RC232 Embedded RF Protocol User Manual

Description

The RC232™ Embedded RF Protocol is used in a range of products from Radiocrafts. The protocol handles host communication, data buffering, addressing and broadcasting and error check. It supports point-to-point, point-to-multipoint and peer-to-peer network topologies.

The RC232™ protocol features described in this document is common to all Radiocrafts modules named RC10xx, RC12xx, RC2x00 and all products with –RC232 in their article number. Device specific data are found in their respective data sheets.

Features

The RC232-protocol is the most easy-to-use protocol for bidirectional wireless transmission of data packets from a transmitter to a receiver. Data entered on one side is received transparent byte by byte at the other side. The RC232 protocol features:

- Complete MAC layer packet protocol
- Transparent and buffered modes
- Addressing
- Broadcasting
- Error check
- 128 byte data buffer
- Power saving schemes
- Easy-to-use UART interface
- RS232/422/485/USB compatible via external level shifter
- Optional UART hardware handshake
- Point-to-point
- Point-to-multipoint
- Peer-to-peer

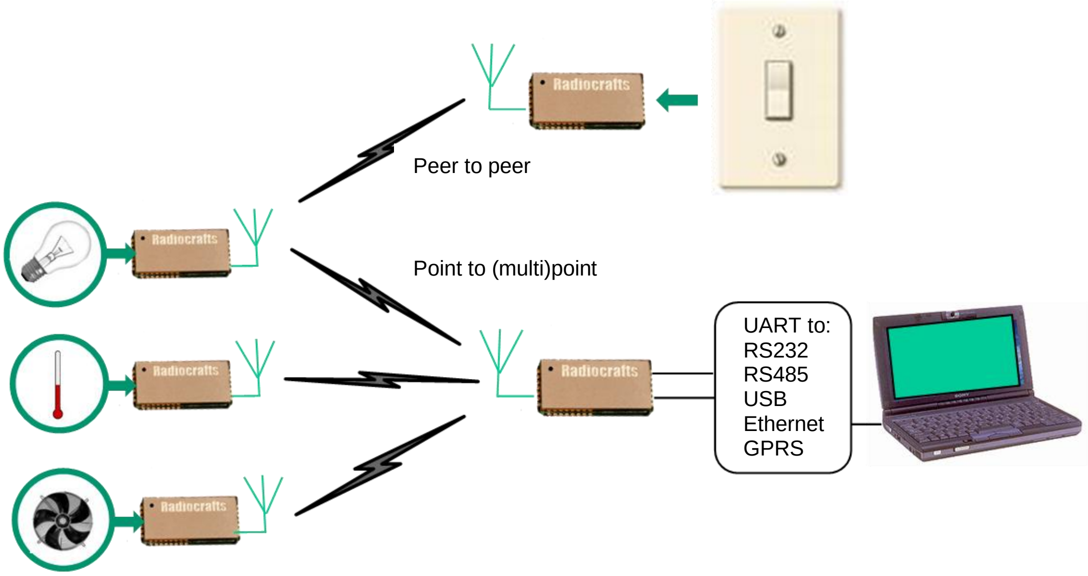

Figure 1: A typical addressed sensor- and actuator application supported by the RC232 protocol

Introduction
The RC232™ embedded RF protocol and command interface is described in this User Manual. Please refer to the Radiocrafts web-site for more information on the modules and their respective data sheets.

RC232™ Embedded Protocol
The RC232™ implements the Medium Access Control (MAC) layer and offers the following:
- Buffered packet transmission mode
- Variable packet length, end character or timeout
- Optional addressing of packets to a unique node, or broadcast to all nodes in a system
- Optional error detection using CRC-16 check sum
- On-the-fly configuration of the radio modem
- Un-buffered transparent mode (on some devices)

The RC232™ embedded protocol is compatible with RS232, RS422 and RS485 serial buses. Data is transferred to / from the module using a UART interface, the same as used for RS232, RS422 and RS485, except that it use logic level signals (3 - 5V logic). Most other UART converters, for instance UART-USB, can also be used together with the module.

The UART interface is used both for communication and configuration. A set of easy-to-use hex commands makes it possible to alter the configuration of the module.

Buffered mode communication
This is the most straight-forward and most commonly used mode. A data packet entered on the UART will automatically be transmitted by the module based on one or more of the following triggers:
- Buffer is full. Buffer size is configurable and is named PACKET_LENGTH
- A predefined time after last bit in last byte is received. The time is configurable and is named PACKET_TIMEOUT
- An end character is received. The end character is configurable and is named PACKET_END_CHARACTER

Only ONE of the triggers has to be present for the module to transmit.

Note the following:
- PACKET_TIMEOUT=0 (zero) means “None”, thus is disabling the feature. If this parameter is not used as trigger for transmission one of the other two has to be configured for the transmission to perform as required. A good practice is to set PACKET_TIMEOUT = 0x02 so the module empties its buffer if an unintentional start bit enters the UART
- If the module transmits based on either full buffer or received end character, the PACKET_TIMEOUT is ignored, thus this configured time does not add to the total time spent for a transmission to take place

Addressing
The module allows addressed packet transmissions and broadcast transmissions. Each module has a SYSTEM_ID (one byte) and its own UNIQUE_ID, UID (one byte). The SYSTEM_ID and UNIQUE_ID can be programmed for each module using the configuration interface. The use of addressing can be enabled with ADDRESS_MODE in the configuration memory.

Each module also has a default destination address, DESTINATION_ID, DID. This address will be added to the data packet if addressing is enabled.

All the nodes in one system should have the same SYSTEM_ID. And each node should be set to a different UNIQUE_ID.

To send a packet to a specific node, set the destination address to the specific node's UNIQUE_ID.

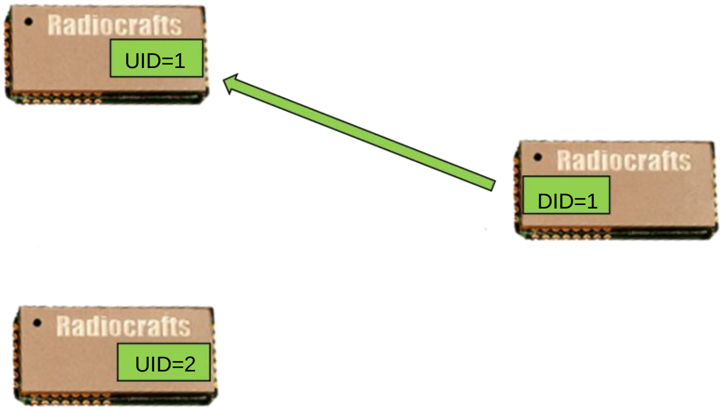

Figure 2: Set DID=UID for an addressed package to arrive at the desired receiver

If a broadcast is to be made, set the destination address to the BROADCAST_ID. By default the BROADCAST_ID is 0xFF (decimal 255), but this can be changed in the configuration. Remember that the BROADCAST_ID cannot be the same as any UNIQUE_ID.

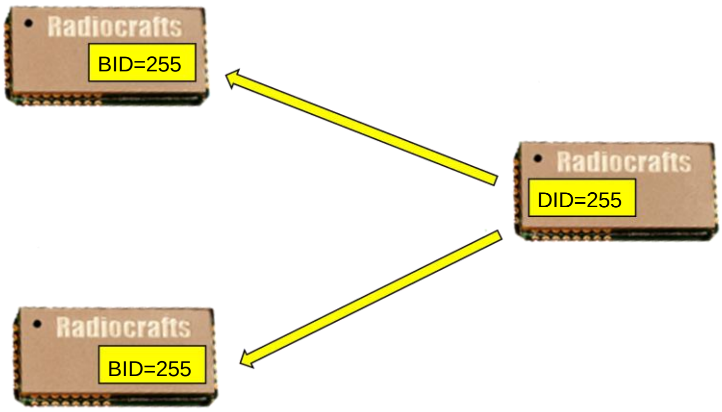

Figure 3: Set DID=BID for a package to arrive at the desired multiple receivers

For addressing to work properly make sure:

- All nodes have addressing enabled (ADDRESS_MODE)
- All nodes within the system have the same SYSTEM_ID
- All nodes within the system have the same BROADCAST_ID
- Each node within the system has one unique UNIQUE_ID

Before transmitting data make sure:

- The DESTINATION_ID is set to the desired receivers UNIQUE_ID
- Or set the DESTINATION_ID to the BROADCAST_ID if the packet is to be received by all nodes

CRC Error Detection

The RC232™ protocol has a built in error detection based on a 16 bit CRC. The error detection can be enabled with CRC_MODE in the configuration memory. If a received packet contains an invalid checksum, it will be discarded and not sent to the host.

UART Interface

A UART serial bus is used as the interface between the module and the host system for data transmission in the buffered mode and for configuration of the module. Normally no flow control (handshake) is used. Any microcontroller with hardware or software UART or UART converter communicating with the module in its configurable UART speed can be used to communicate with the module.

Optionally the CTS and/or RTS/RXTX can be used for hardware flow control:

CTS pin – Clear to send: The low-asserted CTS pin provides flow control for the module. When CTS is asserted (low), serial data can be sent to the module for RF transmission. If the module is busy, like during RF data transmission or reception, the CTS pin will be de-asserted (high) to stop any data transfer to the module.

RTS pin – Ready to send: When RTS is asserted (low) the host allow data to be sent from the module to the host. The host can stop the module from sending data by de-asserting (high) the RTS signal. Note that if the module has data waiting in the receive buffer, it will not be able to receive or transmit further data until the RTS has been asserted and the data in the buffer is transferred to the host.

RXTX pin – RS485 driver control: RXTX is low when the module can receive data on RXD. RXTX is high when the module is transmitting data on TXD and additionally 5 ms for the module to turn from TXD to IDLE mode (see Timing Information in the module data sheet). The RXTX pin is normally connected to the /RE and DE pins on the RS485 driver circuit.

The configuration of the flow control for the UART interface is done by changing UART_FLOW_CTRL in the non-volatile configuration memory.

Note: The module CTS is set up during the first stop bit sent from to module when the buffer is full, and the host should then halt further character transmissions to prevent character loss. If the host cannot detect the CTS quickly enough during hardware handshake, it should be configured for two stop bits.

THE FOLLOWING CHAPTERS APPLY FOR RC10xx and RC12xx (INCLUDING –HP VERSIONS) FAMILIES OF MODULES

For other RC232-modules the features are described in their respective datasheets.

Module Configuration

PRECAUTIONS:
To ensure proper entering and exit of configuration mode follow these simple guidelines:

- Avoid writing to configuration memory unless strictly necessary
- Ensure correct UART speed (within 2% accuracy) at all times
- Always wait for prompt after asserting configuration pin low
- Always keep supply voltage above minimum limit specified in datasheet
- Never switch off module or do Reset immediately after sending 'FF' command, always wait for prompt before further actions
- Ensure configuration mode is not entered unintentionally by keeping any signal connecting to the modules CONFIG-pin controlled (high when not entering configuration mode)
- Always leave configuration mode via 'X'-command

The configuration of the module can be changed in-circuit from the host during operation, at the time of installation of the equipment, at the manufacturing test, or even as a stand alone module. The configuration is changed sending commands on the UART interface after the CONFIG pin has been asserted (low).

Once the CONFIG pin is activated the module enters command mode. The module will then respond by sending a '>' prompt on the TXD pin. This indicates that the module is ready to receive commands. The CONFIG pin can then be de-asserted. Note that the CONFIG pin must be de-asserted *before* the Exit command ('X') is sent to the module in order to return to normal operation.

An exception for de-asserting CONFIG is when using 'Z' to enter SLEEP mode. In this case the CONFIG pin should not be de-asserted but kept low until the module should exit SLEEP mode as de-asserting the CONFIG line wakes the module again. The module will enter normal IDLE mode after exiting SLEEP mode. No 'X' command is then necessary.

After a command is executed, the module responds with the '>' prompt character again indicating it is ready for a new command. Do not send a new command before the '>' prompt is received. The time required to execute a command can vary depending on the command (see the Timing Information section). There is no '>' prompt after the 'X' exit command.

The parameters that are set by commands directly take immediate effect after returning to normal operation (IDLE), but will not be stored in non-volatile memory, and will be lost in case the supply power is turned off or if the module is reset. These parameters are for example the radio channel and output power.

Permanent changes of parameters can be done by writing to the configuration memory using the memory command 'M'. These are for example *default* radio channel, *default* output power, UART handshaking, address mode and CRC mode, see the Configuration Memory section.

A list of commands is shown in the table below. Commands must be sent as ASCII characters or their corresponding binary value. All arguments must be sent as binary values to the module (not as ASCII representation for hex or decimal).

Parameter	Command	Argument in hex (decimal)	Note
Channel	'C' – 0x43	RC1040: 0x01-0x05 (1-5) RC1081: 0x01-0x11 (1-17) RC1090: 0x01-0x09 (1-9) RC1210: 0x01-0x1E (1-30) RC1230: 0x01-0x47 (1-71) RC1240: 0x01-0x45 (1-69) RC1244: 0x01-0x55 (1-85) RC1250: 0x01-0x50 (1-80) RC1280: 0x01-0x50 (1-80) RC1280HP: 0x01-0x50 (1-80) RC1290: 0x01-0x33 (1-51)	Data is stored in volatile memory only. For variants not listed here, refer to the specific data sheet. Note: 5 HP channels
Output power	'P' – 0x50	0x01-0x05 (1-5)	Data is stored in volatile memory only.
Signal Strength (RSSI)	'S' – 0x53	RC12x0: return one byte indicating the signal strength RC10x0: No function	
Destination address	'T' – 0x54	0x00 – 0xFF (0-255)	Data is stored in volatile memory only.
Memory configuration	'M' – 0x4D	(Address, Data): see list of parameters below. 0xFF exits memory configuration.	Used to enter memory configuration menu. Parameters changed are stored in non-volatile memory.
Exit command	'X' – 0x58	(none)	Exit to normal operation mode. All changes of parameters take effect.
Sleep mode	'Z' – 0x5A	(none)	CONFIG pin must be asserted while in SLEEP mode. Exit sleep mode by releasing CONFIG pin.
Test mode 0	'0' – 0x30	(none)	List all configuration memory parameters
Test mode 1	'1' – 0x31	(none)	TX carrier (lower FSK frequency)
Test mode 2	'2' – 0x32	(none)	TX modulated signal RC10xx: FSK square wave RC12xx: PN9 sequence Test mode 1 must be used before 2 can be used. Return to Test mode 1 before exiting configuration mode

Note: ASCII characters are written as 'X', hexadecimal numbers are written like 0x00, and decimal numbers are written like 10 throughout the text. A table of ASCII characters and their respective hex and decimal values are found in the Appendix.

Any invalid command will be ignored and the '>' prompt will be re-sent.

In order to use test mode 1 and 2, test mode 1 must always be set first. Modulation can then be turned on using test command 2. The modulation must be turned off by using test mode 1 again before exiting the configuration mode ('X') in order to ensure proper operation in normal mode.

Example:
To select RF channel 3, send the follow sequence after asserting the CONFIG line and the ‘>’ prompt is received:

Command	Hex	Response	Comment/Note
CONFIG asserted		‘>’	De-assert CONFIG after ‘>’ prompt
‘C’	0x43	‘>’	
3	0x03	‘>’	Wait for ‘>’ prompt
[A new command could be issued here]			
‘X’	0x58	(none)	Module returns to IDLE state

Note that the CONFIG line must be de-asserted after the first ‘>’ prompt was received, but before the ‘X’ command.

Configuration Memory

The table below shows the complete list of configurable parameters stored in non-volatile memory. These values can be changed using the 'M' command. All addresses and arguments must be sent as binary values to the module (not as ASCII representation for hex or decimal). Argument range and factory settings for module variants not listed here are shown in their specific data sheet.

Parameter	Description	Address hex	Argument dec	Factory setting hex (dec)	Comment
Radio configuration					
RF_CHANNEL	Default RF channel	0x00	RC1040: 1-5 RC1081: 1-17 RC1090: 1-9 RC1210: 1-30 RC1230: 1-71 RC1240: 1-69 RC1244: 1-85 RC1250: 1-80 RC1280: 1-80 RC1280HP: 1-80 RC1290: 1-51	0x03 (3) 0x02 (2) 0x05 (5) 0x0A (10) 0x11 (17) 0x36 (54) 0x54 (84) 0x31 (49) 0x29 (41) 0x3D (61) 0x1A (26)	See data sheet for channel frequencies. For variants not listed here, refer to the specific data sheet. Note: 5 HP channels
RF_POWER	Default RF output power	0x01	RC1040: 1-5 RC1081: 1-5 RC1090: 1-5 RC1210: 1-5 RC1230: 1-5 RC1240: 1-5 RC1244: 1-5 RC1250: 1-5 RC1280: 1-5 RC1280HP: 1-5 RC1290: 1-5	0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x05 (5) 0x04 (4)	See data sheet for output power levels. For variants not listed here, refer to the specific data sheet.
RF_DATA_RATE	Default RF data rate	0x02	RC10x0: 1-5 RC1210: NA RC1230: NA RC1240: NA RC1244: NA RC1250: NA RC1280: NA RC1280HP: NA RC1290: 3-5	0x05 (5) 0x03 (3) 0x02 (2) 0x03 (3) 0x03 (3) 0x02 (2) 0x03 (3) 0x03 (3) 0x03 (3)	All RC12xxs except for RC1290 have fixed data rate. 1: 1.2 kbit/s 2: 2.4 kbit/s 3: 4.8 kbit/s 4: 9.6 kbit/s 5: 19.2 kbit/s For variants not listed here, refer to the specific data sheet.
Reserved		0x03		0x00 (0)	
Reserved		0x04		0x02 (2)	
RSSI_MODE	RSSI mode	0x05	RC1040 and RC1090 only: 0:Disabled 1: Analogue RSSI enabled	0x01 (1)	RC12xx does not have analogue RSSI. Use the 'S' command instead.
Reserved		0x06		0x64(100)	
Reserved		0x07		0x00 (0)	
Reserved		0x08		0x00 (0)	
Reserved		0x09		0x00 (0)	
Radio packet configuration					
PREAMBLE_ LENGTH		0x0A	4-8 bytes	0x08 (8)	Do not set above 8.
SOF_CHARACTER		0x0B-0x0D		0xD391DA	Do not change.
ABSOLUTE_MAX_ PACKET_LENGTH		0x0E		0x80 (128)	Limited by hardware. Do not change.
PACKET_LENGTH	Max packet length. When	0x0F	0x01-0x80 (1-128)	0x80 (128)	

	buffer is full, modem will transmit data				
PACKET_TIMEOUT	Time before modem time-out and transmit buffered data	0x10	0x00-0xFE (0-254) 0x00 (0): None 0x01 (1): 32 ms 0x02 (2): 48 ms 0x03 (3): 64 ms 0x7C (124): 2 s 0xF9 (249): 4 s	0x7C (124)	None means packet timeout is disabled (not 0 s). Use packet length or end character instead. Timeout value is (PACKET_TIMOEOUT x 16 ms) + 0/16 ms min/max 0xFE (254) is max, giving 4.080 sec. Default is 2 s = 0x7C (124)
PACKET_END_CHARACTER		0x11	0: None 0x0D (13): CR 0x0A (10): LF 0x5A (90): 'Z'	0x00 (0)	ASCII character
Medium access, addressing and network management					
Reserved		0x12		0x02 (2)	
MAC_MODE		0x13	0:Transparent 1: Buffered	0x01 (1)	Transparent means using RXEN and TXEN.
ADDRESS_MODE		0x14	0: No addressing 1: Reserved 2: Use addressing	0x02 (2)	Using addressing adds SYSTEM_ID and DESTINATION_ID to the radio packet. Set to 0 in transparent mode.
CRC_MODE		0x15	0: None 2: CRC16	0x02 (2)	Set to 0 in transparent mode.
Reserved		0x16		0x00 (0)	
Reserved		0x17		0x00 (0)	
Reserved		0x18		0x00 (0)	
UNIQUE_ID	Unique ID (UID)	0x19	0-255	0x01 (1)	
SYSTEM_ID	System (net or family) ID (SID)	0x1A	0x00-0xFF (0-255)	0x01 (1)	
Reserved		0x1B		0x0A (10)	
Reserved		0x1C		0x0A (10)	
Reserved		0x1D		0x0A (10)	
Reserved		0x1E		0x0A (10)	
Reserved		0x1F		0x01 (1)	
Reserved		0x20		0x01 (1)	
DESTINATION_ID	Default destination address	0x21		0x01 (1)	Set to same as BROADCAST_ADDRESS when broadcasting.
Reserved		0x22		0x01 (1)	
Reserved		0x23		0x00 (0)	
Reserved		0x24		0x00 (0)	
Reserved		0x24		0x00 (0)	
Reserved		0x26		0x00 (0)	
Reserved		0x27		0x04 (4)	
BROADCAST_ADDRESS	Broadcast address	0x28	0x00-0xFF (0-255)	0xFF (255)	All nodes accept messages to this address.
Reserved		0x29		0x08 (8)	
Reserved		0x2A		0x00 (0)	
Reserved		0x2B		0x00 (0)	
Reserved		0x2C		0x00 (0)	
Reserved		0x2D		0x00 (0)	
Reserved		0x2E		0x00 (0)	
Reserved		0x2F		0x00 (0)	
Data and configuration interface, UART Serial Port					
UART_BAUD_RATE	Baud rate	0x30	RC12xx only: 0x00: Not used 0x01: 600	0x06 (6)	BE CAREFUL IFCHANGING AS HOST MAY LOOSE CONTACT

			0x02: 1200 0x03: 2400 0x04. 4800 0x05: 9600 0x06: 19200		WITH MODULE! Does not take effect until module is re-booted / reset. RC10x0 UART baud rate cannot be changed.
Reserved		0x31		0x08 (8)	
Reserved		0x32		0x00 (0)	
Reserved		0x33		0x01 (1)	
Reserved		0x34		0x05 (5)	
UART_FLOW_CTRL	UART flow control	0x35	0: None 1:CTS only 3:CTS/RTS 4:RXTX(RS485)	0x00 (0)	Set to 0 in transparent mode.
DATA_INTERFACE	Data interface	0x36	0x00: UART using RXD and TXD 0x01: Synchronous interface (SDA, SCL) using RXEN and TXEN for direction control	0x00 (0)	When buffered mode is selected for MAC_MODE use UART. For flow control, see above. When transparent mode is selected for MAC_MODE use Synchronous interface.
Reserved		0x37		0x01 (1)	
Reserved		0x38		0x2B (43)	
Reserved		0x39		0x00 (0)	
Reserved		0x3A		0x01 (1)	
Exit from memory configuration		0xFF	No argument should be sent		To exit from command mode the 'X' command must be sent after '>' is received.

To make permanent changes to default values and other parameters, the Memory Configuration command 'M' is used. This command should be followed by pairs of byte being the memory address and the new value to be stored at that address. In order to exit the Memory Configuration mode, the 'address' 0xFF must be sent, but without any data argument. Then wait for the '>' prompt while the internal memory is re-programmed (See Timing Information for typical delay). To completely exit from command mode, the normal exit command 'X' must be sent.

Example:
To change the Unique_ID (at address 0x19) and set it to 100 (0x64), send the following sequence:

	Command	**Hex**	**Response**	**Comment/Note**
CONFIG asserted			'>'	De-assert CONFIG after '>' prompt
	'M'	0x4D	'>'	Module ready to receive address
	0x19	0x19	(none)	
	100	0x64	(none)	
	[new address could be sent here]			
	[new value could be sent here]			
	0xFF	0xFF	'>'	Wait for '>' prompt
	'X'	0x58	(none)	Module returns to IDLE state

Test mode 0 ('0' command) can be used to list all parameters stored in non-volatile memory. This command can be used to verify and check the module configuration.

Power Management

The module can be set in SLEEP mode or OFF mode in order to reduce the power consumption.

The low power SLEEP mode is entered by using the SLEEP command, or by pulling both RXEN and TXEN low. In SLEEP mode the module will not receive or detect incoming data, neither from the host (UART port) nor from the RF transceiver. The module is awakened from the SLEEP mode by a positive edge on the CONFIG, RXEN or TXEN pins.

Note: If UART handshake is used, the RXEN and TXEN pins can not be used to enter SLEEP mode. In this case, use the SLEEP command.

The ultra-low power OFF mode is entered by pulling the ON/OFF pin low. The module will then shut down completely. The module is turned on by setting the ON/OFF pin high (to VCC). After the module has been in OFF mode all operational parameters are set to their default values.

Synchronous Interface for Un-buffered Transparent Data Communication

A synchronous interface is used in the un-buffered transparent mode. SCL is the data clock generated by the module, and SDA is the bi-directional data signal.

To enable un-buffered transparent mode the following settings must be done in the configuration memory:

- MAC_MODE (address 0x13) = 0
- DATA_INTERFACE (address 0x36) = 1
- CRC_MODE (address 0x15) = 0
- ADDRESS_MODE (address 0x14) =0

In the un-buffered mode RXEN and TXEN are used to control the module. To start data transmission the TXEN must be pulled low. The module will then enable the RF transceiver for transmit mode and send a preamble and SOF (start-of-frame). When the module is ready to send data the SCL clock will start to run. Data at the SDA pin is then modulated and sent by the RF transceiver. To end the transmission the TXEN pin must be set high. The SCL clock will then stop and the module will turn off the RX transmitter and return to idle mode. Data are clocked into the module at the positive edge of the clock. Hence, data should be set up at the negative edge.

Note: After RESET the module will start with SCL logic high, and the first bit must be set up at the first negative edge. The timing of the disabling of TXEN will determine if SCL is stopped while high or low. If SCL is stopped while low, the first bit in the next transmission must be set up before TXEN is activated.

In order to receive data the RXEN pin must be pulled low. The module will then search for preamble and SOF. When a preamble and SOF is detected, the module will send the incoming data on the SDA pin using SCL as data clock. Data reception will continue until the RXEN pin is pulled high. The application must determine the actual end of the transmission and terminate the reception by disabling the RXEN pin.

Data should be clocked into the host at the positive edge of the clock, as data are set up at the negative edge in the module.

There is always a small probability that the receiver will do false preamble detection, and start to send data on the SDA and SCL pin, which in this case would only be noise. The application must also handle this situation and abort the reception by disabling the RXEN pin momentarily. Once the RXTX pin is activated again, normal preamble search is resumed.

If both RXEN and TXEN are pulled low, the module enters SLEEP mode, providing very low power consumption.

The table below shows a summary of the control pins used in un-buffered transparent mode.

Mode	RXEN	TXEN	Note
IDLE	High	High	
RX	Low	High	As soon as preamble and SOF is detected, the module sends data on SDA and SCL.
TX	High	Low	As soon as preamble and SOF is transmitted, the module start data clock on SCL and read data on SDA
SLEEP	Low	Low	(Apply also in buffered mode when no HW handshake is used)

CRC and addressing must be turn off using the un-buffered transparent mode.

Appendix: ASCII Table

HEX	DEC	CHR	CTRL
0	0	NUL	^@
1	1	SOH	^A
2	2	STX	^B
3	3	ETX	^C
4	4	EOT	^D
5	5	ENQ	^E
6	6	ACK	^F
7	7	BEL	^G
8	8	BS	^H
9	9	HT	^I
0A	10	LF	^J
0B	11	VT	^K
0C	12	FF	^L
0D	13	CR	^M
0E	14	SO	^N
0F	15	SI	^O
10	16	DLE	^P
11	17	DC1	^Q
12	18	DC2	^R
13	19	DC3	^S
14	20	DC4	^T
15	21	NAK	^U
16	22	SYN	^V
17	23	ETB	^W
18	24	CAN	^X
19	25	EM	^Y
1A	26	SUB	^Z
1B	27	ESC	
1C	28	FS	
1D	29	GS	
1E	30	RS	
1F	31	US	
20	32	SP	
21	33	!	
22	34	"	
23	35	#	
24	36	$	
25	37	%	
26	38	&	
27	39	'	
28	40	(	
29	41	)	
2A	42	*	
2B	43	+	
2C	44	,	
2D	45	–	
2E	46	.	
2F	47	/	
30	48	0	
31	49	1	
32	50	2	
33	51	3	
34	52	4	
35	53	5	
36	54	6	
37	55	7	
38	56	8	
39	57	9	
3A	58	:	
3B	59	;	
3C	60	<	
3D	61	=	
3E	62	>	
3F	63	?	

HEX	DEC	CHR
40	64	@
41	65	A
42	66	B
43	67	C
44	68	D
45	69	E
46	70	F
47	71	G
48	72	H
49	73	I
4A	74	J
4B	75	K
4C	76	L
4D	77	M
4E	78	N
4F	79	O
50	80	P
51	81	Q
52	82	R
53	83	S
54	84	T
55	85	U
56	86	V
57	87	W
58	88	X
59	89	Y
5A	90	Z
5B	91	[
5C	92	\
5D	93	]
5E	94	^
5F	95	_
60	96	`
61	97	a
62	98	b
63	99	c
64	100	d
65	101	e
66	102	f
67	103	g
68	104	h
69	105	i
6A	106	j
6B	107	k
6C	108	l
6D	109	m
6E	110	n
6F	111	o
70	112	p
71	113	q
72	114	r
73	115	s
74	116	t
75	117	u
76	118	v
77	119	w
78	120	x
79	121	y
7A	122	z
7B	123	{
7C	124	|
7D	125	}
7E	126	~
7F	127	DEL

Document Revision History

Document Revision	Changes
1.0	First release
1.1	Configuration memory addresses corrected
1.2	Revision 1.2 apply for modules marked E.S. (Engineering Sample) Data buffer length changed from 200 to 128 Test commands added in Module Configuration ASCII table added in Appendix Minor corrections and editorial changes for clarity
1.3	Revision 1.3 apply for all modules revision 2.0 and onwards Corrected PACKET_TIMEOUT default value to 0x7C Changed ADDRESS_MODE value from 1 to 2 when using addressing Added note on Test mode 2, that Test mode 1 must be used first, and also before exiting configuration mode Included UART baud rate settings for RC12x0
1.4	Clarifications on un-buffered transparent mode added Added data for RC1250 Updated factory setting values in configuration memory table
1.5	Updated graphical presentation of the RC232 protocol Updated tables with more article numbers with their default settings

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