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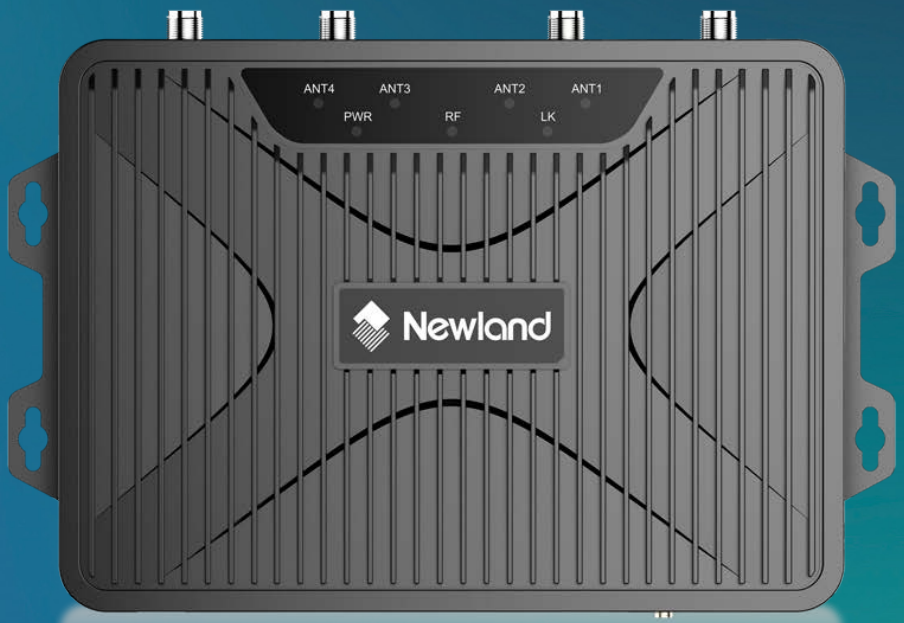

UHF COMMUNICATION PROTOCOL

UHF Devices

Development Manual

Version: V1.0.2

Disclaimer

Please read the manual carefully before using the product and operate it according to the manual. It is advised that you keep this manual for future reference.

Do not disassemble the device or remove the seal label from the device; doing so will void the product warranty provided by Newland Europe BV.

All pictures in this manual are for reference only, and the actual product may differ.

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Revision History

Version	*Description*	*Date*
V1.0.1	Initial release.	
V1.0.2	Read and write commands for new tag operations	

Contents

Preface

Introduction

This development manual describes the communication protocols between the URF series devices developed by Fujian Newland Auto-ID Tech. Co., Ltd. and host computers (PCs, industrial PCs, and servers), as well as the operation of various interface communications.

Chapter Description

Chapter 1: Command Interaction	Describes the message format for command interaction between the URF device and the host.
Chapter 2: Tag Information	Describes the message format for tag information reported during inventory by the URF device.
Chapter 3: Communication Methods	Describes Ethernet and serial communication of the URF device.
Chapter 4: Inventory Methods	Describes the interactive process of tag inventory by the URF device.
Chapter 5: Tag Operations	Describes read and write commands for tag operations.
Chapter 6: Device Query	Describes commands for querying URF device information.

Chapter 1: Command Interaction

The URF device and the host adopt a question-and-answer command exchange mode, where the host issues a command, and the URF device, upon receiving the command, executes the action and replies with a response command.

1.1 Command format

(1) ***Command format from host to URF device***

Field	*Length*	*Description*
Header	7 bytes	Frame header, fixed (HEX: 7E 01 30 30 30 30 40)
Cmd	6 bytes	Command code, consisting of characters A-Z and 0-9
Data	N bytes	Determined by the command code function; can be omitted if not required
Tail	2 bytes	Frame tail, fixed (HEX: 3B 03)

(2) ***Command format from URF device to host***

Field	*Length*	*Description*
Header	7 bytes	Frame header, fixed (HEX: 02 01 30 30 30 30 40)
Cmd	6 bytes	Command code, consisting of characters A-Z and 0-9
Data	N bytes	Determined by the command code function; can be omitted if not required
Status	1 byte	Command execution result: <ACK> (HEX: 06) – Operation successful <NAK> (HEX: 15) – Data value out of supported range <ENQ> (HEX: 05) – Setting category or function item does not exist

Tail	2 bytes	Frame tail, fixed (HEX: 3B 03)

1.2 Command Examples

Example: Asynchronous inventory

Command code: URFIST

Data content: 1 for start, 0 for stop

Example 1: Host sends asynchronous inventory start command (URFIST1):

HEX: 7E 01 30 30 30 30 40 55 52 46 49 53 54 31 3B 03

ASCII: ~<SOH>0000@URFIST1;<ETX>

URF device response to asynchronous inventory start command:

HEX: 02 01 30 30 30 30 40 55 52 46 49 53 54 31 06 3B 03

ASCII: <STX><SOH>0000@URFIST1<ACK>;<ETX>

Example 2: Host sends asynchronous inventory stop command (URFIST0):

HEX: 7E 01 30 30 30 30 40 55 52 46 49 53 54 30 3B 03

ASCII: ~<SOH>0000@URFIST0;<ETX>

URF device response to asynchronous inventory stop command:

HEX: 02 01 30 30 30 30 40 55 52 46 49 53 54 30 06 3B 03

ASCII: <STX><SOH>0000@URFIST0<ACK>;<ETX>

Chapter 2: Tag Information

The tag information message is a message composed by the URF device with the tag EPC, TID and other information inventoried after starting inventory, and is actively uploaded to the host without requiring a response.

2.1 Tag Information Format

The tag information message uses a hexadecimal byte stream mode and big-endian byte order. It consists of a frame header, command code, data length, data content, and checksum, as shown in Table 2-1.

Packet header (2 bytes)	Command code (2 bytes)	Data length (2 bytes)	Data content (N)	Check code (1 byte)

Table 2-1 Tag Information Message

Frame Header: Fixed 2 bytes: AA 55

Command: Fixed 2 bytes: BB CC

Data Length: Specifies the length N of the Data Content field

Data Content: Uses TLV encoding format, where L indicates the length of V (data), as shown in Table 2-2

Checksum: Starts from the packet header to the data content, using XOR checksum

T (1 byte)	***L (1 byte)***	***V***
04	N	EPC data, maximum 64 bytes.
05	N	TID data, maximum 12 bytes.
09	1	RSSI, tag signal strength, unit is dBm, signed byte character.
0A	1	Antenna number, the antenna stored in this tag.
0B	3	Frequency, the frequency when the tag is stored, in KHZ.
0C	4	Timestamp: the time from when the inventory command is executed to when the tag is first read, in milliseconds.
0D	2	Phase value, the high byte is the start phase value, and the low byte is the end phase value.
0E	N	Read count, the number of times the tag has been inventoried.
0F	N	Additional data, returns the data read by the disk embedded read command.
EE	2	Tag information reporting is completed. 0x0000 indicates normal status, and the rest indicate abnormal status codes. Abnormal status code: 0x0001: Temperature too high to stop

Table 2-2 Data Content TLV

2.2 Tag Information Examples

Example: Tag EPC: 11 22 33 44 55 66 77 88 99 AA BB CC
Tag TID: 01 02 03 04 05 06 07 08 09 0A 0B 0C
Antenna number on which the tag was inventoried: Antenna 3

Example 1: Report EPC data
Message: AA 55 BB CC 00 0E 04 0C 11 22 33 44 55 66 77 88 99 AA BB CC 42

Example 2: Report EPC and TID data
Message: AA 55 BB CC 00 1C 04 0C 11 22 33 44 55 66 77 88 99 AA BB CC 05 0C 01 02 03 04 05 06 07 08 09 0A 0B 0C 55

Example 3: Report EPC and antenna number (Antenna 3)
Message: AA 55 BB CC 00 11 04 0C 11 22 33 44 55 66 77 88 99 AA BB CC 0A 01 03 55

Example 4: Report inventory end
Message: AA 55 BB CC 00 04 EE 02 00 00 60

Example 5: GPI2 reports low level
Message: AA 55 BB CC 00 04 03 02 02 00 8F

Example 6: Report EPC and SN data
Message: AA 55 BB CC 00 20 04 0C 11 22 33 44 55 66 77 88 99 AA BB CC A1 10 55 52 46 35 32 30 2D 46 2D 44 46 30 30 30 30 31 DE

Example 7: Heartbeat packet
Message: AA 55 BB CC 00 04 A2 02 00 00 2C

3: Communication Methods

3.1 Ethernet TCP Server Communication

(1) The URF device acts as a TCP server, and the host acts as a TCP client to actively initiate a connection. The URF device default IP is 192.168.1.101, port 8058. The IP can be modified using NSET as needed.

(2) Use NSET to connect to the device and enter the settings interface, as shown in Figure 3-1. Set the data output channel to Ethernet TCP Server, then save to the device, and finally exit NSET.

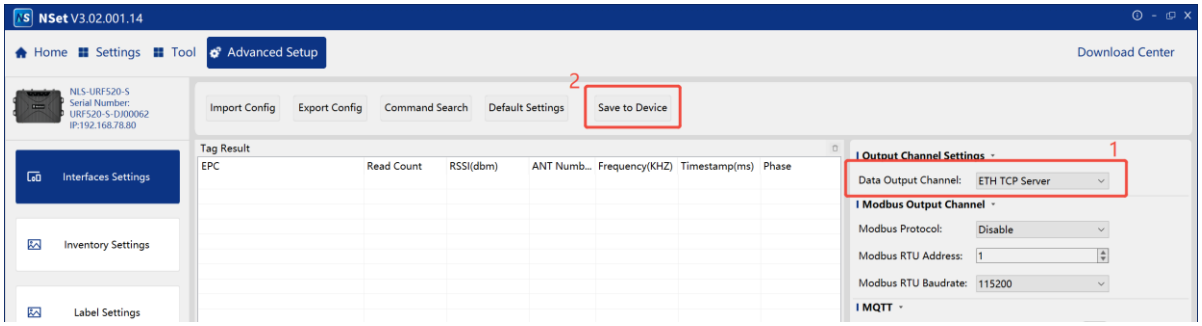

Figure 3-1

(3) The host uses a network debugging tool as a TCP client, as shown in Figure 3-2. Set the remote host address to the IP of the URF device, set the remote host port to 8058, open the connection. Once the connection is successfully established, communication can proceed.

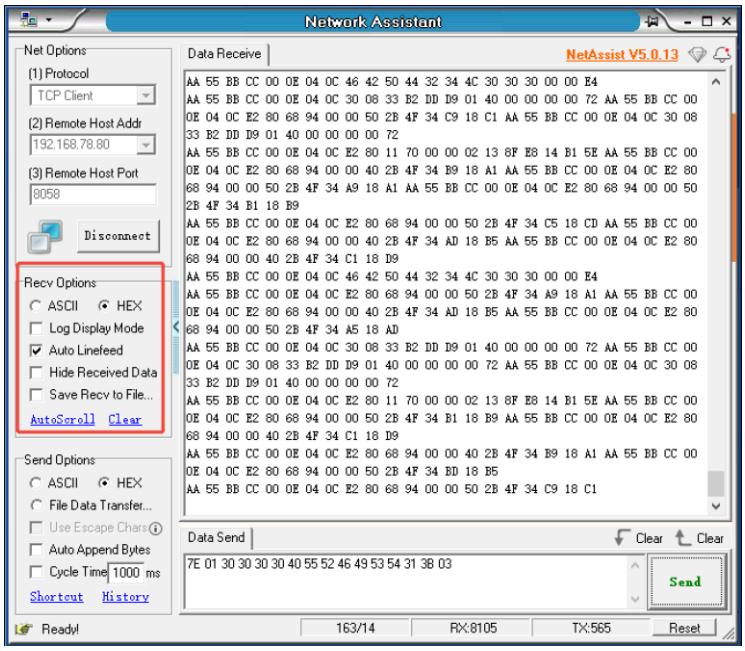

图 3-2

3.2 Ethernet TCP Client Communication

(1) The host acts as a TCP server, and the URF device acts as a TCP client to actively initiate a connection.

(2) Use NSET to connect to the device and enter the settings interface, as shown in Figure 3-3. Set the data output channel to Ethernet TCP Client, set the remote IP address and port to the IP and port of the host server, then save to the device, and finally exit NSET.

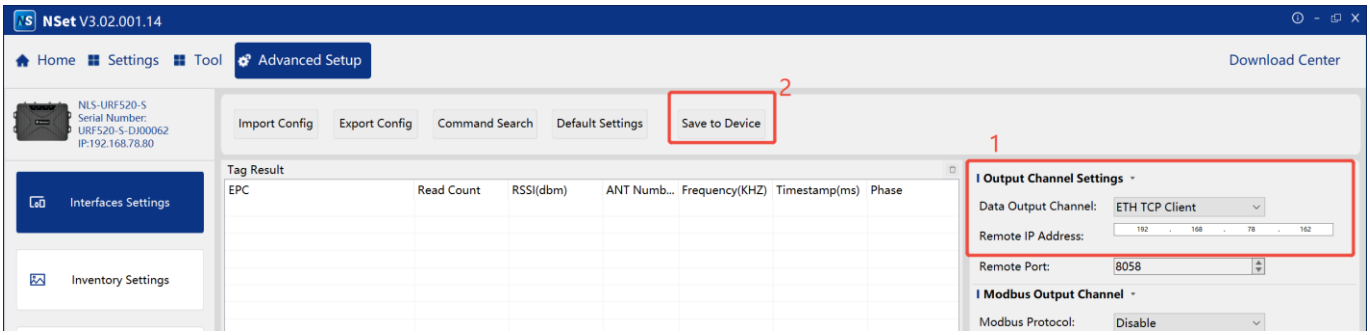

Figure 3-3

(3) The host uses a network debugging tool as a TCP server, as shown in Figure 3-4. Set the host address and port of the network debugging tool according to the actual situation. Open it and wait for the URF device to connect successfully, then communication can proceed.

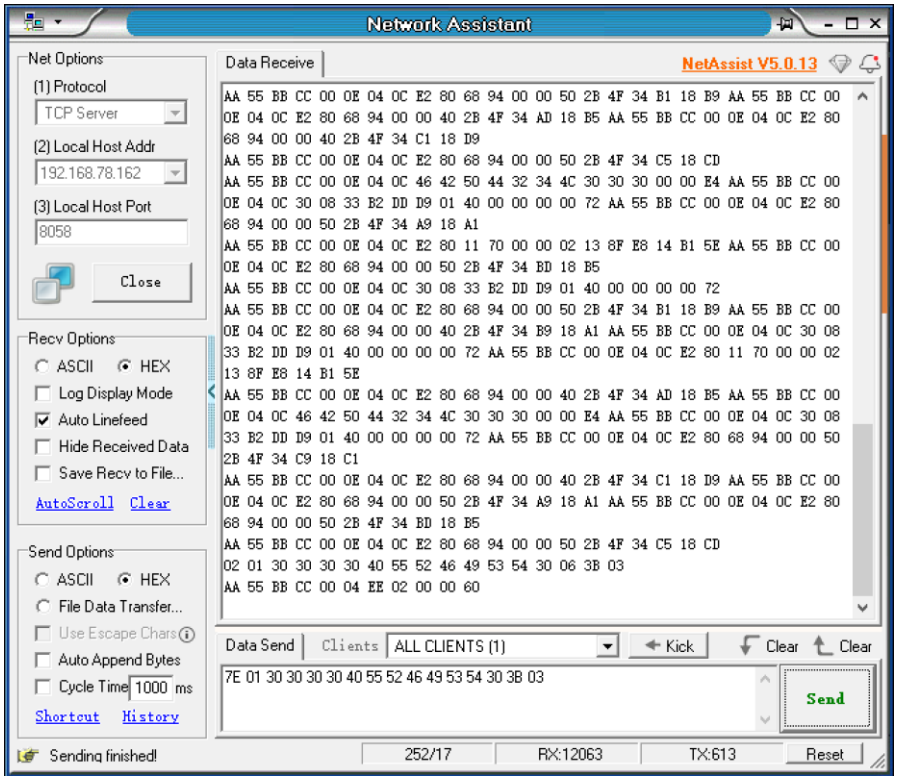

Figure 3-4

3.3 Serial Port Communication

(1) The URF device and the host are connected using an RS232 serial cable. The serial port baud rate is 115200, parity bit N, data bits 8, stop bit 1.

(2) Use NSET to connect to the device and enter the settings interface, as shown in Figure 3-5. Set the data output channel to RS232, then save to the device, and finally exit NSET.

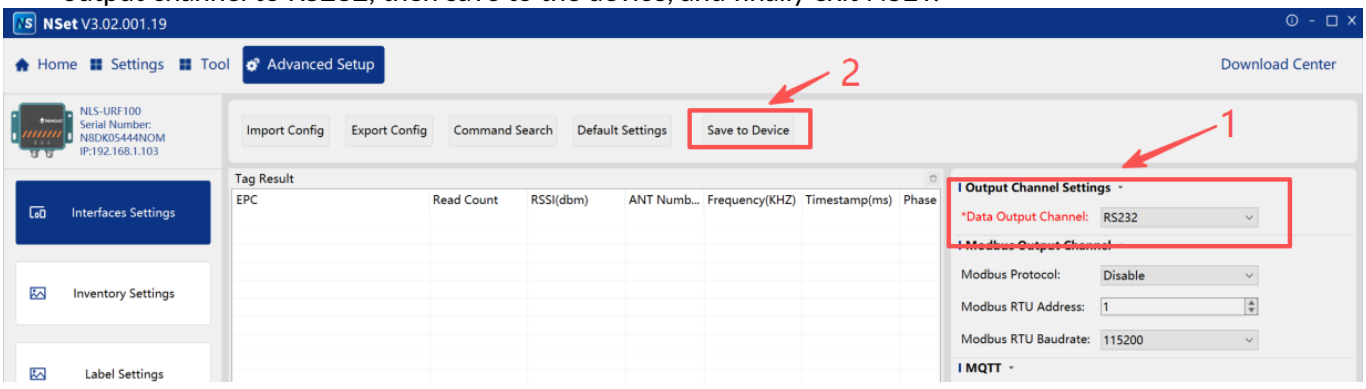

Figure 3-5

(3) The host uses a serial port debugging assistant, as shown in Figure 3-6. Set the parameters of the serial port, open it, and then communication can proceed.

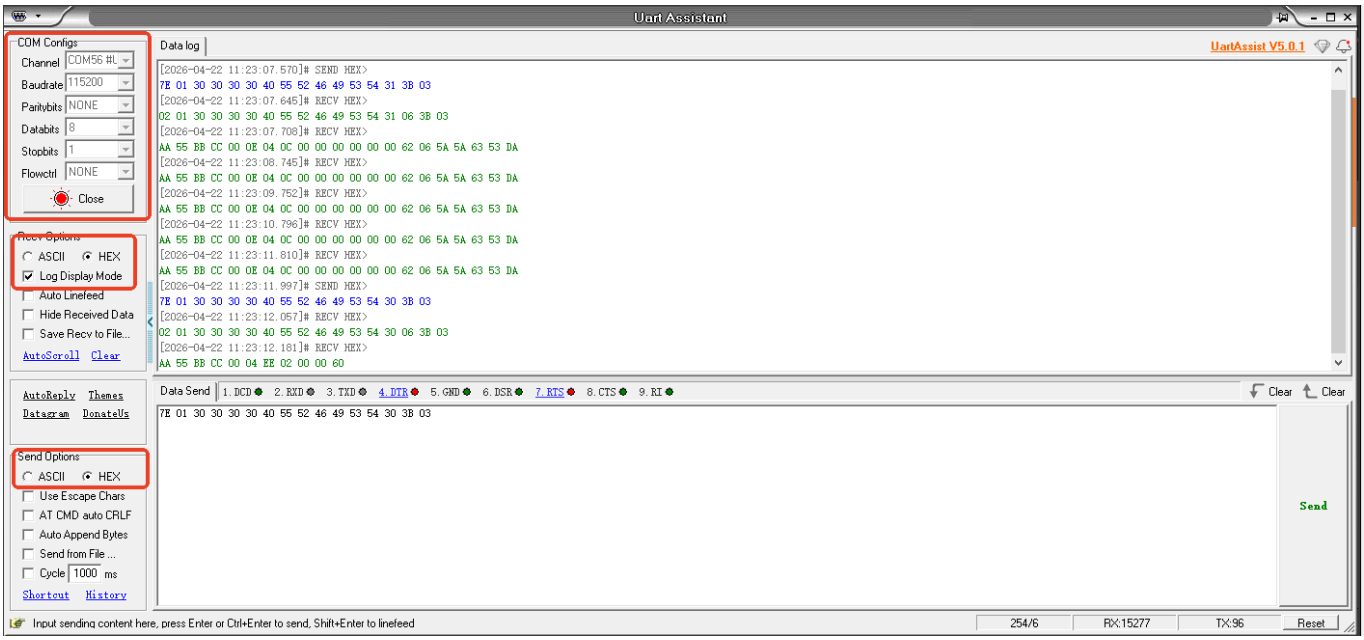

Figure 3-6

Chapter 4: Inventory Methods

4.1 Asynchronous Inventory (URFIST)

(1) The host sends the asynchronous inventory start command (URFIST1).
Downstream message: 7E 01 30 30 30 30 40 55 52 46 49 53 54 31 3B 03
(2) The URF device responds to the asynchronous inventory start command (URFIST1<ACK>).
Upstream message: 02 01 30 30 30 30 40 55 52 46 49 53 54 31 06 3B 03
(3) The URF device starts continuously reporting the inventoried tag information (EPC: 11 11 22 22 33 33 44 44 55 55 66 66).
Upstream message: AA 55 BB CC 00 0E 04 0C 11 11 22 22 33 33 44 44 55 55 66 66 8E
(4) The host sends the asynchronous inventory stop command (URFIST0).
Downstream message: 7E 01 30 30 30 30 40 55 52 46 49 53 54 30 3B 03
(5) The URF device responds to the asynchronous inventory stop command (URFIST0<ACK>).
Upstream message: 02 01 30 30 30 30 40 55 52 46 49 53 54 30 06 3B 03
(6) The URF device reports inventory end.
Upstream message: AA 55 BB CC 00 04 EE 02 00 00 60

4.2 Synchronous Inventory (URFISY)

(1) The host sends the synchronous inventory command for 1000 milliseconds (URFISY1000).
Downstream message: 7E 01 30 30 30 30 40 55 52 46 49 53 59 31 30 30 30 3B 03
(2) The URF device responds to the synchronous inventory command (URFISY1000<ACK>).
Upstream message: 02 01 30 30 30 30 40 55 52 46 49 53 59 31 30 30 30 06 3B 03
(3) The URF device is inventorying, lasting for 1000 milliseconds
(4) The URF device finishes inventory and reports the inventoried tag information (EPC: 11 11 22 22 33 33 44 44 55 55 66 66).
Upstream message: AA 55 BB CC 00 0E 04 0C 11 11 22 22 33 33 44 44 55 55 66 66 8E
(5) The URF device reports inventory end.
Upstream message: AA 55 BB CC 00 04 EE 02 00 00 60

Chapter 5: Tag Operations

5.1 Read (URFTRD)

The "Read" command finds a tag by matching parameters (bank, start address, data length, data content), and then reads data according to the read parameters (bank, start address, data length).

Command format sent by host: URFTRD...W...M...P...L...V...X...Y...Z...T...N. Refer to Table 5-1 for detailed parameter descriptions.

Response format from URF device: URFTRD...W...M...P...L...V...X...Y...Z...T...N...R...<ACK>

Parameter Field	*Description*
Access Password (W)	Fixed 8 characters 00000000. No need to change for tags without encryption protection
Matching Bank (M)	Value range 1-3 1: EPC bank, 2: TID bank, 3: USER bank
Matching Start Address (P)	Unit: bit Note: The EPC ID in the EPC bank starts from 32 bits Example: If EPC ID is AABBCCDD and matching is CCDD, the start address is 48 (16+32) If TID is AABBCCDD and matching is CCDD, the start address is 16
Matching Data Length (L)	Unit: bit Example: If matching data content is AABB, the data length is 16 bits
Matching Data Content (V)	HEX characters
Read Bank (X)	0: RFU bank, 1: EPC bank, 2: TID bank, 3: USER bank
Read Start Address (Y)	Unit: word (2 bytes)
Read Data Length (Z)	Unit: word (2 bytes)
Timeout (T)	Unit: milliseconds, value range 50-2000, set to 1000 if no special requirements
Antenna Number Used (N)	Value range 1-4, set to 1 for single-antenna devices
Execution Result (R)	This field is not present in the host's command, only in the URF device's response 0: Read successful, 1: Read failed If read successful, includes the read data: 0R...<ACK> If read failed, no read data: 1R<ACK>

Tabke 5-1 Read Parameter Description

Example:

Tag EPC: 055421000000000000369A, USER bank contains data 111122223333444455556666

Host sends command to read 6 words of data from the tag's USER bank:

ASCII：

~<SOH>0000@URFTRD00000000W1M32P96L055421000000000000369AV3X0Y6Z1000T1N;<ETX>

HEX：7E 01 30 30 30 30 40 55 52 46 54 52 44 30 30 30 30 30 30 30 30 57 31 4D 33 32 50 39 36 4C 30 35

35 34 32 31 30 30 30 30 30 30 30 30 30 30 30 30 30 33 36 39 41 56 33 58 30 59 36 5A 31 30 30 30 54 31 4E 3B 03

URF device responds with read success:

ASCII：<STX><SOH>URFTRD00000000W1M32P96L055421000000000000369AV3X0Y6Z1000T1N0R

111122223333444455556666<ACK>;<ETX>

HEX：7E 01 30 30 30 30 40 55 52 46 54 52 44 30 30 30 30 30 30 30 30 57 31 4D 33 32 50 39 36 4C 30 35

35 34 32 31 30 30 30 30 30 30 30 30 30 30 30 30 30 33 36 39 41 56 33 58 30 59 36 5A 31 30 30 30 54 31 4E 30 52 31 31 31 31 32 32 32 32 33 33 33 33 34 34 34 34 35 35 35 35 36 36 36 36 06 3B 03

Command Parsing:

Access Password: 00000000W
Matching Bank: 1M
Matching Start Address: 32P
Matching Data Length: 96L
Matching Data Content: 055421000000000000369AV
Read Bank: 3X
Read Start Address: 0Y
Read Data Length: 6Z
Timeout: 1000T
Antenna Number Used: 1N
Execution Result: 0R
Read 6 words of data: 111122223333444455556666

5.2 Write (URFTWR)

The "Write" command finds a tag by matching parameters (bank, start address, data length, data content), and then writes data according to the write parameters (bank, start address, data content).

Command format sent by host: URFTWR...W...M...P...L...V...X...Y...Z...T...N. Refer to Table 5-2 for detailed parameter descriptions.

Response format from URF device: URFTWR...W...M...P...L...V...X...Y...Z...T...N...R...<ACK>

Parameter Field	***Description***
Access Password (W)	Fixed 8 characters 00000000. No need to change for tags without encryption protection
Matching Bank (M)	Value range 1-3 1: EPC bank, 2: TID bank, 3: USER bank
Matching Start Address (P)	Unit: bit Note: The EPC ID in the EPC bank starts from 32 bits Example: If EPC ID is AABBCCDD and matching is CCDD, the start address is 48 (16+32) If TID is AABBCCDD and matching is CCDD, the start address is 16
Matching Data Length (L)	Unit: bit Example: If matching data content is AABB, the data length is 16 bits
Matching Data Content (V)	HEX characters
Write Bank (X)	0: RFU bank, 1: EPC bank, 2: TID bank, 3: USER bank
Write Start Address (Y)	Unit: word (2 bytes)
Write Data Content (Z)	HEX characters. The written data must be word-aligned (2-byte alignment) Example: Correct write: AAAA, AAAABBBB Incorrect write: A, AA, AAA, AAAABB, AAAABB, AAAAB
Timeout (T)	Unit: milliseconds, value range 50-2000, set to 1000 if no special requirements
Antenna Number Used (N)	Value range 1-4, set to 1 for single-antenna devices
Execution Result (R)	This field is not present in the host's command, only in the URF device's response 0: Write successful, 1: Write failed

Table 5-2 Write Parameter Description

Example: Tag EPC: 05542100000000000000369A

Host sends command to write 11112222333334444555566666 at start address 0 in the tag's USER bank:

ASCII :

~<SOH>0000@URFTWR00000000W1M32P96L05542100000000000000369AV3X0Y1111222233334444555566666Z1000T1N;<ETX>

HEX：7E 01 30 30 30 30 40 55 52 46 54 57 52 30 30 30 30 30 30 30 30 57 31 4D 33 32 50 39 36 4C 30 35

35 34 32 31 30 30 30 30 30 30 30 30 30 30 30 30 30 30 33 36 39 41 56 33 58 30 59 31 31 31 31 32 32 32
32 33 33 33 33 34 34 34 34 35 35 35 35 36 36 36 36 5A 31 30 30 30 54 31 4E 3B 03

URF device responds with write success:

ASCII ：

~<SOH>0000@URFTWR00000000W1M32P96L055421000000000000000369AV3X0Y1111222233334444
55556666Z1000T1N0R<ACK>;<ETX>

HEX：7E 01 30 30 30 30 40 55 52 46 54 57 52 30 30 30 30 30 30 30 30 57 31 4D 33 32 50 39 36 4C 30 35

35 34 32 31 30 30 30 30 30 30 30 30 30 30 30 30 30 30 33 36 39 41 56 33 58 30 59 31 31 31 31 32 32 32
32 33 33 33 33 34 34 34 34 35 35 35 35 36 36 36 36 5A 31 30 30 30 54 31 4E 30 52 06 3B 03

Command Parsing:

Access Password: 00000000W
Matching Bank: 1M
Matching Start Address: 32P
Matching Data Length: 96L
Matching Data Content: 055421000000000000000369AV
Write Bank: 3X
Write Start Address: 0Y
Write Data Content: 1111222233334444555566666Z
Timeout: 1000T
Antenna Number Used: 1N
Execution Result: 0R

Chapter 6: Device Query

6.1 Query SN Number (QRYPSN)

(1) The host sends the device SN number query command (QRYPSN).
Downstream message: 7E 01 30 30 30 30 40 51 52 59 50 53 4E 3B 03

(2) The URF device responds to the SN number query command (QRYPSN.....<ACK>).
Example: SN number URF520-003
Upstream message: 02 01 30 30 30 30 40 51 52 59 50 53 4E 53 65 72 69 61 6C 20 4E 75 6D 62 65 72 3A 20 55 52 46 35 32 30 2D 30 30 33 0D 0A 06 3B 03
Note: The data segments 51 52 59 50 53 4E 53 65 72 69 61 6C 20 4E 75 6D 62 65 72 3A 20 and 0D 0A 06 are fixed. What varies depending on the device SN number is 55 52 46 35 32 30 2D 30 30 33 (URF520-003).

6.2 Query Software Version (QRYFWV)

(1) The host sends the device software version query command (QRYFWV).
Downstream message: 7E 01 30 30 30 30 40 51 52 59 46 57 56 3B 03

(2) The URF device responds to the software version query command (QRYFWV.....<ACK>).
Example: Software version V1.02.022.1
Upstream message: 02 01 30 30 30 30 40 51 52 59 46 57 56 46 69 72 6D 77 61 72 65 20 56 65 72 73 69 6F 6E 3A 20 56 31 2E 30 32 2E 30 32 32 2E 31 0D 0A 06 3B 03
Note: The data segments 51 52 59 46 57 56 46 69 72 6D 77 61 72 65 20 56 65 72 73 69 6F 6E 3A 20 and 0D 0A 06 are fixed. What varies depending on the software version is 56 31 2E 30 32 2E 30 32 32 2E 31 (V1.02.022.1).

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