

The EE201 is an e-paper based electronic shelf label with a screen size of 2" and with 802.15.4 based wireless communication.

Preliminary Specifications Manual

All information subject to change without notice.

Document History

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The packing materials are recyclable. We recommend that you save all packing material to use should you need to transport your scanner or send it for service. Damage caused by improper packaging during shipment is not covered by the warranty.

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1. Abstract

This manual provides specifications for the EE201 electronic shelf label (hereafter referred to as “ESL”).

2. Overview

The EE201 is an E-ink based ESL with a 2.4GHz radio for data communication. This product uses Direct Sequence Spread Spectrum RF technology that allows for an ultra-low power consumption combined with a reduced sensitivity to background noise. That means less interference by other radios that operate in the 2.4GHz band. The radio protocol that is used is based on the IEEE 802.15.4 standard that specifies the physical layer and media access control for low-rate wireless personal area networks. The protocol is entirely implemented, except for some small changes that have all to do with the connection protocol to a base station. When the base station is not available the EE201 switches to a non-802.15.4 standard to lower the power. That is especially meaningful when the EE201 is not being used for a prolonged period of time (e.g. during shipping)

A development kit is available that consists out of a base station and several EE201 tags plus a PC demo application that allows people to quickly test the system and makes it easier to integrate this ESL system into an existing back office system.

3. Physical Features

3.1. Dimensions

W 65.7 x H 34.9 x D 13.7 mm

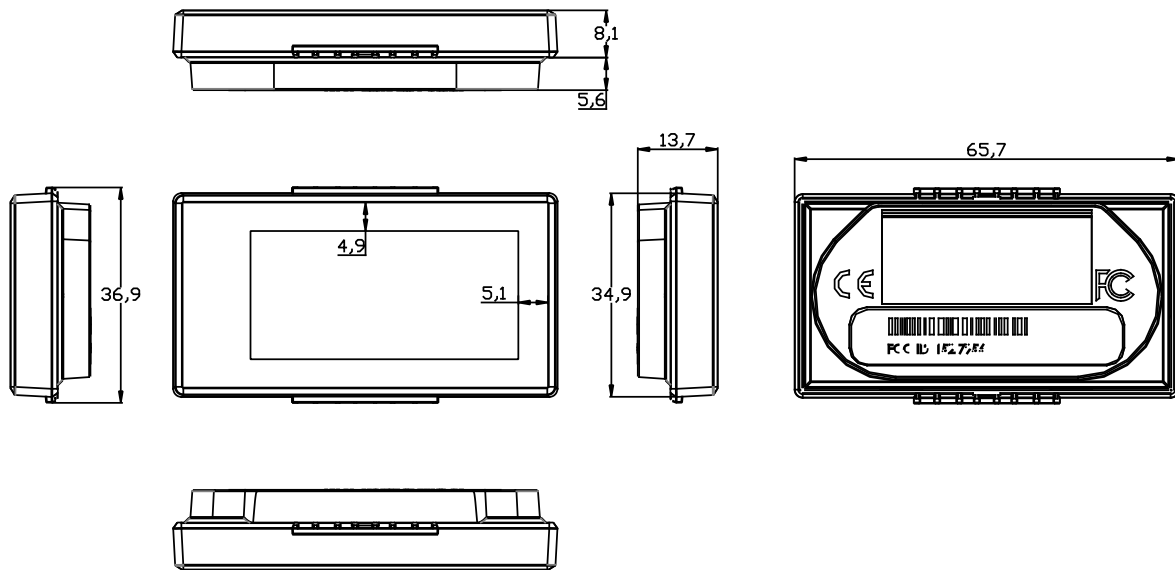


Figure 1: Dimensions

3.2. Weight

40 g (including battery)

4. Environmental Specifications

4.1. Operating Temperature and Humidity

Temperature: 10 to 50° C

Humidity: 20% to 85% RH

4.2. Storage Temperature and Humidity

Temperature: -20 to 60° C

Humidity: 20% to 85% RH

4.3. Static Electricity

Air discharge: ± 8 kV MAX (No malfunction)
 ± 15 kV MAX (No destruction)

Contact discharge: ± 4 kV MAX (No malfunction)
 ± 8 kV MAX (No destruction)

4.4. Drop resistance.

There will be no sign of decreased performance after the following drop test:

Drop the ESL from 1.8 M above the concrete floor (6 sides, 3 times each).

Scratches or discoloration of the casing do not decrease product performance.

5. Controls

Items	Specifications		Remarks
CPU	Type	8051 core 8-bit MCU	
	Internal flash ROM	96KB	
	Internal RAM	6 KB	
	Clock frequency	32 MHz	
LCD	Active area	W 45.8 x H 22.0 mm	
	Number of dots	W 200 x H 96	
	Dot pitch	111 Horizontal 111 Vertical	Dots per Inch
Radio	Modulation	DSSS	
	Frequency	2394 ~ 2507 MHz	Globally approved 2.4GHz band.
	Baud rate	250 Kbits / second	

6. Electrical Specifications

6.1. Electrical Characteristics

Conditions: Operating voltage 3.0V unless otherwise specified

Parameter	Typ	Unit	Remarks
Operating voltage	2.0–3.3	V	Lithium primary battery
Sleep current	<1	uA	When the transmitter and receiver are idle
Poll time	20	seconds	See below

The ESL is in sleep mode almost the entire time. The device wakes up at regular intervals (called the poll time) and it then transmits a poll request to the base station. When the base station has no data to send, it just acknowledges the poll after which the ESL immediately goes back to sleep. The poll rate is configurable and is set to 20 seconds by default. A higher poll rate will decrease the power consumption but will increase the response time.

6.2. Battery

The power is supplied to the ESL by two coin shaped Lithium CR2450 batteries:

- Nominal capacity: 1200 mAh (two times 600mAh)
- Nominal voltage: 3.0 V.
- Maximum self-discharge rate: <1% per year
- Usable time: 7 years minimum (Update frequency: 4 times per day, poll time 20seconds)

7. Radio Specifications

Parameter	Min	Typ	Max	Unit	Remarks
Receiver sensitivity		-97	-89	dBm	Over the entire temp. and operating voltage range
Nominal output power	-3	4.5	7	dBm	
Frequency	2394		2507	MHz	Over the entire temp. and operating voltage range
Transfer rate		250Kbit/s			
RSSI range		100		dB	Signal strength indication that can be reported to the base station

7.1. Protocol

Modified 802.15.4 (Physical layer and Media Access Control layer).

7.1.1. The physical layer

The physical layer (PHY) provides the data transmission service, as well as the interface to the physical layer management entity, which offers access to every layer management function and maintains a database of information on related personal area networks. Thus, the PHY manages the physical RF transceiver and performs channel selection and energy and signal management functions. It operates on the above mentioned frequency band. The PHY layer is 100% compliant and is based on direct sequence spread spectrum (DSSS) technique with a transfer rate of 250 kbit/s.

7.1.2. The medium access control layer

The medium access control (MAC) layer enables the transmission of MAC frames through the use of the physical channel. Besides the data service, it offers a management interface and itself manages access to the physical channel. It also controls frame validation, guarantees time slots and handles node associations. Finally, it offers hook points for secure services. The EE201 does not make use of the optional network beaconing, instead it used a polling mechanism to increase power efficiency. Some changes are made to the standard to allow for more efficient data frames and better power efficiency, especially when nodes are not connected to a base station.

7.2. Security

The 802.15.4 standard 128-bit AES encryption is supported. A secure method for key management is implemented as well. The encryption is optional though and can be configured via the base station. By default the radio traffic is unencrypted.

8. Labeling

8.1. Product label

The product label is affixed to the ESL as shown below.



Figure 2: product label

The barcode shows the product serial number. This is a 'B' is followed by 10 hexadecimal digits. This serial number is the same as the MAC address in the ESL-label, with the first 6 digits replaced by a 'B'.

Material: Base + laminate protection against wear.
 Base: PP film, thickness 80µm, backing with glue.
 Laminate: PET film, clear, thickness 25µm.

The dimensions of the product label are as follows:



Figure 3: product label dimensions

8.2. Shipment box labels

The shipment box labels are made from plain paper and are meant to show the regulatory information on the shipment box as well as the quantity in the box. The label design is shown below. The labels are 150mm*95mm and are made from plain paper with adhesive backing.

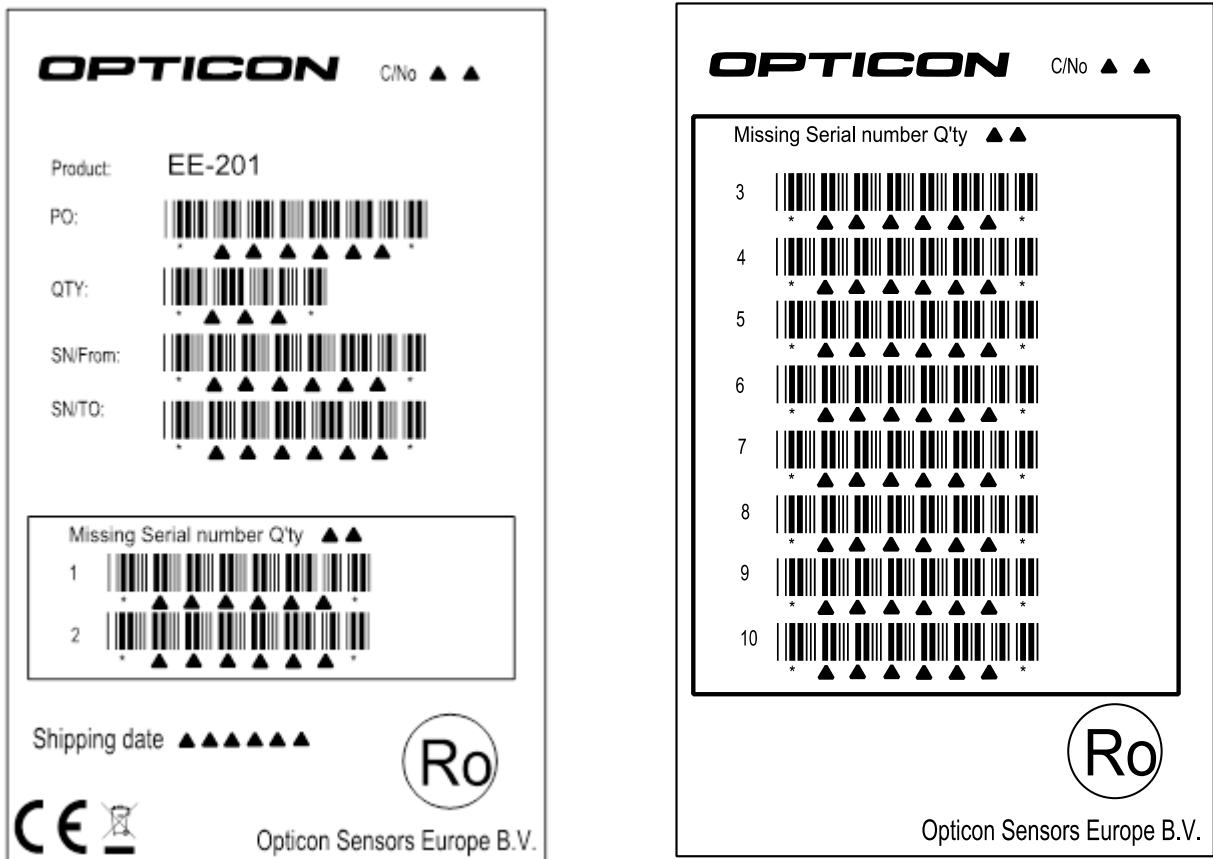


Figure 4: shipment box labels

Label A shows the PO number, the Quantity in the box and the serial number range, all encoded in barcodes as shown. In case there are two or less missing serial numbers, only label A is required. In case there are more than 2 missing serial numbers missing, label B is required to show the rest of the missing serial numbers.

9. Accessories

To mount the ESL onto a rail in a shop, the EE201 can be fitted with a rail attachment system made by HL-display system. This rail attachment accessory can click into a standard rail from **HL** HL-Display and rails are available for nearly all brands of shelves. Please consult a dealer for details on their offering. The shelftaker that fits the EE201 is available from Opticon as an accessory.

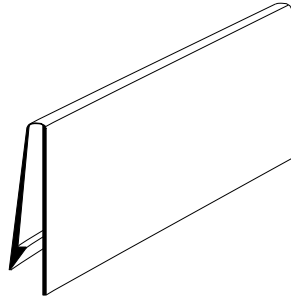


Figure 5: HL hinged shelftaker for data strips.

10. Packaging Specifications

10.1. Individual Packaging Specification

The ESL's do not need to be packed separately. To easily pack them, 30 pcs need to be packed in a plastic molder tray:

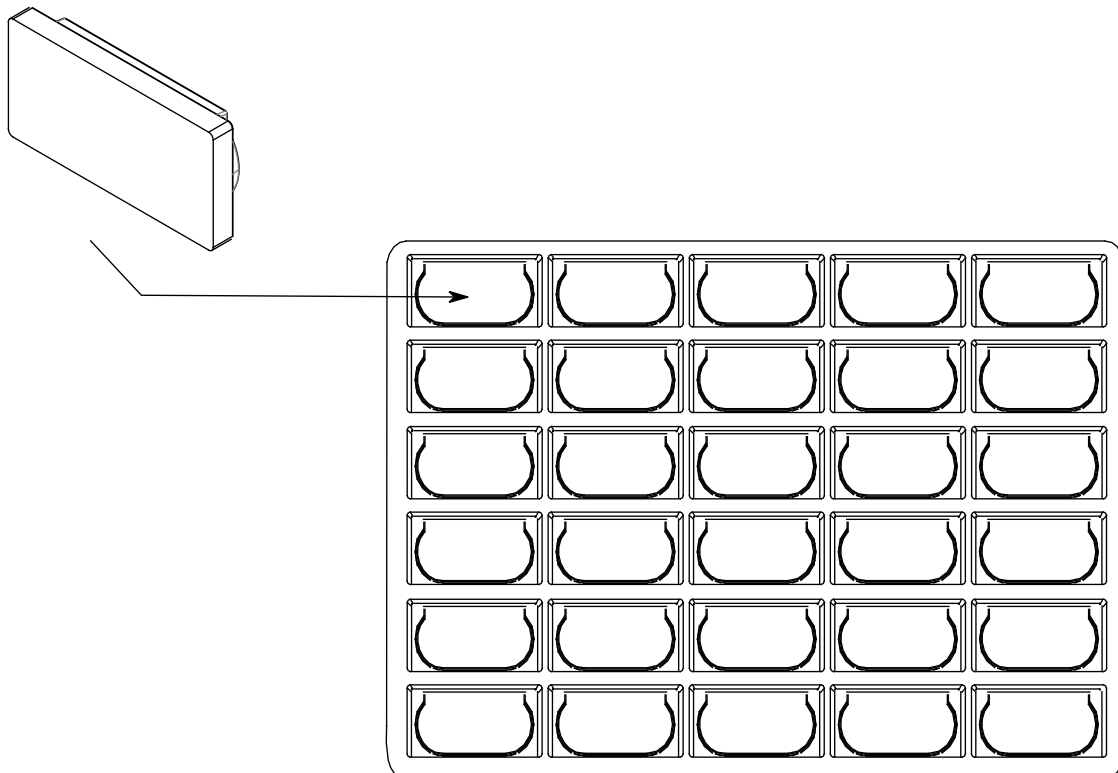


Figure 6: Individual packaging

10.2. Collective Packaging Specification

Pack the tray with 30 EE201's in a plastic bag, fold the open end of the bag and fix it with a piece of tape.

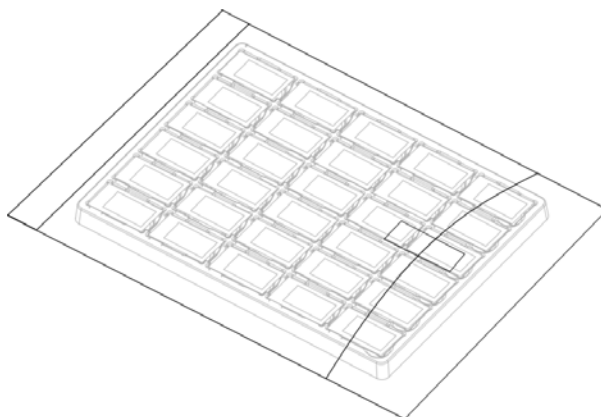


Figure 7: Collective packaging 1

Put 10 stacks, containing 300 ESL's inside a box and stick the shipment box label on the indicated position.

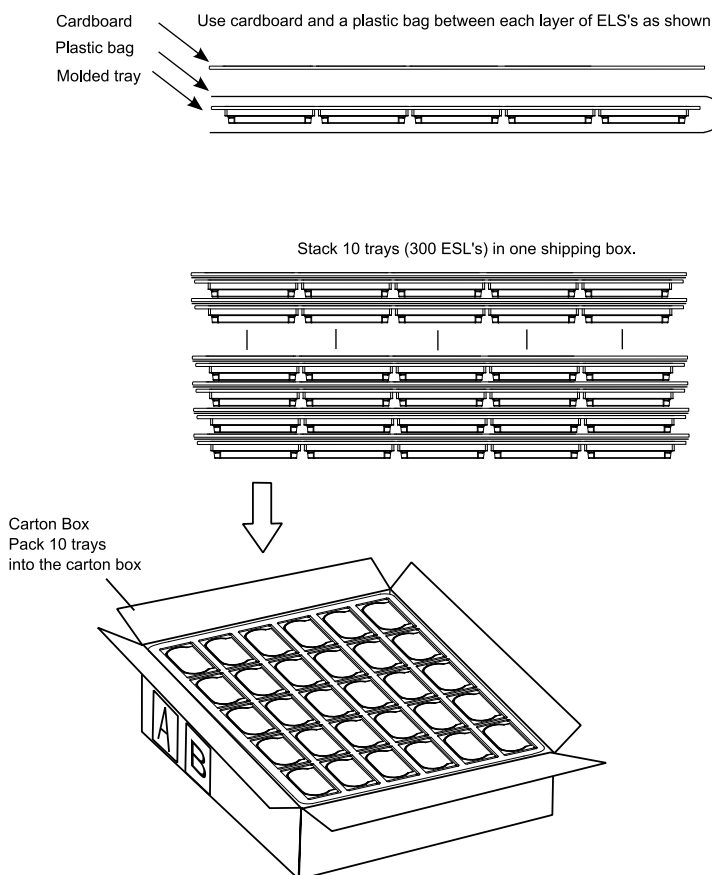


Figure 8: Collective packaging 2

Note: The “RO” mark labeled on the package tray or package box guarantees that the applicable product has passed our test of RoHS restrictions compliance (the restriction of the use of certain hazardous substances in electrical and electronic equipment, 2002/95 EC). However, this document does **not** have any legal weight in the European Union.

11. Regulatory Compliance

11.1. Product Safety

EN60950-1:2001

IEC60950-1:2001

11.2. EMC

EN55022

EN55024

Federal Communications Commission (FCC) Statement

15.21

You are cautioned that changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

15.105(b)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- 1) this device may not cause harmful interference and
- 2) this device must accept any interference received, including interference that may cause undesired operation of the device.

11.3. RoHS

RoHS: The restriction of the use of certain hazardous substances in electrical and electronic equipment, 2002/95 EC.

12. Safety

Handle this product carefully. Do not deliberately subject it to any of the following.

12.1. Shock

Do not throw or drop the ESL.

Do not place heavy objects on the ESL.

12.2. Temperature Conditions

Do not use the ESL at temperatures outside the specified range.

Do not pour boiling water on the ESL.

Do not throw the ESL into the fire.

Do not leave the ESL on the dashboard of a car.

12.3. Foreign Materials

Do not immerse the ESL in liquids.

Do not subject the ESL to chemicals.

12.4. Battery

Replace the ESL when its lifetime has expired. This is after max. 10 years of operation or sooner when the battery is depleted. If the battery is depleted sooner, replace the ESL and treat it as chemical waste and dispose of it according to local regulations.

CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED
BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING
TO THE INSTRUCTIONS

12.5. Other

Do not disassemble this product.

The ESL may be damaged by high voltage discharges.

13. Mechanical Drawing

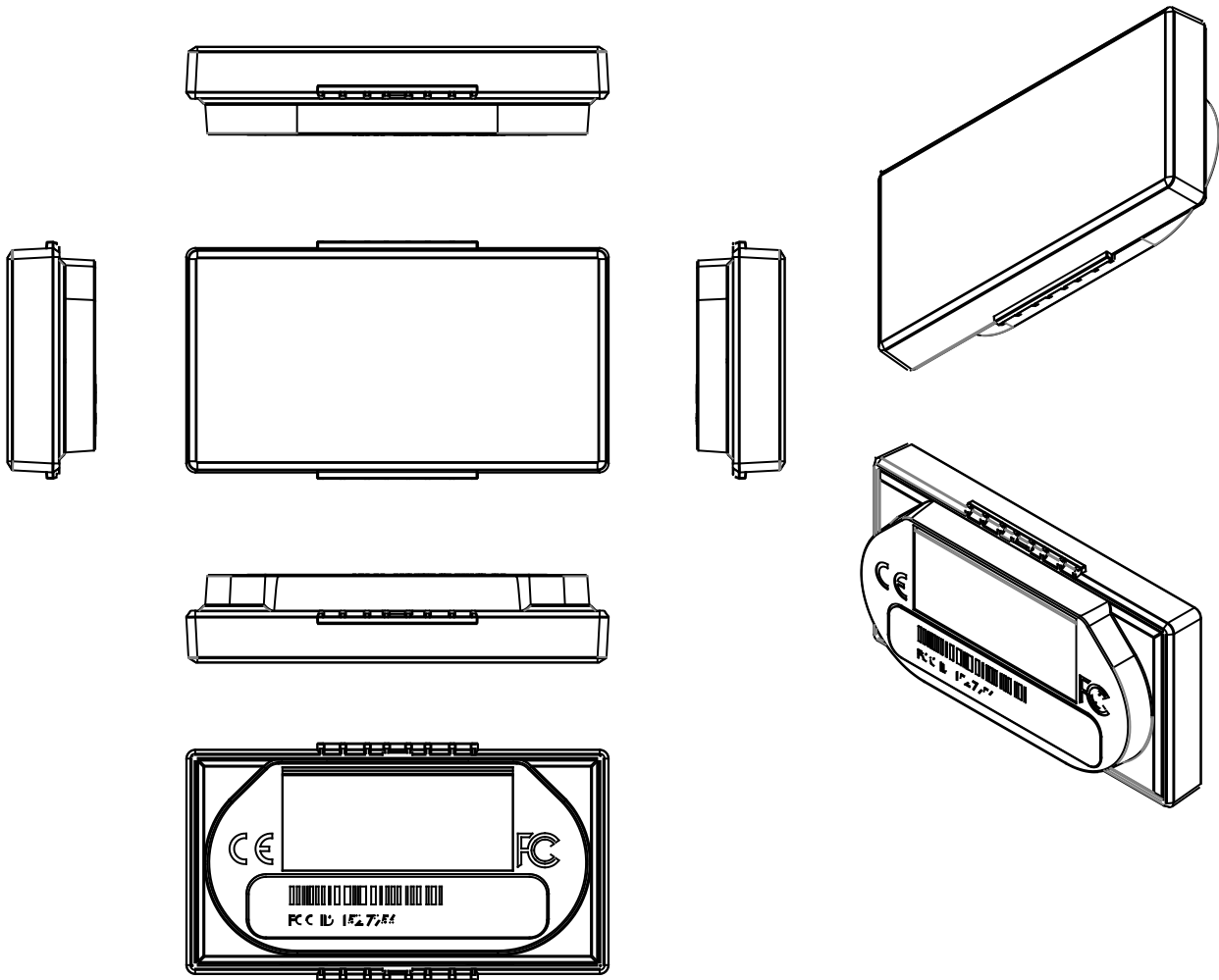


Figure 9: Mechanical drawing