent cover.

Before programming with RC4-232 probe, removing transparent cover is required. Optical insulation is implemented as well as with RC4-IR.

1.11.3 Local Programming with EEPROM Module (E option only)

1.11.3.1 Writing Parameters into EEPROM modules using EEPROM programmer

Programming of parameters into EEPROM module is possible with EEPROM programmer, device which is seen by PC, or Pocket PC as RC4 receiver.

EEPROM programmer could also be used as stand alone device for:

- checking the parameters in EEPROM module
- comparing of 2 EEPROM modules
- copying parameters from module to module

1.11.3.2 Installing of EEPROM Module in RC4 Devices

Before installing EEPROM module, transparent cover should be removed. RC4 can be powered while installing take place, and new parameters will be loaded immediately.

Besides parameters in EEPROM module, there are 2 more copies of them in RC4 device: local copy and remote reprogramable copy. Local copy corresponds to last correct EEPROM module installed in RC4. It is used only for comparison with newly inserted EEPROM module.

Remote reprogramable copy of parameters could be changed using telegrams according to DIN43861-301 standard. This copy is used by RC4 devices in operation.

1.11.3.2.1 Installing of EEPROM module in powered RC4 device

By installing EEPROM module in powered RC4 device, local and remote copy of parameters will be unconditionally and immediately overwritten, and PON internal procedure will be executed. There is no need to switch device OFF and ON.

1.11.3.2.2 Installing of EEPROM module in unpowered RC4 device

When RC4 is powered ON, it checks if EEPROM module is installed, then checks CRC sum of parameters in it, and then it compares EEPROM module with last local copy of parameters. If there is any difference, local and remote copies of parameters will be unconditionally overwritten. PON internal procedure will follow.

2. Parametric Model OF RC4 Device

According to DIN43861-301, ripple control receiver is defined as a group of objects (relays) and parameters. Receiver and objects operation is defined by parameters.

According to DIN 43861-301 object is defined as the smallest part of receiver, which can be addressed separately. Object is not a physical part; it is a group of functions, whose results are reflected on output relays.

Parametric model of RC4 device is used to present all features to users.

2.1 Device Parameters

DEVICE PARAMETERS					
	RECEIVER PARAMETERS				
		REMOTE PROGRAMMABLE	IMPLEMENTED IN RC4 V1.X	CHAPTER	
				THIS DOC.	DIN 43861-301
	System Parameters	-	+	2.1.1	
	Relay Position for ON Command	-	+	2.1.2	
	Relays – Objects Relation	-	+	2.1.3	
	Switching of relays during test	-	+	2.1.4	
	Receiver Address	-	+	2.1.5	7.4
	Manufacturer Code	-	+	2.1.6	6.8
	First Pulse of DIN43861-301 Telegram	-	+	2.1.7	
	Conventional Telegram	-	+	2.1.8	
	Day Cycle Memory	-	+	2.1.8.1	
	Time Synchronization by Conventional Telegram	+	+	2.1.8.2	
	Activate / Deactivate Receiver	+	+	2.1.10	6.13
	Allowed Time between Telegrams	+	+	2.1.11	
	Bridging of Power Supply Loss (POFF time)	+	+	2.1.12	
	Calendar List (DIN43861-301 chapter 6.1), Activating Switching Schedules	+	+	2.1.13	6.1
	Switching Schedule List (DIN43861-301 chapter 6.2)	+	+	2.1.14	6.2
	Copy of last locally programmed Parameters	-	+	2.1.15	
	OBJECTS (1-8) PARAMETERS				

		REMOTE PROGRAMMABLE	IMPLEMENTED IN RC4 V1.X	CHAPTER	
				THIS DOC.	DIN 43861-301
	Objects Addressing - A,B,C,D	-	+	2.1.16	7
	Objects State on Telegram Absence (TA)	-	+	2.1.17	
	Objects States at Power ON (PON)	+	+	2.1.18	
	Object States at Power OFF (POFF)	+	+	2.1.19	
	Active Switching Schedules for Objects	+	+	2.1.20	6.4
	Switching Command Delay	+	+	2.1.21	
	CYC1 Cyclic Function Parameters (DIN43861-301, chapter 6.10)	-	+	2.1.22	6.10
	MYCYC Cyclic Function Parameters	+	+	2.1.23	

Table 1. Device parameters

Before installation, all parameters have to be prepared using PC computer. It is called local programming. Some parameters can be edited only locally, while most, proposed by DIN43861-301 standard, are remote programmable, too. Following chapters describe meaning of all parameters.

2.1.1 System Parameters

- Control signal frequency
- Telegram timing
  - Start pulse
  - Start pause
  - Pulse
  - Pause
- Min. operate voltage
- Max. non-operate voltage
- Min. start pulse duration
- Min. start pause duration
- Min. pulse duration
- Min. pause duration

2.1.2 Relay Position for ON Command

Bistable relays can take ‘a’ or ‘b’ position for ON command. For the reason of compatibility of different manufacturers, this position is parametric definable.

2.1.3 Relays – Objects Relation

RC4 can have up to 4 relays. State of any relay can be set as AND/OR function of states of any 2 objects (8 objects are installed).

2.1.4 Switching of relays during test

Switching of every relay during test can be ENABLED/DISABLED. Only ENABLED relays will change their position during the test.

2.1.5 Receiver Address

According to DIN43861-301, any receiver in system can have unique address (numbers 1, 2, …, 16777215), which is used by system to access only one particular device.

2.1.6 Manufacturer Code

Receivers of different manufacturer may be installed in the field. DIN43861-301 enables selective access to all devices of up to 8 different manufacturers. Manufacturer code (numbers 0-7) is used to select it.

2.1.7 First Pulse of DIN43861-301 Telegram

Switching from conventional to DIN43861-301 telegram is achieved by so called switching command. DIN43861-301 protocol does not necessarily start immediately after switching command. If there are conventional receivers in system, they can expect conventional command up to the last telegram pulse. It is convenient to start DIN43861-301 protocol after all pulses used by conventional telegram. RC4 devices can be programmed to start DIN43861-301 protocol with first pulse of conventional telegram. No switching command is required then.

2.1.8 Conventional Telegram Functions

RC4 receivers recognize 4 conventional telegram commands:

1. \- unchanged object state
2. I set ON (I) object state
3. 0 set OFF (0) object state
4. T start cyclic function

Conventional telegram functions use some pulses as selection, after which active pulse triggers required action on objects (relays). Up to 8 combinations of selection pulses can be set. For any of these combinations two Command pulses are allowed. Any Command pulse can affect any object (-/I/0/T command), and do special command at the same time: day cycle memory (chapter 2.1.8.1), and DIN43861-301 interpreter can be managed; time can be synchronized to “Time for TS command (min)”, without touching date and weekday (chapter 0).

Managing DIN43861-301 interpreter by using special commands flags:

1. DS Switching to DIN43861-301 protocol (D and L subtype only)
2. UE Activate DIN43861-301 interpreter (U subtype only)
3. UD Deactivate DIN43861-301 interpreter (U subtype only)

2.1.8.1 Day Cycle Memory

All conventional commands marked with 'MS' flag will be memorized. 24 hours later receiver waits for telegram. If no telegram is coming and no conventional command is being executed, receiver will repeat yesterday's command.

Only Command pulse can manage Day Cycle Memory by using special commands flags:

1. MS memorize conventional command
2. ME clear day cycle memory and activate it
3. MD deactivate day cycle memory
4. MC clear day cycle memory

Day Cycle Memory is designed to be used with conventional telegram system, and it should not be used with DIN43861-301 telegram system. If you want to use Day Cycle Memory consistently across all subtypes of RC4-P/U/D/L, you have to ensure that no Switching Programs will be active; because RC4-U/D/L will switch relays according to Switching Programs and Day Cycle Memory, simultaneously.

The best practice for configuring parameters is to set default parameters, first. This will inactivate all Switching Programs. After that, set Day Cycle Memory to "Enable". DIN43861-301 interpreter should stay enabled, for proper execution of PON commands in RC4-D/L subtypes.

2.1.8.2 Time Synchronization by Conventional Telegram

By means of conventional command marked with 'TS', it is possible to synchronize time to "Time for TS command (min)", without touching date and weekday. Time will be set with active pulse, and resynchronization of operation will take place after complete telegram.

2.1.9 Conventional Telegram Command Enable

Conventional telegram command can be ENABLED / DISABLED by means of DIN43861-301 extended functions. Only DIN43861-301 commands are further allowed.

2.1.10 Activate / Deactivate Receiver

Using DIN43861-301 function (mode: 1100) receiver can be deactivated: DIN43861-301 is no further active, no remote parameters access is possible and all objects go to OFF (0) state. Activating again is only possible by DIN43861-301 function (mode: 1110).

2.1.11 Allowed Time between Telegrams

If receiver does not receive any telegram for this period of time, it will set the objects to TA state (see objects parameters).

2.1.12 Bridging of Power Supply Loss (POFF time)

If power supply is lost for longer then 'POFF time' (≤ 2 seconds), device shall execute POFF procedure and set objects to POFF state. If POFF time is set to '---', device shall execute POFF procedure after 1,5 second, not touching the objects (regardless of chosen POFF state). After entering POFF procedure, receiver stops all cyclic functions, and waits for power restoration.

2.1.13 Calendar List (DIN43861-301 chapter 6.1), Activating Switching Schedules

Calendar list contains 64 records with indexes 0 to 63. Record comprises: valid period begin date, valid period end date and list of active switching schedules. If valid periods of records are overlapped, record with higher index has a priority. Remote parameterizing is according to DIN43861-301 standard, chapter 6.1.

Calendar list cannot be discarded explicitly. If one does not want to use calendar list, record with index 63 must contain: "01.01. - 31.12. all switching schedules active and obey weekday schedule".

2.1.14 Switching Schedule List (DIN43861-301 chapter 6.2)

Switching schedule list comprises 16 records with indexes 1 to 16. Record consists of 14 pairs of moments (in minutes) since midnight. At these moments pairs objects will be set to I/0 position. Every switching schedule can be checked for weekdays activity. Remote parameterize is according to DIN43861-301 standard, chapter 6.2.

2.1.15 Copy of last locally programmed Parameters

RC4 devices store a copy of last locally programmed parameters. It is possible to restore these parameters at any time, using DIN43861-301 function (mode:0111). After restoring it, PON procedure will be executed.

2.1.16 Objects Addressing - A,B,C,D Areas

Any object can have its own 4-areas address (4-numbers): A (1-6), B (1-32), C (1-16), D (1-16). Objects can be addressed according to DIN43861-301 protocol. By means of DIN43861-301 protocol, every address area can be selected, and then specified in details. If some address areas are not selected, receiver will be addressed in these areas. All selected address areas have to be specified in details in telegram. Object is addressed if received address corresponds with its address.

2.1.17 Objects State on Telegram Absence (TA)

If device is out of service, no monitoring is performed; otherwise, time between telegrams is monitored. If time longer than that specified by TAT parameter is elapsed, objects are set to TA state. TA state can be programmed to: - / I / 0.

2.1.18 Objects States at Power ON (PON)

It is possible, for every object separately, to define command to be executed at power ON:

- \- Unchanged object state
- P set object to the state which was before power OFF
- S do object virtual switching and set to state as if there was no loss of power
- T start MYCYC function
- C start CYC1 cyclic function (DIN43861-301 pog.6.10)
- I set ON (I) object state
- 0 set OFF (0) object state

'-' command will not affect object operation; if any cyclic function was active before loose of power, it will continue to operate.

I/0/P/S commands at PON will be delayed if delay time for object is > 0.

Executing of PON procedure depends on device subtype:

1. Subtype P
   - Any programmed PON command will be executed, except S command.
2. Subtype T
   - Only T and C PON commands will be executed. S command will be executed instead of other commands.
3. Subtype U
   - If time switch mode is active, only T and C commands will be executed. S command will be executed instead of other commands.
   - If time switch is inactive, any programmed PON command will be executed, except S command.
4. Subtypes D, L
   - Procedure is performed only if DIN43861-301 interpreter is active. Any programmed PON command will be executed.

At power ON following steps will be done:

1. Cyclic function and POFF state will be restored from nonvolatile memory
2. Object states will be modified according to PON commands
3. Object states will be modified according to Day Cycle Memory (if enabled)
4. Object states will be set

2.1.19 Object States at Power OFF (POFF)

It is possible, for every object separately, to define command to be executed at power OFF:

-	Unchanged object state
I	set ON (I) object state
0	set OFF (0) object state

Executing of POFF procedure depends on device subtype:

1. Subtypes P, T, U
   - Any programmed POFF commands will be executed
2. Subtypes L, D
   - Procedure is performed only if DIN43861-301 interpreter is active, otherwise not.

Programmed POFF commands are executed without delay. Objects states before power OFF are stored in nonvolatile memory, and can be used by PON procedure. At restoration of power supply, PON procedure will be executed.

2.1.20 Active Switching Schedules for Objects

Any object can use any combination of 16 switching schedules for its operation. Only switching schedules associated to the object, will operate with it.

2.1.21 Switching Command Delay

Delay time may be set to 0-32767 seconds. Random or fixed time delay can be selected. Delays for objects are calculated during PON procedure. All commands for certain object will be always equally delayed.

2.1.21.1 Delaying I/0/P/T Conventional Commands

U/I/P conventional commands will be delayed for every object, if delay time is >0. T command starts MYCYC cyclic function with delay programmed for this object.

2.1.21.2 Delaying I/0 Commands according to DIN43861-301

I/0 command according to DIN43861-301 will be delayed for every object, if delay time is >0. Switching schedules will operate with delay, too.

If CYC1 cyclic function is managed by switching schedule, starting and stopping of operation will be delayed.

2.1.22 CYC1 Cyclic Function Parameters (DIN43861-301, chapter 6.10)

Programming parameters for CYC1 cyclic function is according to DIN43861-301 standard, chapter 6.10. All parameters are locally and remote reprogrammable. Operation of CYC1 cyclic function can be managed by switching schedules (switching pairs moments will start and stop cyclic function). It is possible to restart cyclic function and change I state duration using DIN43861-301 function (mode: 1001).

Remote changing parameters of CYC1 cyclic function is possible using manufacturer specific function defined by DIN43861-301 protocol:

- Nb. of cycles (0-255:0= inactive, 255=infinite)
- Restartable (YES/NO)
- Time units (minute/second)
- Object start state (I/0)
- Object end state (I/0)
- Managed by switching schedule (YES/NO)
- Cycles period (T): 1-4095 (minute or sec)
- I state time (te), % of T: 0-99%

2.1.23 MYCYC Cyclic Function Parameters

All parameters are locally and remote reprogrammable, using manufacturer specific function defined by DIN43861-301 protocol:

- No. of cycles (0-127:0= inactive, 127=infinite)
- Restartable (YES/NO)
- Object start state (I/0)
- Object end state (I/0)
- Synchronize every day
- Synchronize every hour
- Time units (minute/second)
- I state time: 1-4095
- 0 state time: 1-4095

2.2 Local Programming

Local programming means editing RC4 parameters, and transferring it to RC4 devices, using PC computers or Pocket PC.

2.3 Remote Changing of Parameters

Remote changing of RC4 parameters fully complies with DIN43861-301 protocol. All function and address modes, defined in DIN43861-301 standard, are fully supported, so DIN43861-301 standard can be used as reference manual for device operation. Only functions specific for manufacturer, which are also according to this standard, is going to be described in details in the following chapters.

Whenever remote parameters change is done, device resynchronizes its operation, so new parameters become active instantaneously. Any object with PON state set to 'S', will switch to expected position (virtual switching will be performed) immediately, while others will update their state when clock reaches programmed moments according to switching schedules.

2.3.1 Manufacturer Specific Functions

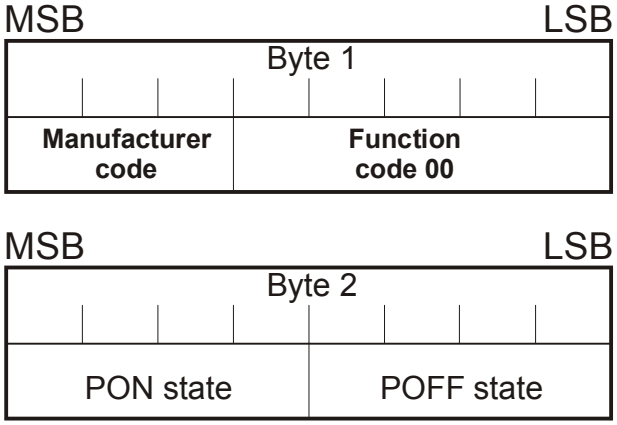
Manufacturer specific functions are, by DIN43861-301 standard, specified and allowed extensions. Manufacturers are free to define their own functions and parameters. Following chapters describe functions added in RC4 devices.

2.3.1.1 Parameterize Object Properties

Remote changing of PON and POFF object states and delay time is possible using manufacturer function according to DIN43861-301.

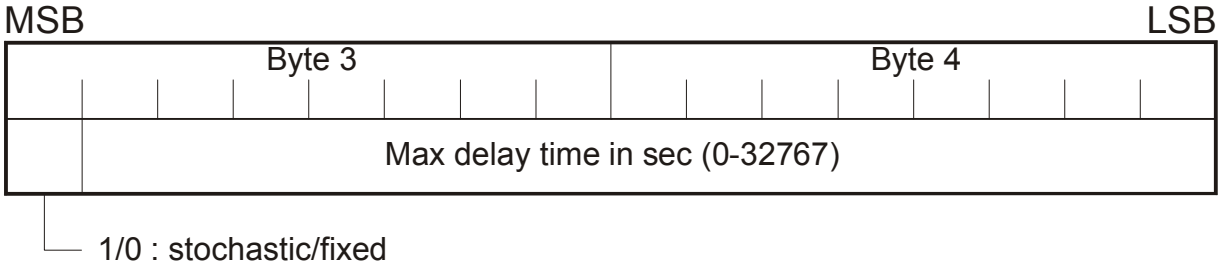
Function mode: 0111

Specification length (in bytes): 4



0000 - unchanged
0001 - I state
0010 - 0 state
0011 - T command
0100 - P state
0101 - S command
0110 - C command

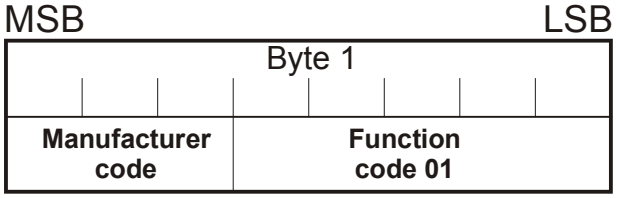
0000 - unchanged
0001 - I state
0010 - 0 state

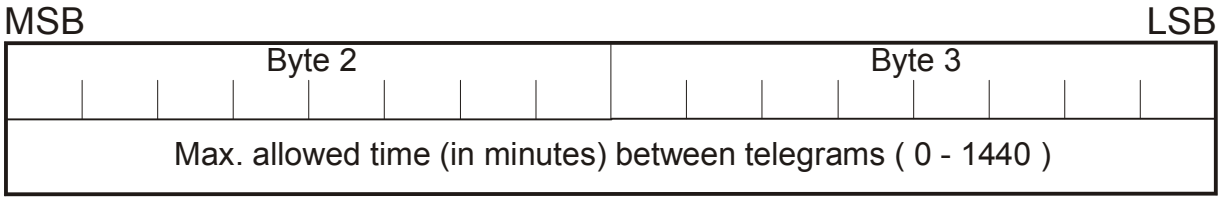


2.3.1.2 Telegram Absence Time Parameterize

Remote changing of allowed telegram absence time (TAT) is possible by using manufacturer function according to DIN43861-301. If time is set to 0, no telegram absence time will be monitored. If time longer than that specified by TAT parameter is elapsed, objects are set to TA state.

Function mode: 0111
Specification length (in bytes): 3





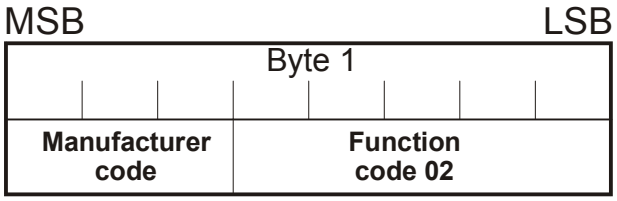
2.3.1.3 Enable / Disable Conventional Telegram Commands

Conventional telegram command can be ENABLED / DISABLED using manufacturer functions according to DIN43861-301.

2.3.1.3.1 Enable Conventional Telegram Commands

Function mode: 0111

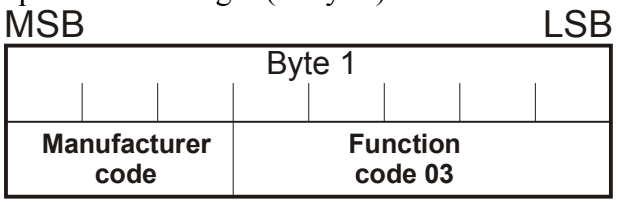
Specification length (in bytes): 1



2.3.1.3.2 Disable Conventional Telegram Commands

Function mode: 0111

Specification length (in bytes): 1



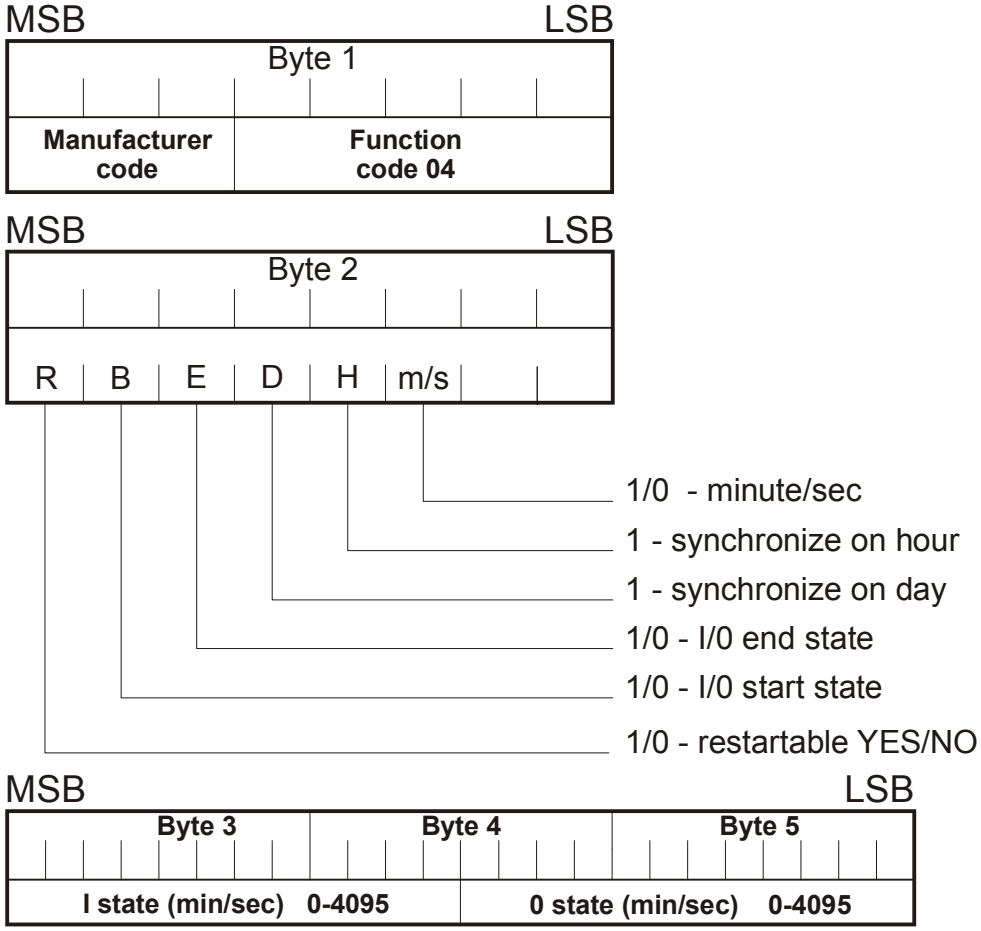
2.3.1.4 MYCYC Cyclic Function

All MYCYC parameters are locally and remote programmable using manufacturer function according to DIN43861-301. MYCYC can be started by conventional or DIN-43861-301 telegram. Automatic synchronization every day or hour can be selected by parameters.

2.3.1.4.1 Changing MYCYC Cyclic Function Parameters

Function mode: 0111

Specification length (in bytes): 5

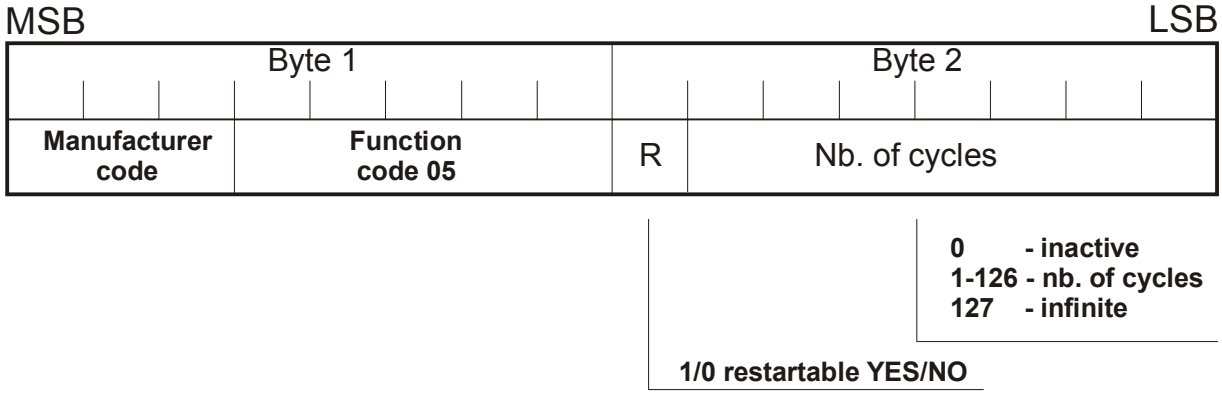


2.3.1.4.2 Starting MYCYC Cyclic Function

MYCYC cyclic function can be started by conventional telegram 'T' command, or using DIN43861-301 telegram.

Function mode: 0111

Specification length (in bytes): 2

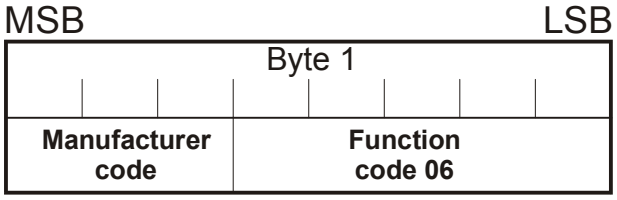


2.3.1.5 Restoring of last locally programmed Parameters

RC4 devices store a copy of last locally programmed parameters. It is possible to restore these parameters at any time, using manufacturer function according to DIN43861-301. After it, PON procedure will be executed.

Function mode: 0111

Specification length (in bytes): 1



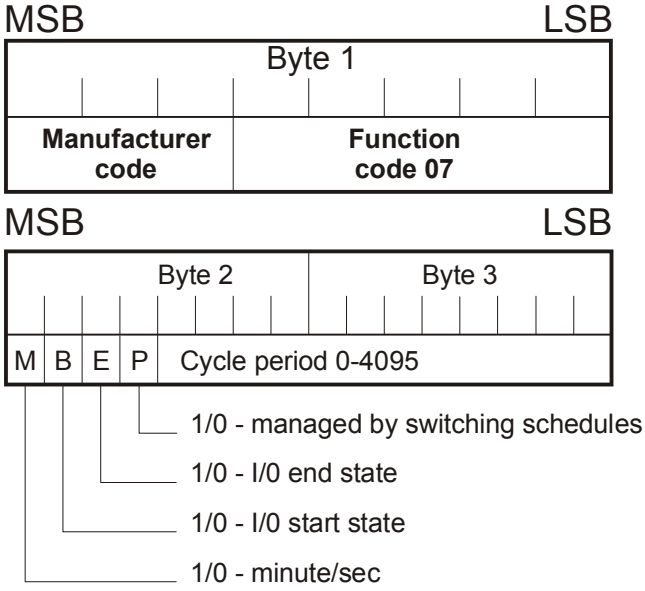
2.3.1.6 Changing fixed Parameters for CYC1 Cyclic Function

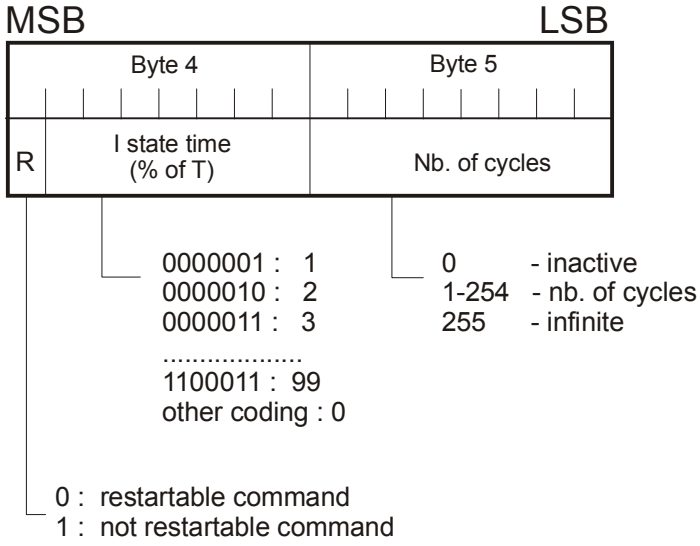
All CYC1 parameters are locally and remote reprogrammable, using manufacturer function according to DIN43861-301. CYC1 can be started by conventional or DIN-43861-301 telegram. CYC1 parameters:

- No. of cycles (0-255:0= inactive, 255=infinite)
- Restartable (YES/NO)
- Time units (minute/second)
- Object start state (I/0)
- Object end state (I/0)
- Managed by switching schedule (YES/NO)
- Cycles period (T): 0-4095 (minute or sec)
- I state time (te), % of T: 0-99%

Function mode: 0111

Specification length (in bytes): 5



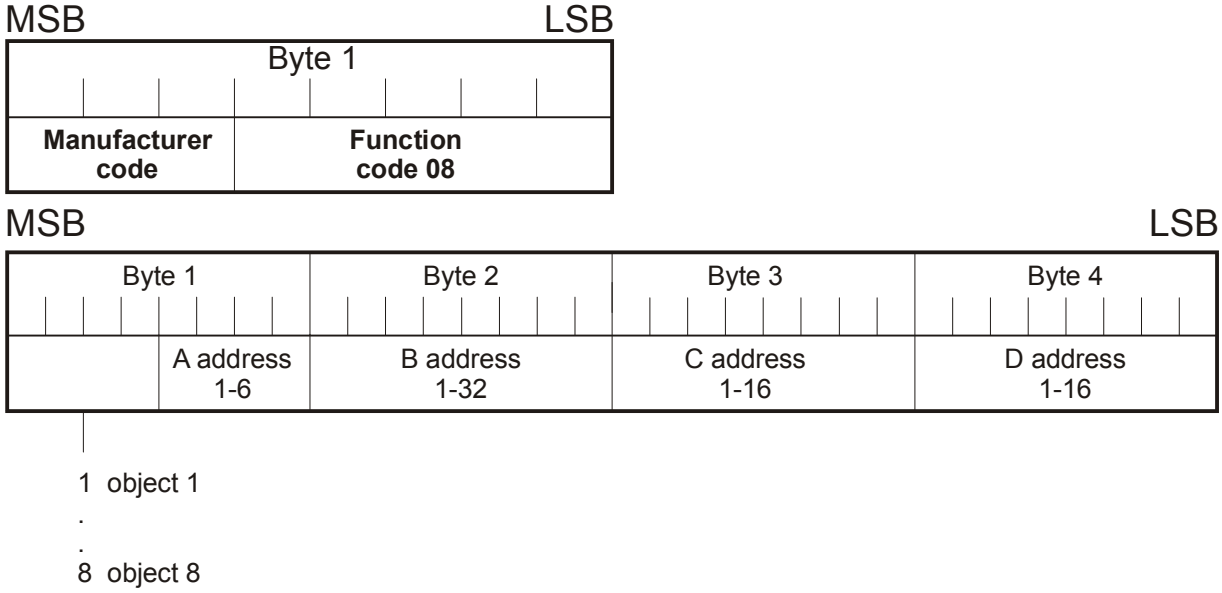


2.3.1.7 Changing Object Address (A, B, C, D areas)

Address for any object can be changed remotely, using manufacturer function according to DIN43861-301. Separate telegram is required to change address for an object. Only A, B, C, D areas address can be changed, not individual address. Device(s) which address has to be changed can be accessed using individual or object addressing mode. It means that changes can be made in a single or in a group of devices at a time.

Function mode: 0111

Specification length (in bytes): 5



3. Receiver Operation

RC4 fully complies with IEC 62054-11 (IEC61037) standard. It can receive conventional and DIN4361-301 telegrams. Received telegrams affect objects and relays states. There are 8 objects implemented, fully according to DIN43861-301. State of any relay can be set as AND/OR function of states of any 2 objects. Conventional telegram commands can be ENABLED/DISABLED, using manufacturer function according to DIN43861-301.

Device operation is fully described by PON/POFF objects action, by the way of receiving and interpreting telegrams and interpreting DIN43861-301 parameters. The following chapters deal with some specific behavior of RC4 devices.

3.1 Performing DIN43861-301 Functions

3.1.1 Device Operation when any Object is addressed, but Function is for the Whole Device

If any object is addressed, the whole device is addressed, too. Any DIN43861-301 function for the whole device will be performed.

3.1.2 Device Operation when the whole Device is addressed, but Function is for Objects

If the Whole Device is addressed, all of its objects are addressed, too.

Any received DIN43861-301 function will be done simultaneously for all objects.

3.1.3 Restartable Cyclic Commands

If DIN43861-301 cyclic command, marked as 'restartable' is received, any currently active cyclic operation will be stopped, and operation with new parameters will be started.

If DIN43861-301 cyclic command marked as 'not restartable' is received, any currently active cyclic operation will continue. New parameters will be taken. If no cyclic function is active, operation with new parameters will be started.

3.1.4 Switch Object to I State (function mode: 0101)

All addressed objects will be set to I state, with programmed delay. Any active cyclic operation on addressed objects is stopped.

3.1.5 Switch Object to 0 State (function mode: 0110)

All addressed objects will be set to 0 state, with programmed delay. Any active cyclic operation on addressed objects is stopped.

3.1.6 Out of Service Command (function mode: 1100)

Using DIN43861-301 function (mode: 1100), receiver is deactivated: only conventional command is further allowed (if enabled); all objects are set to 0 state, with programmed delay. Receiver can be activated again only by DIN43861-301 function (mode: 1110).

3.1.7 Test Command (function mode: 1101)

Increments test counter.

3.1.8 In Service Command (function mode: 1110)

Receiver will be further operational according to DIN43861-301 protocol.

3.1.9 Set Object to 0 States and Disable Related Switch Schedules (function mode: 1111)

This command disables all switch schedules related to addressed object, and sets to 0 state (with programmed delay). Object can be activated again by DIN43861-301 function (mode:0011).

3.2 Priority while Performing Cyclic Functions

DIN43861-301 defines 3 cyclic function with remote programmable parameters. For a given object, only one of them can be active at a time. The last activated cyclic function has the highest priority.

Additionally to DIN43861-301 cyclic function mode 1 (CYC1), all CYC1 parameters are remote programmable. It can be managed by switch schedules, too: I starts operation, while 0 stops it.

3.3 Event Counters

Counters for relay switching, telegram absence or received data error and test telegrams, are implemented in RC4. Relay switching counters are updated for each relay, when switching to I or 0 state is done. If time between telegrams is longer than that specified by TAT parameters, or received data error is detected, error counter will be incremented. DIN43861-301 test function increments test counter.

Counters can be read using PC computers. They are set to 0 during local programming or by DIN43861-301 function (mode: 1011).

3.4 Control Signal Measuring and Telegram History

Control signal voltage is measured during the start pulse of telegram, and stored together with date and time stamp. All pulses of last telegram are also stored. Besides this, control signal voltages for 2 recent test telegram are stored. All stored data can be read using PC computer.

3.5 Parameters Error

If parameters error is detected, all relays are set to ‘b’ position, and STATUS LED and LCD display error.

3.6 Inconsistency of DIN43861-301 Standard

3.6.1 Inconsistent Use of Terms Relay and Object in the same Meaning

- Complete DIN43861-301 document is related to objects, but counters are related to relays.
  Implemented in RC4: Switching counters count relays switching, not objects switching
- DIN43861-301 chapter 7.3.2 is related to relays, but all other functions are defined for objects.
  Implemented in RC4: Individual addressing with object switching (not relay).
  Explanation: No DIN43861-301 function is defined for relays, but for objects.

4. Displaying Operation of RC4 on PC Computers

Software application ***ACE PULSE configurator*** for PC computers (for WINDOWS) is used for online display of RC4 operation. All parameters and working states of device are shown. It is possible to check any application of RC4 device, before mass usage.

5. RC4 as Time Switch Device

RC4 can operate as time switch in 3 modes:

1. Only time switch functions are performed
2. Time switch functions in combination with conventional receiver
3. Time switch functions in combination with DIN43861-301 receiver

Operation reserve is realized by GOLD capacitor (for 40 or 100h) or 3V Li COIN battery. Battery is mounted in holder and easily replaceable without soldering. LCD is used to display date, weekday, time and device status.

Local programming is the same for all device subtypes. Local programming can be done in factory, before delivering. Individual address can correspond to serial number.

Time base calibration is made in factory. Later calibration is possible in laboratories.

5.1 RC4 Time Switch (subtype T)

RC4 subtype T operates as time switch device only, but still using DIN43861-301 parameters. No remote changing of parameters is possible. PON object states are always set correctly according to programmed tariff scheme. Year, week or day tariff program can be programmed.

5.2 RC4 Time Switch + Conventional Receiver (subtype U)

RC4 subtype U operates as time switch device using DIN43861-301 parameters simultaneously with conventional telegram receiver. No remote changing of parameters is possible. PON object states are always set correctly according to programmed tariff scheme. Year, week or day tariff schedule can be programmed.

Activation / deactivation of time switch functions, and time synchronization to 00:00:00 are possible using conventional ripple control telegrams.

5.3 RC4 Time Switch + DIN43861-301 Receiver (subtype L)

RC4 subtype L operates as time switch device and receiver according to DIN43861-301 standard. Year, week or day tariff schedule can be programmed.

To get correct PON object state according to programmed tariff scheme, PON state has to be programmed to 'S' (virtual switching). To start cyclic function at power on, PON state has to be programmed to 'T' (MYCYC) or 'C' (CYC1).

5.4 Time Base Calibration

Time base calibration is allowed only under conditions defined by IEC 62054-21 (IEC61038). Time base is temperature compensated. It is assumed 23°C during calibration. Buttons and connectors for calibration are shown by Figure 1.

To start calibration, jumper CAL must be inserted before powering on. At power on calibration mode will be entered, date: 01.01.01. and time: 6-00:00 will be set, but not displayed. Calibration mode is finished with power off and removing jumper CAL.

While calibrating, signal frequency of 4096,000 Hz is measuring. Any deviation of this value must be entered using P/A and T/E buttons. Using P/A button blinking digit can be edited, while T/E button moves editing to next digit, or sign.

Deviation [in ppm, with sign] that must be entered, can be calculated using relation:

dfq =((fm-4096)/4096)*1E6 [ppm]

Time base accuracy (temperature and starting quartz deviation), can be checked by measuring 4096,000 Hz any time, using formula:

4096 = fm - 4096*((dfq+dft)/1E6) [Hz]

Where:

fm- measured control frequency [Hz]

dfq – starting quartz deviation [ppm], entered during calibration

dft – temperature deviation [ppm]

'dfq' and 'dft' can be read at any time by holding P/A button longer than 12 seconds. 'dfq' is shown leftmost and 'dft' rightmost.

6. Technical Data

- Mounting dimensions 125x83 mm, according to DIN43861-2
- Supply voltage U_N 230V, 100V (+15%;-20%), 50 Hz
- Power consumption < 0,8 W / 9 VA cap
- Control frequency fs 160 Hz-1400 Hz
- Operate voltage Uf ≥ 0,5% U_N (programmable)
- Non-operate voltage Unf ≤ 0,3% U_N (programmable)
- Filtering A/D converter + digital signal processing
- Control signal voltage measuring
- Decoding conventional ripple control telegram up to 255 pulses
- Decoding telegrams according to DIN43861-301
- Operates according to DIN43861-301 switching programs
- Cyclic and timer operation
- Programmable relays action at power on
- Programmable relays states at power off
- Real time clock features:
  - Time base Q = 32,768 kHz
  - Accuracy better than 5 x 10E-6 (at ref. temperature +23°C)
  - Temperature compensation: better than 1 x 10E-5 (–25 to +70 °C)
  - Operation reserve time
    - GOLD capacitor 40/60/100h
    - Li battery 35 mAh 10 years
- Output relays: up to 4 bistable, magnetic latch:
  - Soldered type
    - Switching current Ic ≤ 16 A , cosφ=1; 8A, cosφ=0,4
    - Switching voltage Uc ≤ 400 Vac
    - Life cycles > 400000 (Ic= 5A) ;> 120000 (Ic=10A)
  - PLUG-IN type: up to 3
    - Switching current Ic ≤ 25 A , cosφ=1; 10A, cosφ=0,4 or 60/40A, cosφ=1;
    - Switching voltage Uc ≤ 400 Vac
    - Life cycles > 400000 (Ic= 5A) ;> 120000 (Ic=10A)
- Climatic conditions:
  - Operating temperature range -25°C to +70°C
  - Housing protection IP53
  - Terminal cover protection IP31
- Standards:
  - IEC 62054-11 (IEC 61037/CELENEC HD434 ,VDE 0420)
  - IEC 62054-21 (IEC 61038)
  - IEC 62052-21 (IEC 61037 and IEC 61038)
  - DIN43861-301
  - DIN43861-2
  - IEC 62056-21 (IEC 61107)
- Serial communication interface: asynchronous, 4800 Bauds, 8N1
- PLUG-IN EEPROM module for parameters
- IR communication interface according to IEC 62056-21 (IEC61107)
- Operation of RC4 can be displayed on PC computers in real time

- All RC4 parameters are programmable using serial communication interface:
  - Control signal frequency
  - Min. operate/ max. non-operate control signal level
  - PON/POFF object state
  - Telegram timing
    - No. of pulses
    - No. of pulses for selection
    - First DIN43861-301 pulse in conventional telegram
    - Start pulse duration
    - Start pause duration
    - Pulse duration
    - Pause duration
  - Assigning meaning to pulses
    - Selection pulses (neutral, 0, 1)
    - Command pulses (affect the objects, start DIN43861-301 protocol)
    - Cyclic functions synchronization

7. Ordering Data

Ripple Control Receiver- Time Switch	RC4-	_	-	___	_	_	_	_	-_ ___
Conventional receiver only		P							
Time Switch only		T							
P type + Time Switch + LCD		U							
DIN 43861-301 receiver		D							
D type +LCD		L							
Relays-16A, soldered: K1,K2,K3,K4 ..			16A						
-25A, PLUG-IN, K1,K2,K3			25A						
-40/60A, PLUG-IN, K1,K2,K3 ..			40A						
Relay K1 installed				1					
K1 not installed				0					
Relay K2 installed					1				
K2 not installed					0				
Relay K3 installed						1			
K3 not installed						0			
Relay K4 installed (16A soldered)							1		
K4 not installed							0		
Supply voltage 230 V								2	
Supply voltage 100 V								1	
Operation reserve:-GOLD C 40h									C4
-GOLD C 60h									C6
-GOLD C 100h.....									C9
-Li battery 35 mAh.									B3
……-NO.....								(no marking)	
IEC61107-IR interface									I
RS232 to optical interface								(no marking)	
PLUG-IN EEPROM module[1]									E

Example:

RC4-U-16A0100-2C4I RC4 conventional ripple control receiver and time switch, LCD, relays 16A soldered, K2 installed, supply voltage 230 V, Back-up supply: GOLD C 40h, IEC61107-IR interface.

[1] EPROM module can be used only with PLUG-IN relays and without RS232 interface

8. Packaging-Dimensions and Weight

		Dimensions of Cartons (mm)/Weight (kg)				
Type: RC4-X		**1 pc 190x108x85**	**5 pcs 442x230x205**	**10 pcs 442x230x205**	**20 pcs 560x355x205**	**54 pcs[2] 785x395x340**
16A	1000-2C4I	407	2.235	4.370	8.640	23.078
	1100	440	2.400	4.700	9.300	24.860
	1110	472	3.560	5.020	9.940	26.588
	1111	504	2.720	5.340	10.580	28.316
25/40A	1000-2C4I	420	2.300	4.500	8.900	23.780
	1100	480	2.600	5.100	10.100	27.020
	1110	540	2.900	5.700	11.300	30.260

[2] Most suitable for Europallets