Technical Manual
For the
L-RX201 Reader

Document Number:	**EAB-02710-01-TM**
Client:	**User**
Date:	**24 DECEMBER 2004**
Issue:	**V1.0**
Status:	**Final**
Classification:	**Confidential**
S/W File Name	**EAB-02710-01-TM.DOC**

AMENDMENT HISTORY

Issue	Date	Amendment Details	Amended By
01	14 Dec 2004	Final	Des Reddy

Table 1: Amendment History

APPROVALS

Number	Name	Designation	Date	Signature
1.	A. Evangelidis	Technical Director		
2.	D. Rabe	Product Manager		
3.	Des Reddy	SW Engineer		
4.	Charl Neuhoff	System Engineer		
5.	Stefan Goosen	Design Engineer		

Table 2: Approvals

REFERENCED DOCUMENTS

Number	Title	Document Number	Rev	Source
1.	Tag User Manual	EAA-00000-04.pdf	04	
2.				
3.				
4.				
5.				

Table 3: Referenced Documents

ABBREVIATIONS

Abbreviation	Meaning
CR	Carriage Return
EOM	End of Message
I/O	Input/Input
ID	Identity
LF	Line Feed
LSB	Least Significant Bit/Byte
M	Meter
mm	Millimetre
MSB	Most Significant Bit/Byte
NC	No Connection
PC	Personal Computer
Pwr	Power
RF	Radio Frequency
RFID	Radio Frequency Identification
Rx	Receive
SOM	Start of Message
TBA	To be Announced
TX	Transmit
UPS	Uninterruptible Power Supply
RSSI	Received Signal Strength Indicator
PCB	Printed Circuit Board
EMI	Electromagnetic Interference
ESD	Electrostatic discharge

Table 4: Abbreviations

TABLE OF CONTENTS

1 SCOPE

1.1 Identification

Wavetrend Technologies Ltd developed the L-RX201 reader to be used in conjunction with the Wavetrend active tags. The reader performs the following functions:

- Receives, decodes and validates data from the Wavetrend active tags.
- Outputs the relevant tag data onto a Reader Network.
- Performs an exception reporting function by only relaying tag messages that conform to the specific reconfigured filtering conditions.

1.2 Product Overview

Figure 1: L-RX201 Reader

The reader comprises of the following components:

- RF Module (RF Receiver and Demodulator).
- The Network Communications module that includes a Micro-controller.
- The LED indicators on the output connectors.

The basic Reader block diagram is illustrated in Figure 2 below.

The 485 Reader can be used with the following Wavetrend Antennas: LAN-100 / 200 / 300 / 350 / 400.

1.3 Functional Diagram

The L-RX201 Reader has the following functional structure.

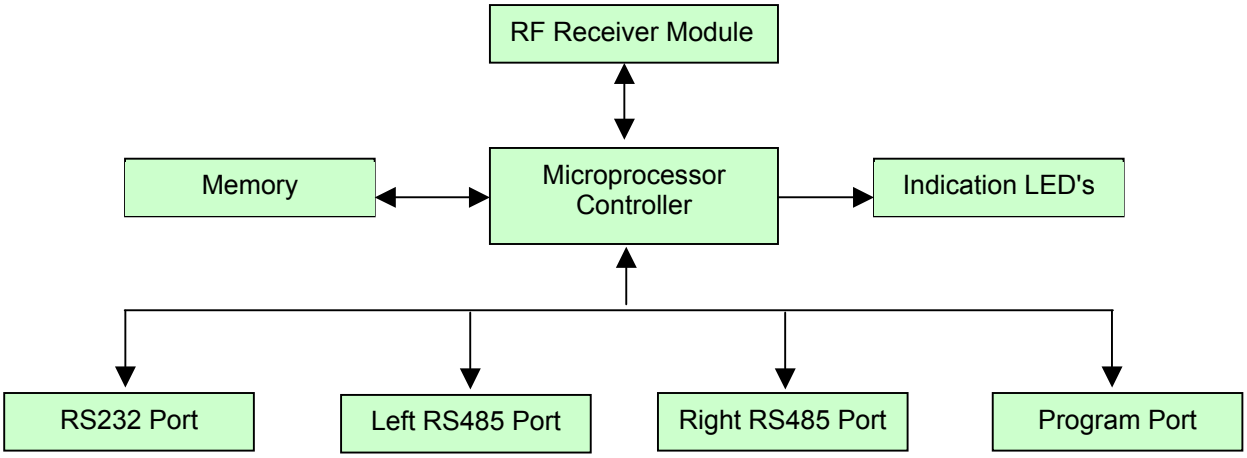

Figure 2: L-RX201 Receiver functional diagram

This reader consists of a microprocessor controller with onboard firmware that communicates directly with the RF Receiver module and connects to the outside world via 3 serial interfaces. Data can be sent independently to and from the 2 x RS485 ports and will be simultaneously represented on the RS232 port. All connections are done via 2 x RJ45 connectors and are protected against EMI and ESD noise.

2 NETWORKING

2.1 SINGLE NETWORK STRUCTURE

The L-RX201 readers are connected together in a daisy chain type format. That is, Reader 1 is connected to Reader 2, which is connected to Reader 3 etc. A single reader network can address a theoretical maximum of 254 readers. Communications between readers is done via a 2-wire RS485 connection. Connections from reader 1 to the PC can be done from the “Left” port via a RS232 or RS485 connection. This network need not necessarily connect to a PC, but can be some other device such as a buffer or handheld computer etc.

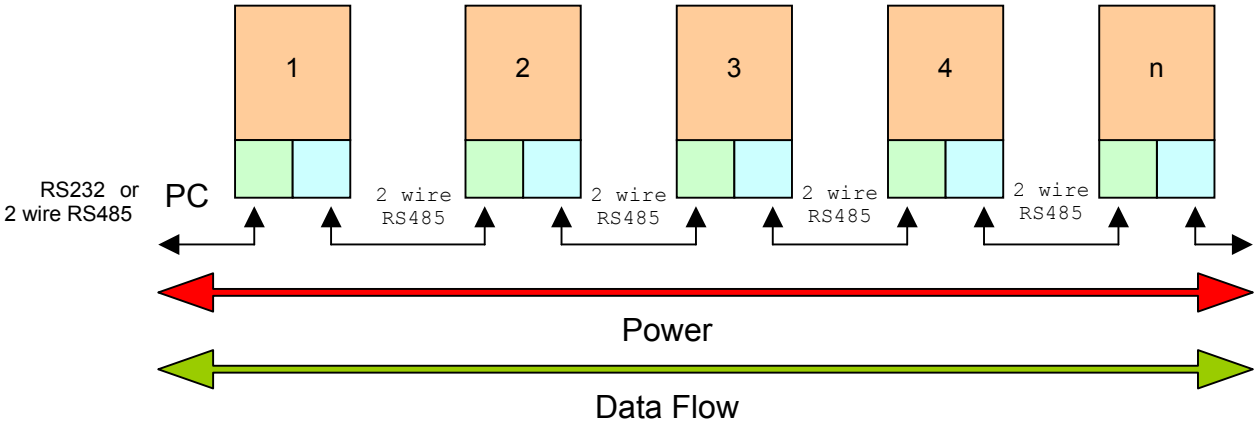

Figure 3:

Power is also carried to each reader via the data cable between the readers. Each connection between readers consists of 4 wires only. (**The other wire strands should not be connected**)

- Power
- Ground
- RS485+
- RS485-

The connections have been designed in such a way that the cable forms a straight “through” connection and does not require the twisting or changing of any wires between readers. This makes the installation of this network very simple and since each RS485 connection between readers is theoretically a separate network, distances between them can be up to 1.2 km can be achieved. This distance is based on the RS485 standard and is dependant on the quality of the cable used. RS485 termination resistors are included in each reader and therefore do not need to be added as an afterthought. Data packets run bi-directionally up and down this network enabling a reader to perform its functions.

The network operates at speeds of up to 115200 baud and as low down as 9600 baud. The communication baud rate can be altered by using the application software (W-RX201-SW-DEMO which is available from the Wavetrend website). For more information, refer to the predefined commands in section 4 of this document. Data communication to and from the PC must be at the same baud rate. The reader net may be supplied with power from multiple points within the network. When more than one PSU is used, the supplies must be connected via the ground line. **In the event that the PSU’s are not commonly connected, the maxi-**

mum differential voltage between the negative supply lines must not exceed 7V. It is important that a stable power supply be used. If more than one power supply is used it is important that the first command sent after the power has stabilised is the Reset Network command.

For ease of installation, it is recommended that the standard Wavetrend W-PS300 Tracking power supply unit is used. For more information please consult the website.

2.2 BASIC NETWORK OPERATION

Each reader can be individually addressed via 2 addressing techniques. The entire network can be sent a broadcast command by assigning the reader destination address as value 255. These addressing techniques are explained further in this document.

Figure 4: The RS485 ports on each reader are defined as a left port and a right port.

Data transmitted from the “right port” of a reader would be received in the “left port” of the receiver to the right of it and vice versa. With this kind of configuration, it is possible for the reader to control the direction that the data is flowing, and handle it accordingly. The complete network would look as follows:-

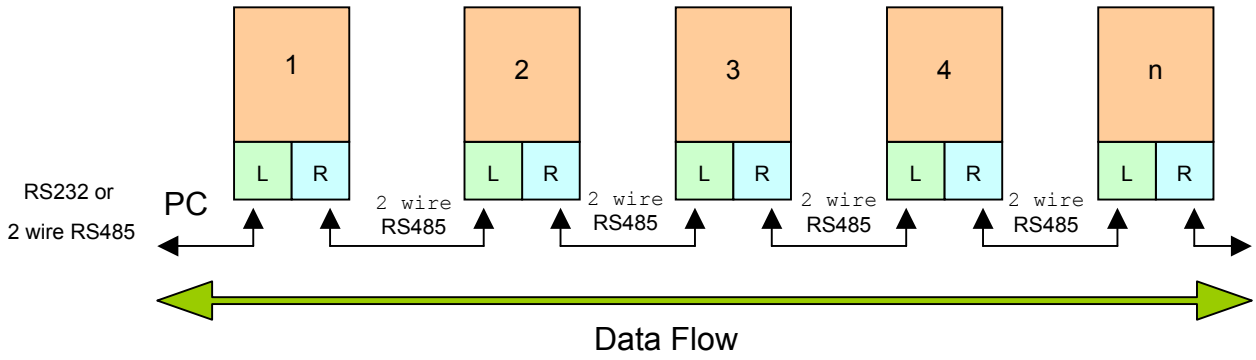

Figure 5:

This network works on a Command and Response type operation. That is, a command is sent down to a specific reader in a left to right direction, while the response is sent back from right to left. Simply, commands run left to right, while responses run from right to left.

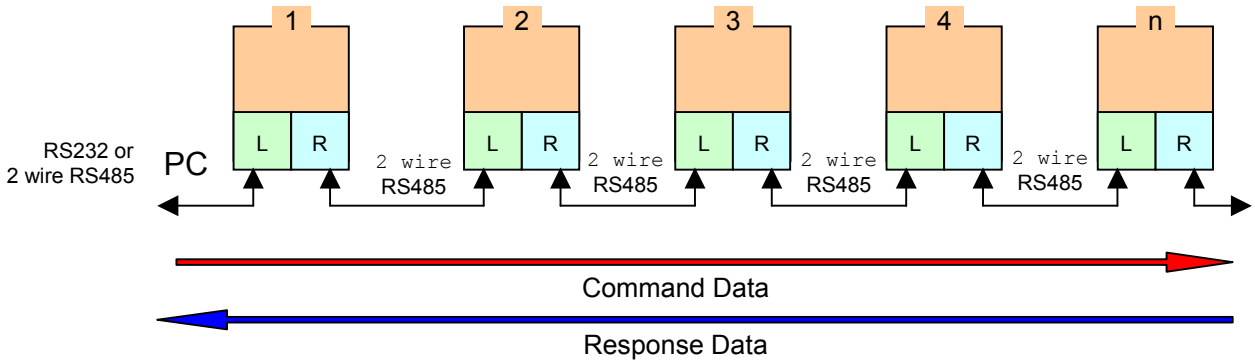

Figure 6:

Each Command and Response is formatted into a specific packet of data with error checking. Data can only flow in one direction at a time since the hardware is using a single serial port to control all this serial data.

As the reader network is able to determine data direction, it is possible to establish which reader is at position 1 on the network and from this the consecutive addresses can be established. There are 2 distinct methods of addressing a reader when sending out a command.

- The first address is called the NODE ID. This is the electrical address of the reader and is defined automatically by its position in the network. The first reader (very left) would be assigned NODE ID 1 and would then increment consecutively to the right until a maximum of 254.
- The second address is called the READER ID. This address is defined by the user and is written to the non-volatile memory of each reader and can be from 1 to 254. The NODE ID is fixed according to its position on the reader network unlike the READER ID, which is configured by the user.

If a reader is removed from the network, or simply bypassed, the NODE ID's will naturally change. The function of the READER ID is therefore to allow a consistent and permanent address assignment to each reader. Logically, one would use NODE ID addresses in a command packet to assign a READER ID to a specific reader. NODE ID's provide a failsafe method of always accessing the correct reader if the network structure is known.

2.3 ESTABLISHING NODE ID ADDRESSING (AUTOMATIC ASSIGNMENT)

At power up, the NODE ID's are automatically established from the readers' physical connection position on the network.

This whole process takes about 3.5 seconds at power up and consists of the following sequences.

1. Each reader powers up and sets its data flow in a right hand direction.
2. Each reader then continuously sends ' * ' s out of their right hand RS485 ports, and prepares to receive this character in their left hand RS485 ports. This character is sent out in single bursts every 25ms. This avoids any framing errors should a reader not be able to lock onto the data stream in the correct position from start up.
3. If an ' * ' is received in the left RS485 port, the TAG LED (slave indicator) is illuminated to indicate this. Each reader, except for the first reader on the reader network, will therefore receive this character on its left hand RS485 port.
4. The first reader has now been established.
5. This process of sending out the right hand RS485 port lasts for 1 second.

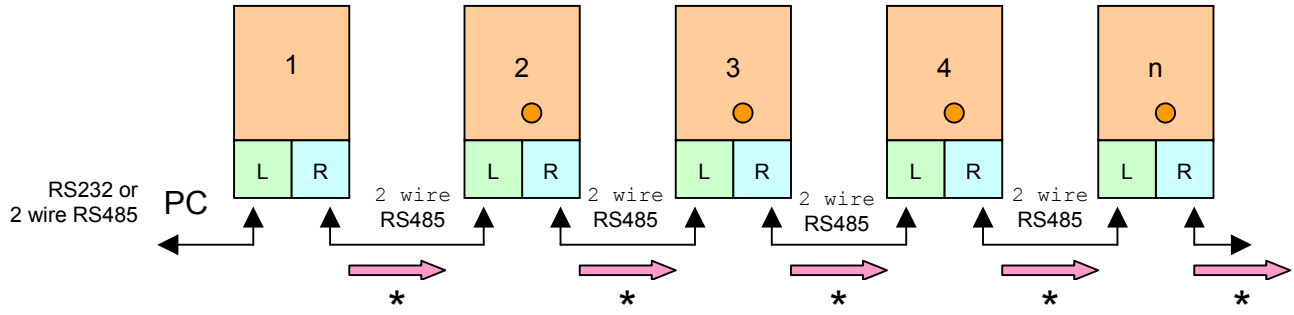

Figure 7:

6. Once the first reader has been established, it will start continuously sending its NODE ID out of the right hand RS485 port. This will be a continuous ' 1 ' and lasts for 500ms.

7. Each remaining reader, on receiving a byte, assumes it to be the NODE ID of the reader to the left of it adds 1 to this value and assigns it as its own NODE ID. This new NODE ID is passed again to the right. This continuous sending of NODE ID's to the right has a ripple down effect on the network, until every receiver has been assigned its NODE ID and the network has stabilised.

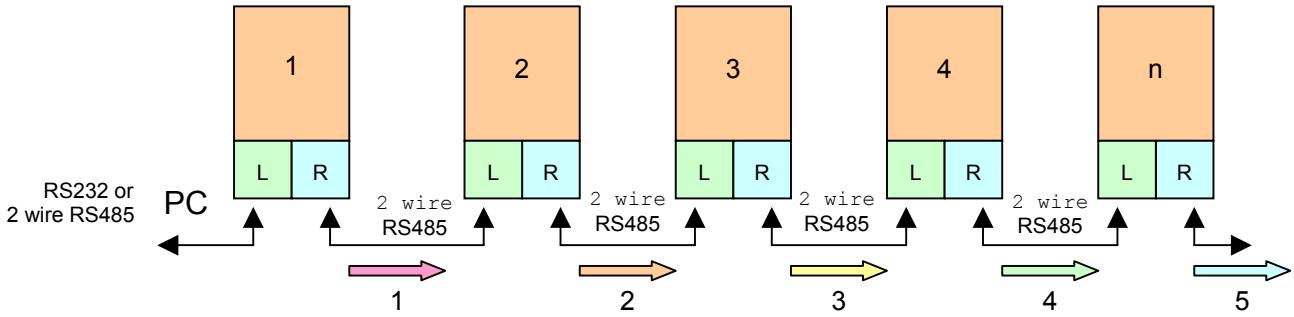

Figure 8:

8. Although the first reader on the reader network only sends the NODE ID 1 out for 500ms, the rest of the network remains in this receive - add 1 - transmit mode for a full second. This prevents any erroneous data from the first reader on the network corrupting the whole network assignment.
9. There is now a further 1-second delay before the whole network is now ready and active. The first reader on the reader network actually waits a further 2 seconds after its 500ms timeout before it becomes active, making it active 500ms after the others.

2.4 PACKET CONTROL

As explained earlier, data is passed between the readers on the reader network in a specific packet format structure. For optimisation purposes, the data packet is transmitted byte for byte as it is received and single reader does not wait until the complete data packet is received before transmitting it on to the next reader. The reader at the opposite end of the network would therefore have its packet delayed by the time taken to transmit a single byte down the length of the network. This is a relation of the baud rate and the number of readers on the network.

After start up, the readers are all set into the idle condition, waiting for either a command or response packet from the network. Here they will wait until they receive a command from the PC or a response packet from another reader. The IDLE/OK status LED will illuminate at this stage.

Command packets (Left to Right) are transmitted across the entire length of the network.

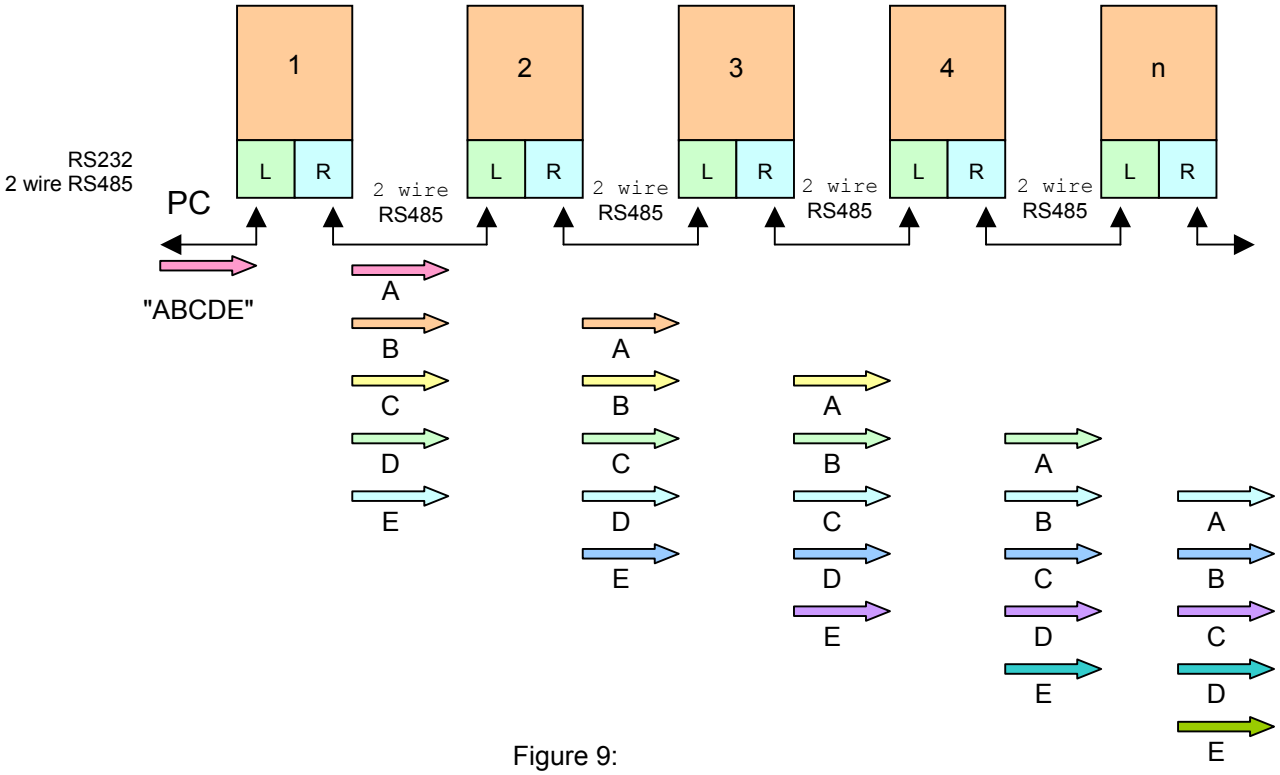

Figure 9:

In the idle mode, data can be received from either direction. Since there is only one serial port on the microprocessor, the header byte received will determine which direction the packet is being received from. Once this byte has been received, the communication drivers are immediately set-up to flow the data in the correct direction. They will stay in this direction until the entire packet has been received, or the communications has timed out, whereby the reader will go back into the idle mode.

While this data is being transmitted down the network, each reader assembles the packet in its memory for analysis when completed. Once a complete command packet is received, the contents are analysed for errors and addressing. Should this be a Command packet, the addressed reader(s) will then respond. After receiving a complete packet, each reader will immediately switch back into the idle mode. (Receive from both directions). In this mode, the next packet (should there be any) will automatically be passed in the correct direction.

Should there be a break of more than 25ms between any bytes of the data packet, each reader will automatically switch back into the idle mode and ignore that packet. In this way, any communications failure will not result in the network locking up.

Should a spontaneous response packet be initiated eg Network Reset as a result of a power glitch, the packet will be passed back to the PC

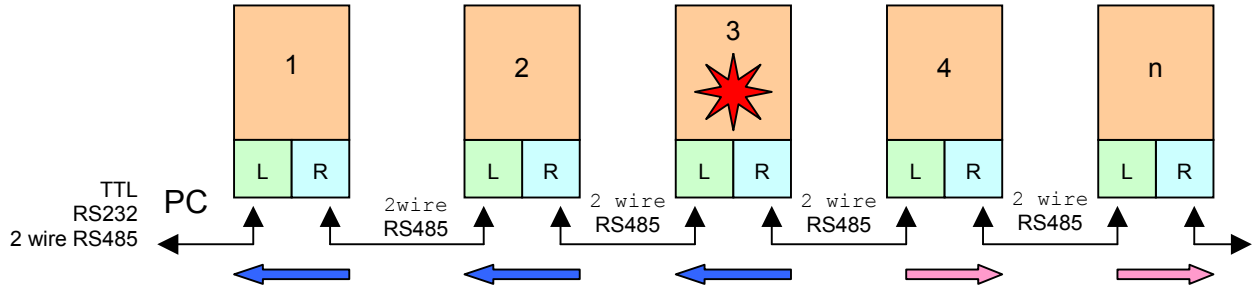

Figure 10:

Each time a valid packet is received, the Packet RX LED will flash. This can be used to determine whether valid communications is taking place.

Response packets are now sent back exactly the same way as the command packet, but in the opposite direction. Each reader would assemble the packet as it is passed through to determine when the response is complete. Once it has received a complete response, the reader will switch into the idle mode, ready for the next Command packet.

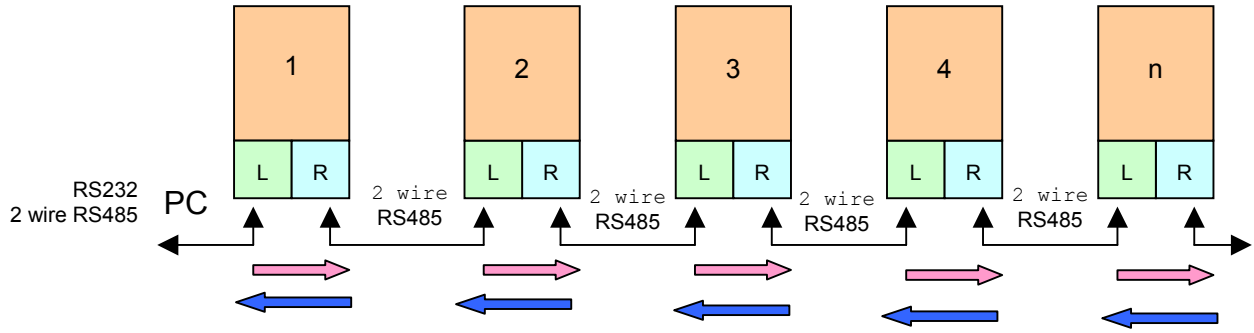

Figure 11: Idle Status of the network

2.5 AUTO POLLING MODE

The readers can be set into a mode that will allow this reader network system to be “auto-polled” ie free running. When the first reader on the network has the auto polling enabled, it will automatically determine the number of readers connected to its network and sequentially send commands out to receive the tag data from each reader using the 'Get Tag Packet Command 0x06'. These tag packets pass through the first reader and onto the PC. In this mode, the PC will receive a continuous stream of tag packets without the need for it to poll the individual readers on the network. This can be used on systems that have no ability to send data out to the network, or need to only monitor the tag data as it appears, making it a very simple system without complicated polling routines.

Where no tag data is available, an empty reply packet will be sent back. This enables the monitoring software to determine if there are any readers on the network that are not responding, and suggest the appropriate action.

Since this data is being received on a continuous basis, a mechanism has been put into place to enable the PC to stop this process so that commands can be sent out to the network. This can be achieved by sending a break character (in this case , ' * ') to the first reader on the network. Should the first reader receive this character, it will stop sending 'Get Tag Packet' commands until such time that it is instructed to go back into Auto Polling mode, OR the system is switched off and powered up again.

Since the network can not see the PC while it is passing a packet from right to left (ie to the PC), it will be necessary to time this character to when the data packets are flowing left to right. This can be tricky, so the suggested method is to simply send a large number of ' * ' characters (400 - 500) to the network. In this manner, the network will always see these characters.

To guarantee a break occurring, send 400 x ASCII 255 + ' * ' characters. The Ascii 255 character will ensure that there is no possibility of a framing error occurring and the break character not being seen.

400 x

0xFF	*

Breaking the polling sequence does not alter the Auto Polling Flag in the Data EEPROM, but only suspends polling. After a physical reset, this system will start polling again unless the auto polling is disabled with the appropriate command.

Auto Polling sequences start with a complete system communications reset to ensure that the network is seen correctly. This happens each time the auto polling is switched on. Even at power up.

In the case where RF modems are used, it is important not to use the auto-polling mode and to communicate with the reader(s) by its reader address and not the node address.

3 PROTOCOLS AND ADDRESSING

As mentioned earlier data flowing on this network have a specific packet format. This format is defined as follows:

3.1 COMMAND PACKETS

0xAA	Data Length	Network ID	Receiver ID	Node ID	Command Byte	Data ….	Checksum

All bytes are HEX Values

Packet	Name	Bytes
1.	Header	1 Byte [0xAA]
2.	Length	1 Byte (Number of Bytes in data section)
3.	Network ID	1 Byte
4.	Receiver ID	1 Byte
5.	Node ID	1 Byte
6.	Command	1 Byte
7.	Data	Can have up to 64 Bytes of Tag Data
8.	Checksum	1 Byte (XOR from Length to Last Data Byte), CRC

CHECKSUM = [Length] XOR [Network ID] XOR [Receiver ID] XOR [Node ID] XOR [Command]…XOR [Data]…

3.2 RESPONSE PACKETS

0x55	Data Length	Network ID	Receiver ID	Node ID	Command Byte	Data ….	Checksum

All bytes are HEX values.

Packet	Name	Bytes
1.	Header	1 Byte [0x55]
2.	Length	1 Byte (Number of Bytes in data section)
3.	Network ID	1 Byte
4.	Receiver ID	1 Byte
5.	Node ID	1 Byte
6.	Command	1 Byte
7.	Data	Can have up to 64 Bytes of Tag Data
8.	Checksum	1 Byte (XOR from Length to Last Data Byte), CRC

CHECKSUM = [Length] XOR [Network ID] XOR [Receiver ID] XOR [Node ID] XOR [Command]…XOR [Data]…

Command and Response packets are essentially identical except for the header character. This different header character enables equipment receiving all the data to differentiate between command and response packets. Since the RS232 port presents all the data at all times, it will be necessary here to be able to differentiate between these packets.

3.3 ADDRESSING TECHNIQUES

The addressing system for the reader network has been made as flexible as possible. This will allow for various configurations and keep the system open for later expansion.

When addressing a reader, there are 3 addresses to take into account: -

1. Network ID - Identifies the network (used in multi-network configurations)
2. Reader ID - User defined address for a specific reader - Permanent address.
3. Node ID - Hardware address. This address is defined by the readers' position on the network

All three of these bytes can be set in the header bytes of the command packet.

If a zero is placed into any of these positions, it is an indication to the firmware to ignore this parameter, and only use the remaining addresses to determine the reader being addressed.

If a value of 255 is placed into any of these addresses, it is an indication to the reader that this command is being broadcast to that appropriate level. A 255 value in the Network ID byte means that the command is being broadcast over all the networks. Whereas, a 255 in either the Receiver ID bytes or Node ID bytes would indicate that the command is being broadcast to all the readers in that network.

Node ID addresses take priority over Receiver ID addresses. That is, a valid Node ID address will be accepted before a valid Receiver ID.

When commands are broadcast, there is no response packet generated. The only exception for this is the Reset Network Command.

A simple flow diagram for this logic would be as follows:

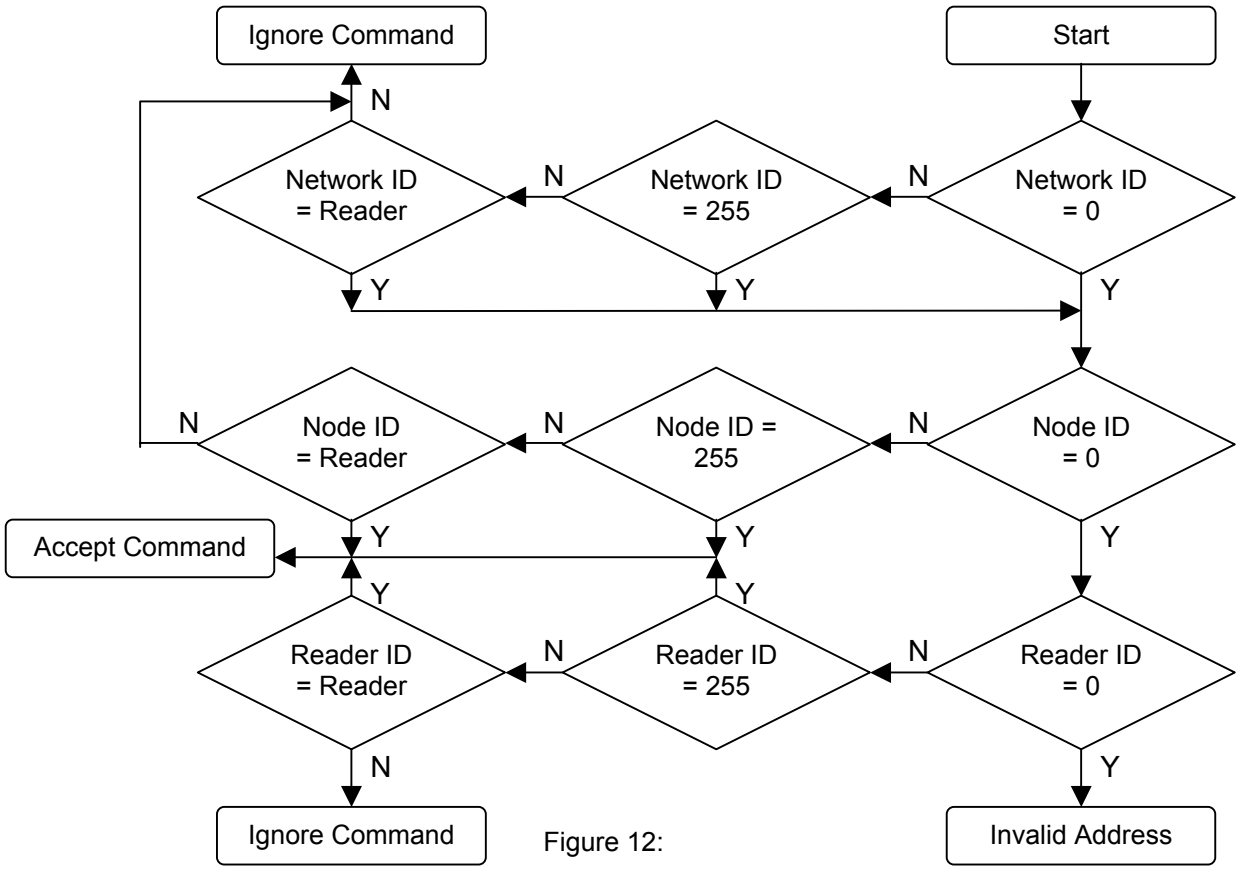

Figure 12:

Some examples would be as follows:

Network ID	Receiver ID	Node ID	Effect
0	0	0	Invalid - will have no response
0	12	0	Access Reader with Reader ID = 12
0	0	5	Access Reader at position 5 on the network
0	12	5	Access Reader at position 5 on the network. Reader ID address is ignored
1	0	0	Invalid - will have no response
1	4	0	Access Reader with Reader ID = 4 on Network 1
1	0	123	Access Reader at position 123 on Network 1
255	12	0	Access all Readers with Reader ID = 12 on all the networks
255	0	45	Access Reader at position 45 on all the Networks
255	255	0	Access all possible readers
255	0	255	Access all possible readers
0	255	255	Access all possible readers

4 COMMANDS

4.1 LIST OF READER COMMANDS

The following is a list of the commands that are available for the L-RX201 reader :

Value	*Function*	*Expect Response*
0x00	Reset Network	Reply Packet
0x01	Enable Auto Polling	Continuous
0x02	Disable Auto Polling	Reply Packet
0x03	Ping Reader	Reply Packet + Error Number
0x04	Set Network ID	Reply Packet
0x05	Set Reader ID	Reply Packet
0x06	Get Tag Packet	Tag Packet
0x07	Get RSSI Value	Reply Packet + RSSI
0x08	Set RSSI Value	Reply Packet
0x09	Set Site Code	Reply Packet
0x0A	Get Site Code	Reply Packet + Site Code
0x0B	Set Receiver Gain	Reply Packet
0x0C	Get Receiver Gain	Reply Packet + Gain
0x0D	Set Alarm Filter	Reply Packet
0x0E	Get Alarm Filter	Reply Packet + Status
0x0F	Get Number of invalid Tags	Reply Packet + Counter
0x10	Get Supply Voltage	Reply Packet + Voltage
0x11	Start RF white noise calculation	Reply Packet
0x12	Get RF white noise result	Reply Packet + Result
0xFE	Set Baud Rate	No Reply – Broadcast only
0xFF	Get Version Information	Reply Packet + Version Data

4.2 DESCRIPTIONS OF COMMANDS

4.2.1 Reset Network Command

The function of this command is to reset the entire network and re-establish the NODE ID addresses. The NODE ID address in the command packet should hold a 255 (broadcast value) to ensure that the entire network enters into the reset sequence. Only reader at position 1 will respond with the reply packet. This is the only condition under which a response is sent from a broadcast command.

Note: receiving a reset network reply packet at any point where no reset command was sent, will imply that a spontaneous reset has occurred. This would probably be as the result of a power problem.

Command

0xAA	0x00	0x00	0x00	0xFF	0x00	Checksum

Response

0x55	0x00	Network ID	Receiver ID	0x01	0x00	Checksum

4.2.2 Enabling Polling Mode Command

The function of this command is to set the reader at position 1 into an Automatic Polling sequence. It sets the Auto Polling flag in the Data EEPROM of the reader to enable Auto Polling after power up.

It will establish the size of the network by sending out tag requests until such time that it gets no response. This will determine the number of readers on the network. Once this has been established, it will sequentially poll each reader indefinitely. Data responses from the readers pass through the first reader 1 and onto the PC. Readers without a valid tag will respond with an empty packet of data. This will enable the monitoring software to determine if any readers are no longer responding. This command can be addressed directly to reader 1, or on a broadcast basis. When broadcasting, any reader that is not reader at position 1 on the network, will disable its Auto Polling flag in its Data EEPROM section on the reader to avoid any problems in the future because of incorrect parameters.

This command is used to restart the Auto Polling if it has been stopped by a break character. (See Auto Polling section)

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x01	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x01	Checksum

4.2.3 Disable Auto Polling Command

The function of this command is to disable the Auto Polling feature after power up by resetting the Auto Polling flag in the Data EEPROM of the reader. This command can be addressed directly to reader 1, or on a broadcast basis.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x02	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x02	Checksum

4.2.4 Ping Reader Command

The Ping Command is simply used to check if a reader is on the network and responding correctly. It can be used to read back Network ID's, Reader ID's and Node ID's. Inserted into the response from a Ping Command is an Error Number. This number refers to the last error the respective reader has experienced. Once read, this number is cleared.

To clear all the errors on all the readers, simply broadcast a Ping Command.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x03	Checksum

Response

0x55	0x01	Network ID	Receiver ID	Node ID	0x03	Error Number	Checksum

Error Numbers are as follows:

Error Number	*Definition*
0	No errors encountered
1	Unknown reader command received
2	Tag Table underflow error
3	Command Packet checksum error
4	RF Module - Unknown command response
5	RF Module - Unknown general response
6	RF Module - Re-sync failure
7	RF Module - Command response failure
8	RF Module - Receive response failure
9	No response packet received from polled reader

4.2.5 Set Network ID Command

The function of this command is to assign the Network ID as well as commit it to the Data EEPROM of the reader.

Command

0XAA	0x01	Network ID	Receiver ID	Node ID	0x04	New Network ID	Checksum

Response

0X55	0x00	Network ID	Receiver ID	Node ID	0x04	Checksum

4.2.6 Set Reader ID Command

The function of this command is to assign the Reader ID as well as commit it to the Data EEPROM of the reader.

Command

0XAA	0x01	Network ID	Receiver ID	Node ID	0x05	New Reader ID	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x05	Checksum

4.2.7 Get Tag Packet Command

This will be the most commonly used command on any system. Its function is to request a data packet from the reader, which contains the tag data packet if there is one ready for sending. A tag packet is removed from the readers' buffer, and returned with this command, making room for a new tag packet.

New tags received by the RF Module are stored in the Reader Buffer and the existing tags are deleted in a FIFO method in order to keep the data current. If no tag is ready for sending to the PC, an empty packet is sent back. That is, no data in the Data field.

The reader has a 3-stage buffer which allows for 3 tag data packets to be stored.

Command

0XAA	0x00	Network ID	Receiver ID	Node ID	0x06	Checksum

Response (empty)

0x55	0x00	Network ID	Receiver ID	Node ID	0x06	Checksum

Response (Tag Packet)

0x55	Data Length	Network ID	Receiver ID	Node ID	0x06	Data	Checksum

The following is a detailed representation of the response data:

Byte	Name	Data	Example	Description
1	Header	0x55	85	Header of 485 packet
2	No. Data Bytes	0x20	32	Number of bytes in Data part (Byte 6 to 37).
3	Network ID	0x01	01	Network identifier
4	Receiver ID	0x01	80	Actual value from reader that is stored.
5	Node ID	0x01	01	Position no of the reader on the reader network
6	Command ID	0x06	06	Command identifier linked to a response.
7	Header	'!'	33	Header. Fixed value
8	Header	'*'	42	Header. Fixed value
9	Header	'*	42	Header. Fixed value
10	Interval		49	Time Interval between transmissions
		48 0x30		1 Transmission every 30 seconds
		49 0x31		1 Transmission every 1.5 seconds
		50 0x32		1 Transmission every 0.8 seconds
		51 0x33		1 Transmission every 0.4 seconds
		32 0x20		1 Transmission every 15 seconds
11	Counter	0 → 127	129	2nd Counter (7 Bit Counter with bit (Bits 0 → 6)) Bit 7 → Reed Open/Close
12	FW Version	0 → 255	31	Firmware Version Number (31/ 10) = v3.1
13	Reserved	'B'	66	Reserved
14	Reserved	'C'	67	Reserved
15	Alarm Counter	0 → 255	0	Movement Counter
16	Age byte	0 → 255	0	Life Cycle Counter Byte of Tag (MSB)
17	Age byte	0 → 255	152	Life Cycle Counter Byte of Tag
18	Age byte	0 → 255	136	Life Cycle Counter Byte of Tag
19	Age byte	0 → 255	60	Life Cycle Counter Byte of Tag (LSB)
20	Site code	0 → 255	0	Vendor Code (MSB)
21	Site code	0 → 255	0	Vendor Code
22	Site code	0 → 255	4	Vendor Code (LSB)
23	Tag ID	0 → 255	0	Tag ID (MSB)
24	Tag ID	0 → 255	0	Tag ID
25	Tag ID	0 → 255	0	Tag ID
26	Tag ID	0 → 255	108	Tag ID (LSB)
27	Type of tag	0 → 255	50	Tag is Fused. Cannot be re-programmed
		48 0x30		Tag is not Fused. Can be re-programmed.
		50 0x33		

28	Reader Address	0 → 255	80	Stored address of the reader
29	RSSI Value	0 → 255	127	RSSI Value (Signal Strength)
30	Tag CRC	0 → 255	177	Tag data checksum (see below to calculate)
Byte	***Name***	***Data***	***Example***	***Description***
31	Reserved	0x20	32	Reserved
32	Alarm byte	0 → 255	80	Alarm Byte (50 or 51)
33	Node ID	0 → 255	80	Node ID
34	Network ID	0 → 255	0	Network ID
35	Reader RSSI	0 → 255	0	RSSI Threshold set on the reader
36	FW Version	0 → 255	40	Firmware Version
37	LF	0 → 255	10	Post-amble
38	CR	0 → 255	13	Post-amble
39	Reader CRC	0 → 255	45	Checksum of total data packet

Note: To calculate and verify the checksums referenced at **[Byte 30]** and **[Byte 39]** of the data packet you would need to evaluate the following calculations. Please note that all example values from the table above is represented in byte format and not in hexadecimal.

Tag CRC = [Byte 10] + [Byte 11] + [Byte 15] + [Byte 16] + [Byte 17] + [Byte 18] + [Byte 19] + [Byte 20] + [Byte 21] + [Byte 22] + [Byte 23] + [Byte 24] + [Byte 25] + [Byte 26] + [Byte 27] + [Byte 32]

Reader CRC = [Byte 2] xor [Byte 3] xor ….. xor [Byte 37] xor [Byte 38]

If we use the example data values from the table above and apply the above checksum equations, we should get the following results which will verify the checksums .

4.2.8 Set RSSI Value Command

This command will set the RSSI value and commit it to the Data EEPROM of the reader. It also initiates an RF Module reset and writes the new value to the RF Module. Broadcasts here are useful to set all the readers to their most sensitive etc. The RSSI value ranges from 0 to 255 where 0 value being the most sensitive.

Command

0xAA	0x01	Network ID	Receiver ID	Node ID	0x07	New RSSI	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x07	Checksum

4.2.9 Get RSSI Value Command

This command will return the RSSI value currently stored in the Data EEPROM section of the reader.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x08	Checksum

Response

0X55	0x01	Network ID	Receiver ID	Node ID	0x08	RSSI	Checksum

4.2.10 Set Site Code Command

The sitecode is a 3-byte value assigned to all Wavetrend L-Tags. It is a property of the tag, which describes a customer site installation. The Set SiteCode function is to store a sitecode value to the Data EEPROM of the reader. Once a value is stored in the reader, it will enable the reader to filter out any tags that it receives that do not correspond to the stored sitecode value.

When the sitecode is set to 0 value, the reader will allow ALL tags to be read, hence the reader is said to be open. Setting a specific sitecode will result in only tags that have that sitecode to be read and reported.

Command

0xAA	0x03	Network ID	Receiver ID	Node ID	0x09	Site 1	Site 2	Site 3	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x09	Checksum

4.2.11 Get Site Code Command

This command will return the active Site Code stored in the specific reader.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x0A	Checksum

Response

0x55	0x03	Network ID	Receiver ID	Node ID	0x0A	Site 1	Site 2	Site 3	Checksum

4.2.12 Set Receiver Gain Command

This command will set the RF Module into its 2 different gain levels.

Gain = 0 (Low Gain Mode – Short range reader)

Gain = 1 (High Gain Mode – Long range reader)

Command

0xAA	0x01	Network ID	Receiver ID	Node ID	0x0B	Gain	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x0B	Checksum

4.2.13 Get Receiver Gain Command

This command will return the Receiver Gain Mode value stored in the reader.

Gain = 0 (Low Gain Mode – Short range reader)

Gain = 1 (High Gain Mode – Long range reader)

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x0C	Checksum

Response

0x55	0x01	Network ID	Receiver ID	Node ID	0x0C	Gain	Checksum

4.2.14 Set Alarm Tag Filter Status Command

This command will filter out tags with a specific Alarm condition. The function sets a status value in the Data EEPROM section of the reader.

Command

0xAA	0x01	Network ID	Receiver ID	Node ID	0x0D	Status	Checksum

Status = 0 - Report all tags

Status = 1 - Report only tags with an Alarm condition

Status = 2 - Report only tags without any Alarm condition

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x0D	Checksum

4.2.15 Get Alarm Tag Filter Status Command

This command will return the current Alarm tag filter status value stored in the reader.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x0E	Checksum

Response

0x55	0x01	Network ID	Receiver ID	Node ID	0x0E	Status	Checksum

Status = 0 - Report all tags

Status = 1 - Report only tags with an Alarm condition

Status = 2 - Report only tags without any Alarm condition

4.2.16 Get Invalid Tag Count

This command will return the number of Invalid Tags received by the RF module since the last read. This data is calculated by the RF Module and is a direct interpretation of tag collisions or read failures. This is a 2-byte value.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x0F	Checksum

Response

0x55	0x02	Network ID	Receiver ID	Node ID	0x0F	Count_H	Count_L	Checksum

Count_H – Counter High Byte

Count_L – Counter Low Byte

4.2.17 Get Power Supply Voltage (Not implemented yet)

This command will return the voltage of the power supply at this reader. It is a single byte and represents the power in 0.1 voltage increments. E.g. Value 131 = 13.1 Volts

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x10	Checksum

Response

0x55	0x01	Network ID	Receiver ID	Node ID	0x10	Voltage	Checksum

4.2.18 Start Environmental Noise Level Value Calculation

This command will set the reader into an evaluation mode in order to calculate the environmental white noise level at 433.92 MHz. The unit will remain in evaluation mode for a time period of 40 seconds. During this period no tag transmissions will be decoded. Once the calculation has been completed, the reader will resume normal operation.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x11	Checksum

Response

0x55	0x00	Network ID	Receiver ID	Node ID	0x11	Checksum

4.2.19 Get Environmental Noise Level Value

This command will retrieve the calculated value (between 0 and 255) of the environmental white noise level. Take note that this command can only follow after the *Start Environmental Noise Level Value Calculation*. If a command is send down to the unit, while still in evaluation mode, the reader will cancel the calculation process, reset and continue normal operation.

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0x12	Checksum

Response

0x55	0x01	Network ID	Receiver ID	Node ID	0x12	Noise	Checksum

4.2.20 Reset Network Baud Rate Command

This command will reset the network Baud Rate. It will only accept a broadcast command and there is no response sent. Changes are immediate and will result in a communication loss if the PC does not change its baud rate accordingly.

Command

0xAA	0x01	0xFF	0xFF	0xFF	0xFF	Rate	Checksum

Rate 0 = 115200 baud

Rate 1 = 57600 baud

Rate 2 = 38800 baud

Rate 3 = 19200 baud

Rate 4 = 9600 baud

4.2.21 Get Receiver Version Information Command

This command will return the Receiver Version Information. These include

CFV - Controller Firmware Version

RFV - RF Module Firmware Version

CHV - Controller Hardware Version

RHV - RF Module Hardware Version

Command

0xAA	0x00	Network ID	Receiver ID	Node ID	0xFF	Checksum

Response

0x55	0x04	Network ID	Receiver ID	Node ID	0xFF	CFV	RFV	CHV	RHV	Checksum

RF Module versions are read directly from the module itself. This data is in the following format:

Value = 13 = Version 1.3

5 INTERFACES AND CONNECTIONS

5.1 INTERFACES

The interface standards are as follows:

- Interface Serial RS232 / RS485
- Baud 115 kB/s, 57.6 kB/s, 38.4 kB/s, 19.2 kB/s, 9.6 kB/s Selectable via program port
- Parity None
- Start bit 1
- Stop 1
- Data Bits 8

The factory default settings for the L-RX201 are as follows :

- Baud 115200
- Mode Auto Polling Mode
- RSSI 0 (Implies that the reader is open to read all tags with any rssi value)
- Site code 0 (Implies that the reader is open to read all tags with any sitecode value)

5.2 CONNECTIONS

The receiver has 2 x RJ45 connectors for network data I/O.

Figure 13: 485 Reader Top View

RJ45 Socket Left Side (In)

Pin	Pin Name	Description
1.	RS232 RXD	RS232 Receiver Pin
2.	RS232 TXD	RS232 Transmit Pin
3.	PWR	6V → 18V DC
4.	GND	Ground
5.	RS485+	Non-Inverted RS485
6.	RS485-	Inverted RS485
7.	TTL TXD	TTL RS232 Transmit Pin
8.	TTL RXD	TTL RS232 Receive Pin

Note that all the various communications levels (RS232, RS485 and TTL) are at all times carrying the same data, i.e. the exact same for the LEFT ('IN') RJ45 RS485, will be on RS232 as well as TTL.

RJ45 Socket Right Side (Out)

Pin	Pin Name	Description
1.		
2.		
3.	PWR	6V → 18V DC
4.	GND	Ground
5.	RS485+	Non-Inverted RS485
6.	RS485-	Inverted RS485
7.		
8.		

Only 4 wires must be used when connecting these readers onto a network, ie:

- Power
- Ground
- RS485+
- RS485-

These wires are arranged in such a way on the connector that a straight through connection between readers is all that is needed. These connections are located in the centre of the 8 pin RJ45 connector and are wired as follows:

OUT RJ45	*Name*	*IN RJ45*
3	Power	3
4	GND	4
5	RS485+	5
6	RS485-	6

6 DIAGNOSTICS

6.1 DIAGNOSTIC LEDS

The 4 LED's on the RJ45 connectors indicate functions of the system and are used entirely for diagnostic purposes. Their assignments are as follows (from left to right):

Figure 14: 485 Reader

6.1.1 Normal Mode

LED	Colour	Function
Poll	Orange	Successful Poll of current reader
Packet RX	Green	Valid Packet Received – From either direction
Tag RX	Orange	Valid Tag received from the RF Module
System Idle	Green	Indicates that the system communications are Idle and OK

6.1.2 Auto Poll Mode (Master reader only)

LED	Colour	Function
Poll	Orange	Successful Poll of current reader
Packet RX	Green	Valid Packet Received – Return packet only
Tag RX	Orange	Valid Tag received from the RF Module
Cmd Request	Green	Command request packet sent

6.1.3 Communications Reset (Start-up)

LED	Colour	Function
Master	Orange	Reader identified as Master reader
	Green	Not used
Slave	Orange	Reader identified as Slave reader
Break RX	Green	Startup break characters transmitting

7 SPECIFICATIONS

7.1 ENCLOSED 485 READER

Figure 15: L-RX201 with LAN-100 Antenna

7.2 TECHNICAL SPECIFICATION

RF Specifications	*Function / Value*
Rx Frequency	433 Mhz
Demodulation	ASK
Sensitivity	-103 dBm
Bandwidth	700 kHz
Stability	2ppm / °C
Electrical Specifications	
Supply Voltage	6V DC – 18V DC
Max current consumption	± 72 to 90 mA
ESD protection	2kV Human Body Model
Interface	RJ45 connectors
Environmental	
Operational temperature	-10º C to +60º C
Storage temperature	-20º C to +70º C
Humidity	5% to 90% (non condensing)
Physical	
Size	84 mm x 40 mm x 19 mm
Weight	45 grams
Colour	Charcoal
Type of material	ABS (ultrasonically sealed)
Input/Output Connections	2 x RJ45 Sockets

Certification

The following standards applied in accordance with Article 5 of the directive, 1999/5/EC:

- EN 300 220-1 V1.2.1 (1997-11)
- ETS 300 683 (1997-03).
- FCC (Part 15)

Summary of tests:

Test Type	*Function / Value*
Effective radiated power	25 MHz-4 GHz
EN55022	Radiated emissions 30 MHz – 1 GHz
EN55022	Conducted emissions 150 kHz – 30 MHz
EN61000-4-3	Radiated immunity 80 MHz – 1 GHz, excl 433.92 MHz ± 20 MHz
EN61000-4-4	Electrical fast transients
EN61000-4-2	Electrostatic discharge
EN61000-4-6	Conducted immunity 150 kHz – 80 MHz