control solutions
TERACOM



IP65 RS232 RFID Reader
ACR220-T / ACR220-T-O

USER MANUAL

1. Introduction

ACR220-T/ACR220-T-O is an IP65 RS232 RFID Reader designed for industrial identification, machine control and access control applications. The device reads 125 kHz EM4102-compatible RFID tags and transmits their unique identifiers through an RS-232 serial interface to an external controller, PLC or computer.

Unlike standalone RFID access controllers, the device does not make local access decisions. Instead, it operates as an RFID terminal, allowing the host system to perform authentication and control the application logic. Based on the received RFID tag ID, the host can control the available outputs and LED indication.

ACR220-T provides a relay output, while ACR220-T-O provides two open-drain outputs: OUT for general-purpose control and BUZZER for controlling an external buzzer.

The device is housed in a rugged IP65 enclosure with fully encapsulated electronics for reliable operation in demanding industrial and outdoor environments. Its cylindrical body with an M32×1.5 mounting thread enables quick installation into control panels, machines and equipment.

2. Features

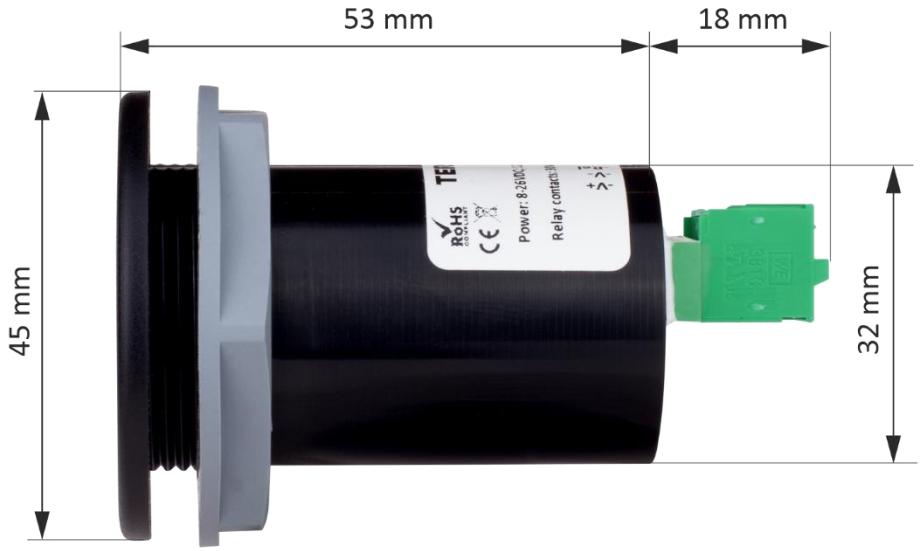
- 125 kHz RFID reader compatible with EM4102 RFID tags
- IP65 enclosure with fully encapsulated electronics for industrial and outdoor applications
- Standard M32×1.5 panel-mount design with integrated RFID antenna
- RS-232 interface for communication with PLCs, computers and embedded controllers
- Transmits RFID tag identifiers for host-based authentication and control
- Host-controlled outputs and LED indication for external control and user feedback
- Compatible with LockyMonitor-3 software for configuration, maintenance and firmware updates

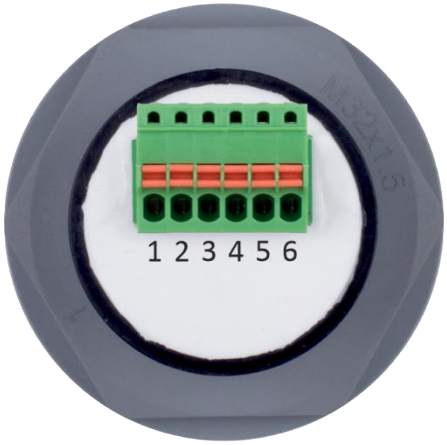
3. Specifications

- Physical characteristics
  Dimensions: Ø45 × 71 mm
  Mounting hole diameter: Ø32 mm
  Connector: 2.5 mm pluggable screwless push-in
- Environmental limits
  Operating temperature range: -20 to +60 °C (-4 to +140 °F)
  Operating relative humidity range: 10 to 90 %RH (non-condensing)
- Ingress protection
  Device body: IP65
  Connector: IP20
- Power requirements
  Operating voltage range (including -15/+20 % according to IEC 62368-1): 10 to 26 VDC
  Current consumption:
  ACR220-T (relay ON): 35 mA @ 12 VDC
  ACR220-T-O: 18 mA @ 12 VDC
- RFID characteristics
  Operating frequency: 125 kHz
  Supported RFID tags: EM4102 compatible
  Typical reading range: Up to 3 cm*
  * The actual reading distance depends on the RFID tag type, installation conditions, and surrounding environment.

- RS-232 interface
  Communication settings: 19200 bps, 8 bits, 1 stop bit, no parity
- Relay output (ACR220-T)
  Contacts: NO and COM
  Maximum switching voltage: 24 VDC / 30 VAC
  Maximum switching current: 0.5 A
  Caution! The device does not contain any internal overcurrent protection facilities on the relay contact lines. External fuses or short circuit current limiting circuit breakers, rated to 0.5 A, are to be used for overcurrent protection of the connecting lines.
  Caution! In case of switching an inductive load, an RC snubber or a diode is to be used for relay contact protection (arc suppression).
- Open-drain OUT (ACR220-T-O)
  Maximum switching voltage: 26 VDC
  Maximum switching current: 0.5 A
- Open-drain BUZZER (ACR220-T-O)
  Maximum switching voltage: 26 VDC
  Maximum switching current: 0.5 A

4. Dimensions and Pinout





Pin	ACR220-T	ACR220-T-O
1	Positive power supply	Positive power supply
2	GND	GND
3	Relay NO contact	Open-drain OUT
4	Relay COM contact	Open-drain BUZZER
5	RS-232 Rx	RS-232 Rx
6	RS-232 Tx	RS-232 Tx

5. Device operation

During normal operation, the red LED blinks three times per second, indicating that the device is ready to read RFID tags.

When an EM4102-compatible RFID tag is detected, the green LED flashes once and the tag UID is transmitted to the host system through the RS-232 interface. The tag UID is transmitted once when the RFID tag is detected.

The device also accepts commands from the host system to control the available outputs and LED indication. ACR220-T provides a built-in relay output, while ACR220-T-O provides two open-drain outputs: OUT for external control and BUZZER for driving an external buzzer.

Both variants use the same communication protocol and accept the same host commands.

6. Communication protocol

ACR220-T/ACR220-T-O uses a proprietary binary communication protocol over the RS-232 interface. This section describes the packet structure, reader messages, host commands, response packets and CRC calculation used for reliable data exchange.

6.1. Packet format

All data exchanged between ACR220-T/ACR220-T-O and the host system is transmitted in binary packets. Each packet starts with a fixed start byte, followed by a length field, a command identifier, optional command data and a CRC byte for error detection.

The general packet format is shown below.

Byte	Description
1	Start byte (0xF5)
2	Packet length
3	Command
4...n	Command data (optional)
Last	CRC

Where:

- Start byte – Always 0xF5 and marks the beginning of a packet.
- Packet length – Total number of bytes following the start byte, including the CRC byte.
- Command – Identifies the message or command type.
- Command data – Optional parameters associated with the command.
- CRC – 8-bit cyclic redundancy check calculated using the polynomial $x^8 + x^5 + x^4 + 1$.

6.2. Reader message

The reader message is transmitted automatically by ACR220-T/ACR220-T-O when an RFID tag is detected. The message is initiated by the device and does not require a request or acknowledgement from the host system.

When an EM4102-compatible RFID tag enters the reading range, the device reads its UID (Unique Identifier) and transmits it to the host system.

The reader message is transmitted once when the RFID tag is detected.

The EM4102-compatible RFID tag transmits a 64-bit data frame containing the tag UID together with framing and error-checking information. The device decodes and verifies the received frame, removes the framing and error-checking information, and transmits only the five-byte UID (Unique Identifier) to the host system.

Example:

[F5][08][0B][01][07][DB][7C][73][7B]

Byte(s)	Description
F5	Start byte
08	Packet length
0B	Message identifier
01 07 DB 7C 73	RFID tag UID
7B	CRC

6.3. Host commands

Host commands are transmitted by the host system to control ACR220-T/ACR220-T-O. Every valid command is acknowledged by the device with a response message. The acknowledgement message uses the same command identifier with bit 7 set (command + 0x80). Commands with an invalid format or incorrect CRC are ignored.

The following sections describe the commands supported by the device.

6.3.1 Output control command

The Output Control command activates the built-in relay on ACR220-T or the OUT open-drain output on ACR220-T-O for the specified pulse duration. The command is transmitted by the host system whenever output activation is required by the application. Typically, it is sent after processing the received RFID tag UID.

The output pulse duration can be specified from 1 to 240 seconds.

Example:

[F5][04][16][05][E7]

Byte(s)	Description
F5	Start byte
04	Packet length
16	Output control command
05	Output pulse duration (seconds)
E7	CRC

If the packet is received correctly, the device activates the corresponding output for the specified duration and returns the following acknowledgement message:

[F5][03][96][99]

Byte(s)	Description
F5	Start byte
03	Packet length
96	Output control acknowledgement
99	CRC

If the received packet contains an invalid CRC or an invalid packet format, the command is ignored and no response is transmitted.

6.3.2 LED control command

The LED Control command controls the built-in red and green LEDs. The command specifies which LED is activated, the activation duration and the flashing period.

The activation duration can range from 0 to 255 seconds. A value of 0 keeps the selected LED off.

The flashing period can range from 0 to 255 and is specified in 100 ms increments. A value of 0 keeps the selected LED continuously ON for the specified activation duration.

Example:

[F5][06][17][01][11][05][9E]

Byte(s)	Description
F5	Start byte
06	Packet length
17	LED control command
01	LED selection: 01 – red, 02 – green, 03 – both
11	Activation duration (seconds)
05	Flashing period (×100 ms)
9E	CRC

In this example, the red LED is activated for 11 seconds and flashes with a 500 ms ON / 500 ms OFF cycle.

If the packet is received correctly and all parameters are within the specified ranges, the device executes the command and returns the following acknowledgement message:

[F5][03][97][C7]

Byte(s)	Description
F5	Start byte
03	Packet length
97	LED control acknowledgement
C7	CRC

If one or more command parameters are outside the specified ranges, the device returns the following response:

[F5][03][17][4B]

Byte(s)	Description
F5	Start byte
03	Packet length
17	Invalid parameter response
4B	CRC

If the received packet contains an invalid CRC or an invalid packet format, the command is ignored and no response is transmitted.

6.3.3 Buzzer output control command

The Buzzer Output Control command controls the BUZZER open-drain output on ACR220-T-O. ACR220-T accepts and processes the same command, but no physical output is activated.

The activation duration can range from 0 to 255 seconds. A value of 0 stops the BUZZER output.

The pulse period can range from 0 to 255 and is specified in 100 ms increments. A value of 0 activates the BUZZER output continuously for the specified duration.

Example:

[F5][05][18][05][05][2E]

Byte(s)	Description
F5	Start byte
05	Packet length
18	Buzzer output control command
05	Activation duration (seconds)
05	Pulse period (×100 ms)
2E	CRC

In this example, the BUZZER output is activated for 5 seconds in pulse mode with a 500 ms ON / 500 ms OFF cycle.

If the packet is received correctly and all parameters are within the specified ranges, the device executes the command and returns the following acknowledgement message:

[F5][03][98][86]

Byte(s)	Description
F5	Start byte
03	Packet length
98	Buzzer output control acknowledgement
86	CRC

If one or more command parameters are outside the specified ranges, the device returns the following response:

[F5][03][18][0A]

Byte(s)	Description
F5	Start byte
03	Packet length
18	Invalid parameter response
0A	CRC

If the received packet contains an invalid CRC or an invalid packet format, the command is ignored and no response is transmitted.

6.3.4 Service tag command

The Service Tag command starts the procedure for assigning a new service tag. This command can be used when the existing service tag is lost or needs to be replaced.

After receiving the command, the device enters service tag assignment mode for 20 seconds. During this period, both LEDs flash simultaneously, indicating that the device is waiting for an RFID tag to be presented.

Example:

[F5][03][20][76]

Byte(s)	Description
F5	Start byte
03	Packet length
20	Service tag command
76	CRC

If the packet is received correctly, the device enters service tag assignment mode and returns the following acknowledgement message:

[F5][03][A0][FA]

Byte(s)	Description
F5	Start byte
03	Packet length
A0	Service tag command acknowledgement
FA	CRC

If the received packet contains an invalid CRC or an invalid packet format, the command is ignored and no response is transmitted.

6.4. CRC calculation

All packets transmitted between the host system and ACR220-T/ACR220-T-O include an 8-bit CRC (Cyclic Redundancy Check) used for error detection.

The CRC is calculated over all packet bytes except the start byte (0xF5). The CRC field itself is not included in the calculation.

The CRC uses the polynomial:

$x^8 + x^5 + x^4 + 1$

The following C function implements the CRC algorithm used by ACR220-T/ACR220-T-O:

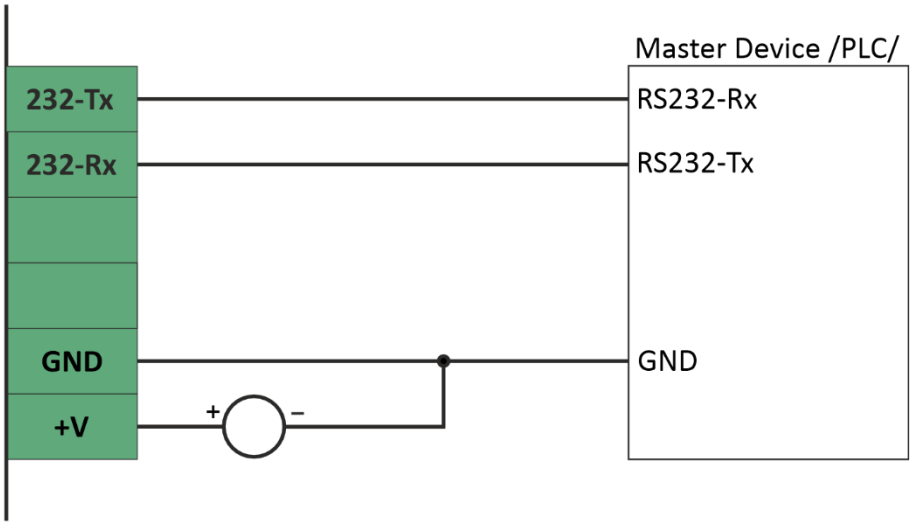
```
uint8_t CalculateCrc(uint8_t *pFrameData, uint8_t bBufferLength)
{
   uint8_t i, j;
   uint8_t bByte, bCRC;
   bCRC = 0;
  for (i = 0; i < bBufferLength; i++)    // Process each byte of the frame
   {
      bByte = pFrameData[i];
      for (j = 0; j < 8; j++)            // Process each bit of the byte
      {
         if (bByte & 0x01)
         {
            bCRC ^= 1;
         }
         if (bCRC & 0x01)
         {
            bCRC ^= 0x18;
            bCRC >>= 1;
```

```
            bCRC |= 0x80;
          }
          else
          {
            bCRC >>= 1;
          }
          bByte >>= 1;
        }
      }
      return bCRC;
    }
```

If the calculated CRC does not match the received CRC value, the packet is considered invalid. Reader messages are transmitted without expecting an acknowledgement from the host system. Host commands containing an invalid CRC are ignored and no response is transmitted.

7. Typical RS-232 connection

The diagram below shows a typical RS-232 connection between ACR220-T/ACR220-T-O and a master device or PLC. The Tx and Rx lines must be cross-connected, and both devices must share a common GND reference.

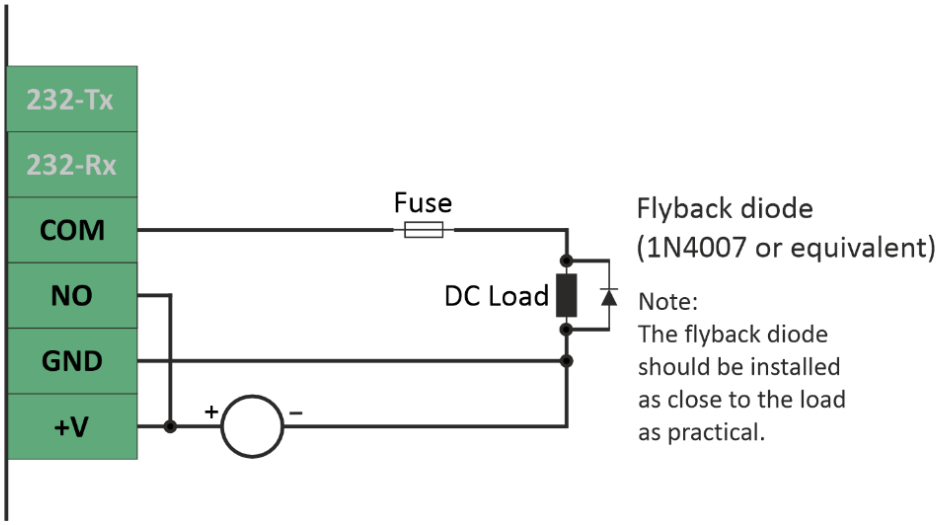


8. Typical output connections

8.1. Relay output connections (ACR220-T)

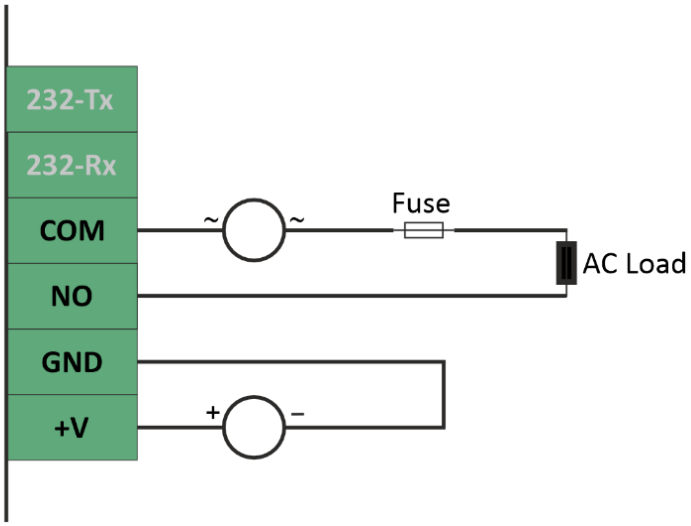
The relay output can be used to switch DC and AC loads within the electrical ratings specified in this manual. Typical connection examples are shown below.

When switching an inductive DC load, install a flyback diode (for example, 1N4007 or equivalent) across the load. To provide effective protection, the diode should be installed as close to the load as practical.



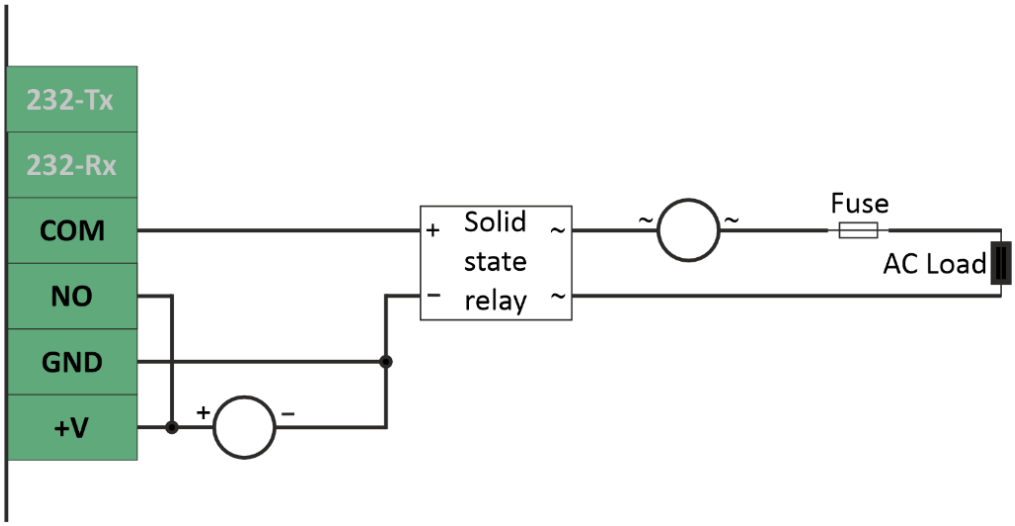
Typical DC load connection

When switching AC loads, protect the output circuit with an appropriately rated fuse. For inductive AC loads, additional suppression components may be required depending on the application.



Typical AC load connection

For applications requiring frequent switching, higher load currents, or extended relay service life, the relay output may be used to drive a solid-state relay (SSR) instead of switching the load directly.

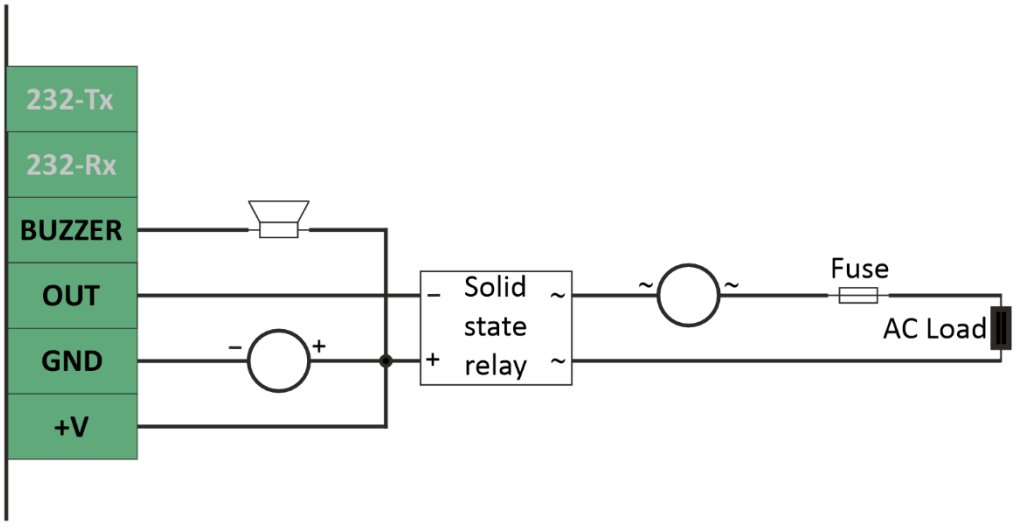


Typical AC load connection using a solid-state relay

8.2. Open-drain output connections (ACR220-T-O)

ACR220-T-O provides two open-drain outputs: OUT for external control and BUZZER for driving an external buzzer. Both outputs switch the connected load to GND and require an external power supply for the load.

The diagram below shows a typical application where the OUT output controls a solid-state relay (SSR) for switching an AC load, while the BUZZER output drives an external buzzer. The connected loads must remain within the electrical ratings specified in this manual.



9. Configuration

ACR220-T/ACR220-T-O can be configured using the LockyMonitor-3 software through the RS-232 interface. The software provides access to device settings and firmware update functions.

To enable configuration mode, the device must first be switched from normal terminal operation to service mode using the supplied service tag.

10. Operating environment

The device is intended for operation in a Pollution Degree 2 environment, at altitudes up to 2000 meters above sea level.

When the device is integrated into a larger system, all other system components must comply with applicable EMC (Electromagnetic Compatibility) requirements and be suitable for operation under the same environmental conditions.

11. Safety precautions

The device must not be used for medical, life-support, or life-saving applications, or in any system where a failure of the device could result in serious injury or loss of life.

To reduce the risk of fire, only flexible stranded conductors with a minimum cross-sectional area of 0.5 mm² must be used for wiring.

To prevent electric shock and fire hazards, the device must not be exposed to liquids, rain, or excessive moisture. Objects containing liquids must not be placed on or near the device.

Ensure adequate ventilation around the device. Failure to maintain the recommended free space around the device may result in overheating and potential damage. Sufficient space must also be provided to allow safe connection and disconnection of cables.

The device must be operated strictly within the limits specified in this documentation. Operation outside the specified conditions may impair the protection provided by the device and lead to unreliable operation.

Teracom OOD does not guarantee correct operation of the product if it is used under conditions that differ from those specified by the manufacturer. In no event shall Teracom OOD be held responsible or liable for indirect or consequential damages resulting from the use or application of this product.

12. Maintenance

The device does not require routine maintenance during normal operation.

Periodically inspect the device to ensure that it is in good operating condition, that all electrical connections are secure, and that there are no signs of mechanical damage.

Clean the device using a dry cloth only. Do not use liquid or aerosol cleaners. Magnetic or electrostatic cleaning devices, as well as abrasive materials, must not be used.

Following these maintenance guidelines helps ensure reliable operation and extends the service life of the device.

13. Disposal and recycling

Please recycle all applicable materials in accordance with local regulations.



Do not dispose of the device as regular household waste.

Electronic components should be properly recycled to minimize environmental impact.

