BIG CLOCK TECHNICAL MANUAL

Professional LED Matrix Clock System
Model: BC-ESP32S3-M128X32 | Rev. 1.6

TABLE OF CONTENTS

1.0 INTRODUCTION

The BIG CLOCK is a professional clock system based on the ESP32-S3 microcontroller with a 128x32 pixel LED matrix display. The device is designed for broadcast applications, television studios, and professional environments that require time accuracy and reliable display.

NOTE:
The system uses a DS3231 Real Time Clock (RTC) to maintain time accuracy even when there is no network connection. NTP synchronization ensures millisecond accuracy when connected to the Internet.

1.1 SYSTEM ARCHITECTURE

- Microcontroller: Espressif ESP32-S3
- Display: 128×32 pixel (2×64×32) RGB LED matrix
- RTC: DS3231 with ±2ppm accuracy
- Configuration interface: Web-based
- Protocols: WiFi 802.11 b/g/n, NTP v4

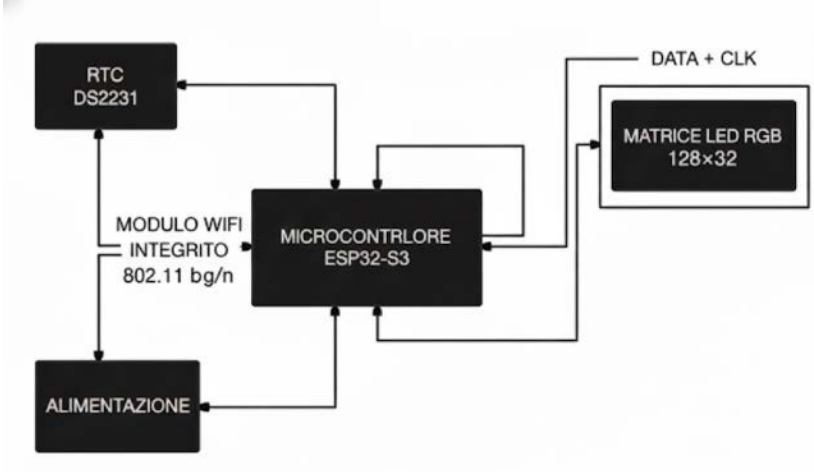
2.0 PRODUCT SPECIFICATIONS

2.1 MAIN FEATURES

- 128×32 pixel RGB LED Matrix display (2×64×32)
- 4 configurable display modes
- Color depth: 16-bit (65,536 colors)
- Adjustable brightness: 0-255 levels
- WiFi connection status indicator
- Automatic daylight saving time/standard time alignment

2.2 CONNECTIVITY AND NETWORK

- Dual-band WiFi 802.11 b/g/n
- Automatic NTP synchronization
- Integrated access point for configuration
- Static IP configuration support
- Configurable NTP server
- Customizable time zone (POSIX)



3.0 INSTALLATION AND CONFIGURATION

3.1 SYSTEM REQUIREMENTS

- Available 802.11 b/g/n WiFi network
- Web browser for initial configuration
- Mobile device or computer for setup

3.2 EXTERNAL POWER SUPPLY SPECIFICATIONS

The system uses a high-power external switching power supply:

Power: 100W (5V/20A)
Power supply: ANGEEK Switching Power Supply
Input voltage: 110V-220V AC with IEC connector
Output voltage: 5V DC 20A
Technology: Switching mode
Efficiency: >90% at nominal load
Protections: Overvoltage, overcurrent, short circuit, overtemperature
Certifications: CE, UL, RoHS

SAFETY WARNING:
Use only the supplied power supply. Connect the IEC connector of the power supply to a grounded outlet (110V-220V). The power supply provides 5V/20A for continuous operation of the LED matrices.

3.3 INSTALLATION PROCEDURE

3.3.1 Power Supply and Connection

1. Connect the IEC connector of the BIG CLOCK system to a grounded outlet (110V-220V).
2. Verify that the IEC connector is fully inserted and locked
3. The integrated power supply activates automatically upon connection
4. Wait for the automatic startup sequence to complete

TECHNICAL NOTE:
The integrated power supply provides 5V/20A (100W) to power both LED matrices and the control system with adequate safety margin for continuous 24/7 operation in a broadcast environment.

3.3.2 Wall Mounting

1. Identify the two upper holes on the PETG enclosure (342mm center-to-center distance)

2. Mark the mounting points on the wall using the holes as a guide
3. Secure the screws or anchors appropriate for the type of wall (drywall, masonry, etc.).
4. Check the stability and correct alignment of the fixing points.
5. Hang the clock using the two upper holes in the PETG container.
6. Check that the device is stable and correctly oriented

SAFETY WARNING:
The case is made of PETG. Use only appropriate mechanical fasteners. Do not expose the case to temperatures above 60°C or prolonged direct sunlight.

3.4 STARTUP SEQUENCE

When powered on, the system performs the following bootstrap sequence:

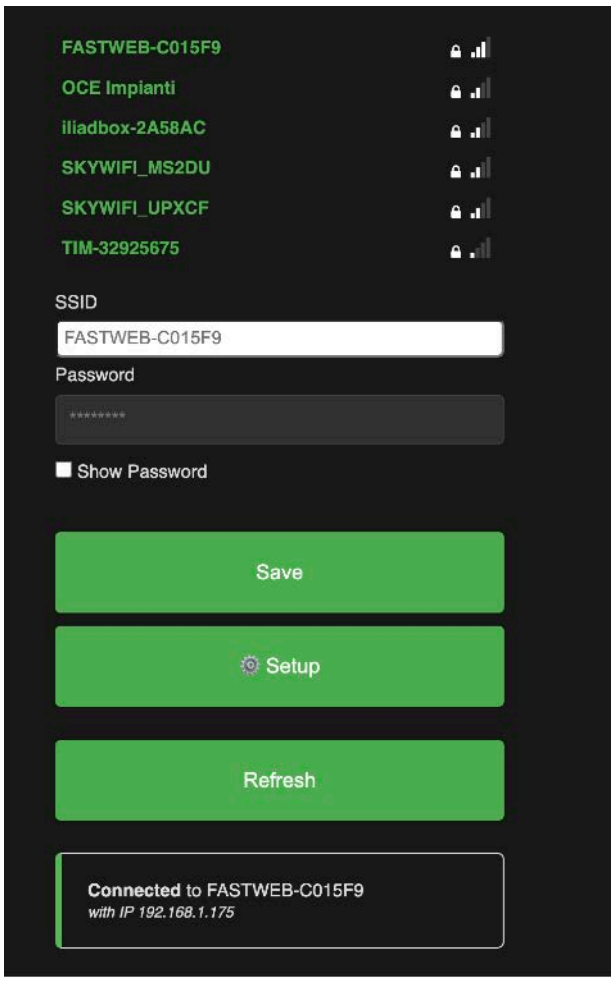
1. **Hardware initialization** (2-3 seconds)
2. **Operating System Loading** (3-5 seconds)
3. **Network Interface Configuration** (5-10 seconds)
4. **Time Synchronization** (up to 15 seconds)
5. **Start Operating Mode** (immediate)

4.0 WIFI NETWORK CONFIGURATION

4.1 ACCESS POINT MODE (AP MODE)

If no WiFi configuration is saved, the device automatically starts in Access Point mode:

```
SSID: BIG-CLOCK-SETUP
Protocol: 802.11n
Security: WPA2-PSK
Password: bigclockadmin
IP address: 192.168.4.1
Subnet Mask: 255.255.255.0
```

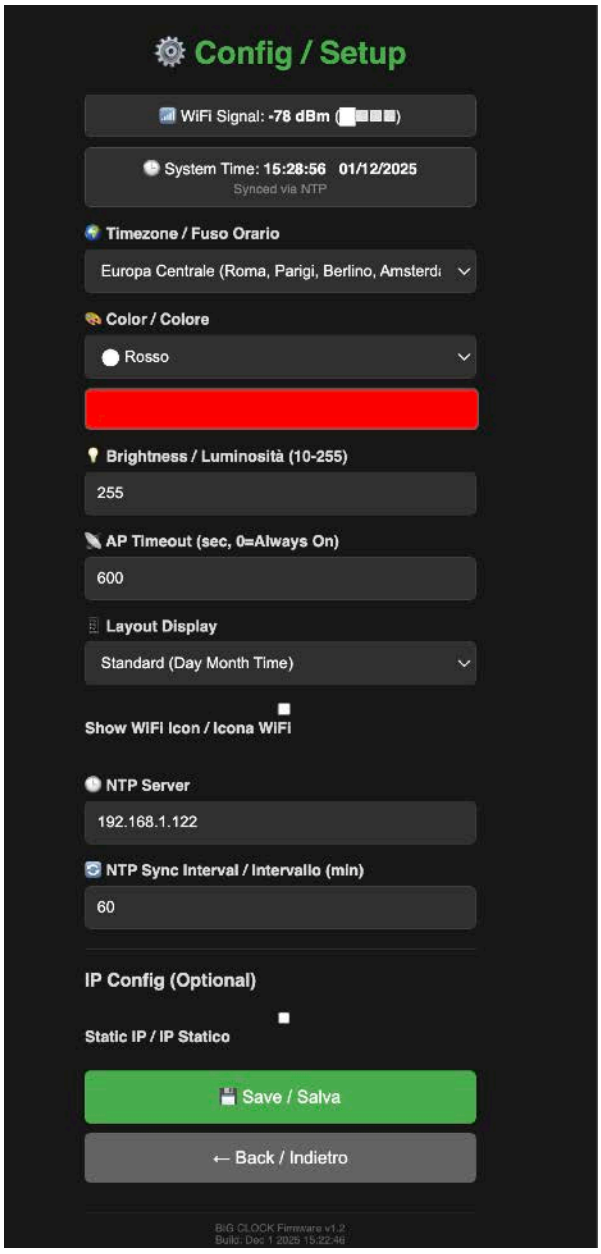


4.2 NETWORK CONFIGURATION PROCEDURE

1. Identify and connect to the "BIG-CLOCK-SETUP" WiFi network with the password "bigclockadmin."
2. Launch your web browser and enter the address 192.168.4.1
3. Select the target WiFi network from the automatic scan
4. Enter the security credentials for the selected network
5. Configure advanced parameters if necessary (static IP, time zone)
6. Save the configuration and wait for the automatic restart

4.3 ADVANCED CONFIGURATION PARAMETERS

PARAMETER	TECHNICAL DESCRIPTION	RANGE/ DEFAULT VALUE	NOTES IMPLEMENTATION
Primary NTP Server	Time synchronization server	pool.ntp.org	Configurable multiple entry
Time Zone	POSIX string format	CET-1CEST,M3.5.0,M10.5.0/3	Supports automatic DST
Synchronization interval	NTP update period	60 minutes	Range: 5-1440 minutes
Connection timeout	WiFi attempt timeout	30 seconds	Configurable 10-120s



4.4 STATIC IP CONFIGURATION

IMPLEMENTATION NOTE:
Static IP configuration is recommended for installations in broadcast environments where network addressing must be predetermined.

```
IP address: [configurable]
Gateway: [configurable]
Subnet Mask: [configurable]
Primary DNS: [configurable]
Secondary DNS: [configurable]
```

5.0 SYSTEM OPERATION

5.1 CONTROL INTERFACE

The device is equipped with two physical control buttons for reset operations:

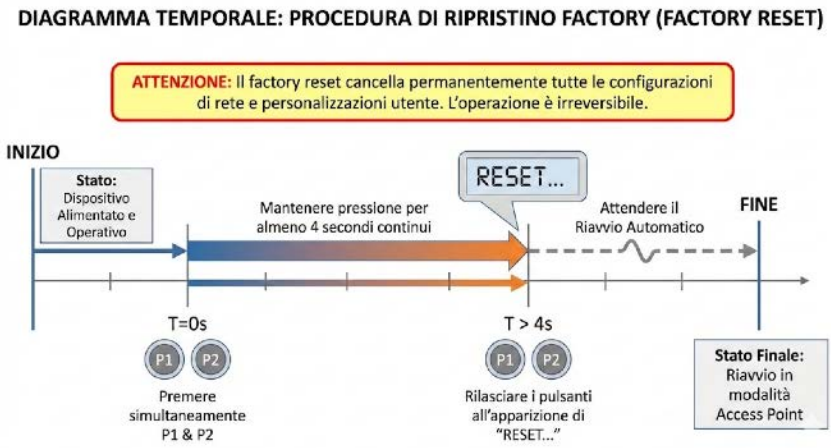
IMPORTANT NOTE:
The physical buttons only implement the complete reset function (Factory Reset). The layout change and brightness adjustment functions are only available via the web interface.

BUTTON	PRIMARY FUNCTION	PROLONGED ACTION	COMBINED FUNCTION
P1 (Top)	None (combination only)	N/A	Factory Reset (4+ seconds)
P2 (Lower)	None (combination only)	N/A	Factory Reset (4+ seconds)

5.2 FACTORY RESET PROCEDURE

WARNING:
The factory reset permanently deletes all network configurations and user customizations. This operation cannot be undone.

1. Ensure that the device is powered and operational
2. Press both P1 and P2 buttons simultaneously
3. Hold them down for at least 4 seconds
4. Release the buttons when the message "RESET..." appears
5. Wait for the device to automatically restart in Access Point mode



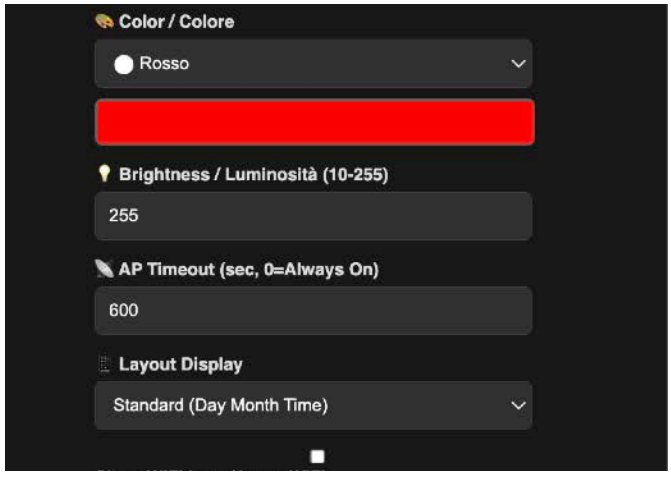
5.3 CONNECTION STATUS INDICATOR

The lower left corner of the display constantly shows the status of the WiFi connection:

INDICATOR	SIGNAL STRENGTH	TECHNICAL DESCRIPTION	SERVICE QUALITY
▓▓▓▓	Excellent (-50 to -60 dBm)	Maximum reliability	Optimal
▓▓▓▒	Good (-60 to -70 dBm)	Stable connection	Acceptable
▓▓▒▒	Sufficient (-70 to -80 dBm)	Possible micro-interruptions	Limited
▓▒▒▒	Weak (-80+ dBm)	Unstable connection	Inadequate
X	No connection	Offline or network error	Not working

6.0 DISPLAY MODES

6.1 AVAILABLE DISPLAY LAYOUTS



The system supports 4 display modes that can only be configured via the web interface:

Layout 0: Standard Mode

Complete configuration with display:

- Hours and minutes: HH:MM format (maximum size)
- Seconds: SS format (small size, right corner)
- Full date: Day + Month format
- WiFi indicator: lower left corner
- NTP Status: lower right indicator

Layout 1: Time Only Mode

Minimalist configuration optimized for readability:

- Hours and minutes: HH:MM format (maximum possible size)
- No secondary information displayed
- Maximum contrast and visibility from a distance
- Status indicator: discreet overlay

Layout 2: Time + Seconds Mode

Time-focused configuration with precision:

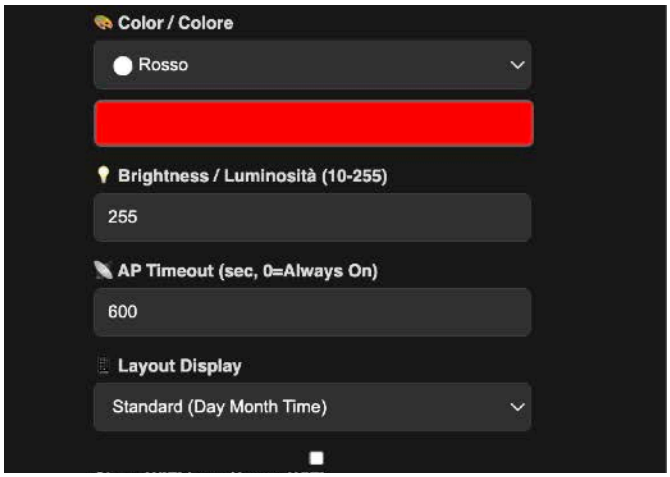
- Hours and minutes: HH:MM format (large size)
- Seconds: SS format (medium size, integrated)
- Date: small DD/MM format (optional)
- Optimal balance between readability and completeness

Layout 3: Extended Date Mode

Complete information configuration:

- Hours and minutes: HH:MM format (medium size)
- Seconds: SS format (small size)
- Day of the week: extended (MONDAY, TUESDAY, etc.)
- Full date: DD MMMM YYYY
- All available time information

6.2 COLOR AND BRIGHTNESS CUSTOMIZATION



Color White

Blue color

Green color

NOTE:*Color and brightness settings can only be configured via the web interface and are saved in non-volatile memory. The physical buttons do not allow manual adjustment of these parameters.*

7.0 MAINTENANCE

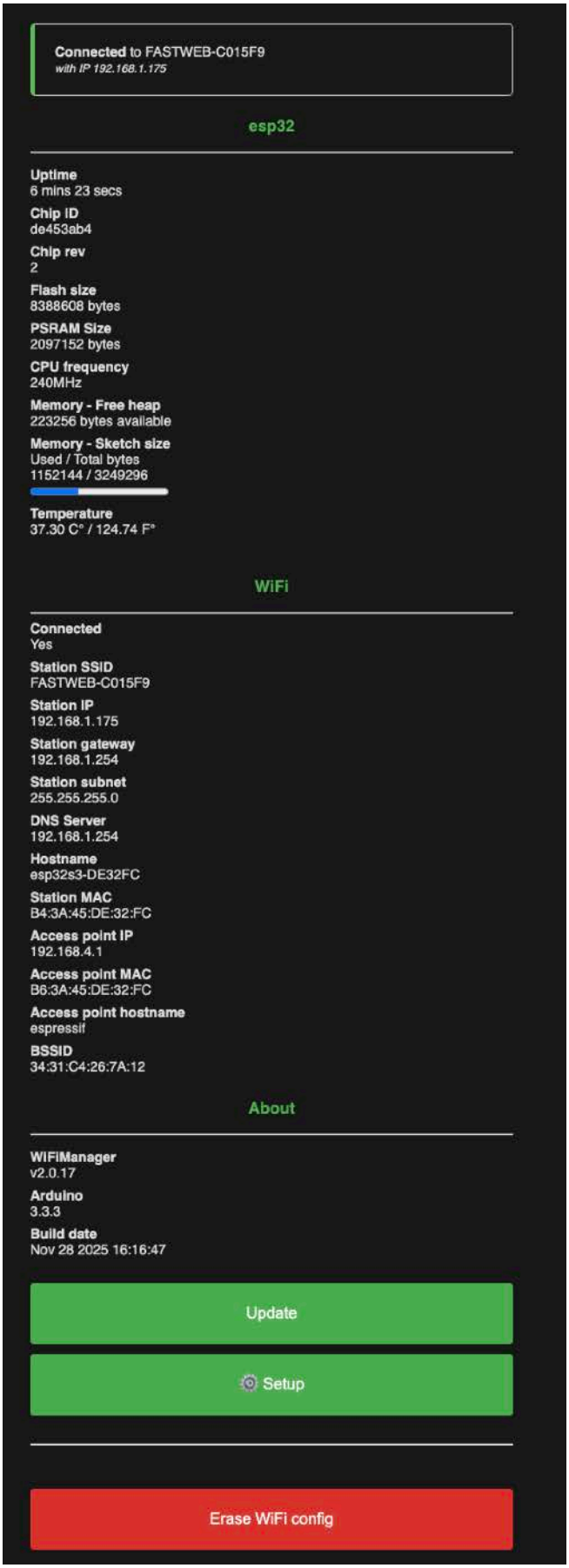
7.1 CLEANING AND ROUTINE MAINTENANCE PROCEDURES

1. Turn off the device and disconnect the power supply
2. Use a dry or slightly damp microfiber cloth
3. Clean the display surface with gentle circular movements
4. Avoid chemicals, solvents, or abrasives
5. Do not apply liquids directly to electronic components
6. Periodically check that the connectors are working properly

7.2 FIRMWARE UPDATES

The system supports firmware updates via OTA (Over-The-Air):

- Automatic download when connected to the Internet
- Silent installation in the background
- Automatic restart after update
- Automatic rollback in case of error
- Complete logging of update operations



8.0 DIAGNOSTICS AND TROUBLESHOOTING

8.1 ERROR CODES AND SYSTEM MESSAGES

DISPLAY MESSAGE	ERROR CODE	POSSIBLE CAUSE	CORRECTIVE ACTION
"Loading..."	N/A	Normal system startup	Wait for completion
"WiFi setup..."	N/A	Searching for WiFi configuration	Wait or configure AP
"IP: xxx.xxx.xxx.xxx"	N/A	Connection successful	Normal operation
"AP: 192.168.4.1"	N/A	Access Point Mode	WiFi configuration required
"Clock Error"	RTC-001	RTC reading error	Restart or check hardware
"NETWORK ERROR"	NET-001	WiFi connection timeout	Check network or configuration
"NTP SYNC FAILED"	NTP-001	NTP synchronization timeout	Check Internet connection

8.2 ADVANCED TROUBLESHOOTING

HARDWARE DIAGNOSTIC PROCEDURE:

1. Check power supply
2. Check connector continuity
3. Visually inspect components for damage
4. Check that the integrated internal power supply is working correctly
5. Contact authorized technical support

9.0 TECHNICAL SPECIFICATIONS

9.1 HARDWARE SPECIFICATIONS

COMPONENT	TECHNICAL SPECIFICATIONS
Microcontroller	Espressif ESP32-S3 Dual core 240MHz 512KB SRAM 8MB Flash
LED display	128×32 pixel matrix (2×64×32) 16-bit RGB 4096 total pixels 1.5mm pixel pitch
Real Time Clock	Maxim DS3231 Accuracy ±2ppm Integrated backup battery I2C interface
Power	Internal ANGEEK 5V/20A 100W Transformer 110V/220V→DC-5V Switching mode, efficiency >90% Multiple integrated protections
Power	Typical: 8W Maximum: 25W (peak) Standby: 1.2W Capacity: 100W nominal
Physical dimensions	Display: 192×48mm (2×96×48) Enclosure: 690×190×77mm (PETG, L) Weight: 650g (PETG + components)

9.2 SOFTWARE SPECIFICATIONS

FEATURE	SUPPORT
Operating System	FreeRTOS ESP-IDF Framework Arduino Core compatible
Network Protocols	WiFi 802.11 b/g/n WPA/WPA2/WPA3 TCP/IP Stack DHCP Client
Time Services	NTP v4 SNTP POSIX Time Zone Automatic DST
Web Interface	HTTP Server HTML5/CSS3/JavaScript WebSocket for real-time updates Responsive Design
Updates	OTA Updates Signature verification Automatic rollback A/B partitioning
Storage	8MB Flash SPIFFS file system Non-volatile configurations Persistent logging

9.3 ENVIRONMENTAL SPECIFICATIONS AND CERTIFICATIONS

PARAMETER	SPECIFICATIONS	NOTES
Operating temperature	0°C to +40°C	Optimal performance 15°C-25°C
Relative Humidity	20% to 80% non-condensing	Anti-condensation protection

Storage temperature	-20°C to +60°C	Original packaging
Operating altitude	0 to 2000 m above sea level	Derating above 1000 m
Vibrations	IEC 60068-2-6	Tested 10-500Hz
Shock	IEC 60068-2-27	Tested 15g/11ms

10.0 COMPLIANCE AND CERTIFICATIONS

10.1 EC DECLARATION OF CONFORMITY

The BIG_CLOCK Model BC-ESP32S3-M64X32 product complies with the following European directives:

- EMC Directive 2014/30/EU
- Low Voltage Directive 2014/35/EU
- RoHS Directive 2011/65/EU
- REACH Directive 1907/2006/EC

10.3 INFORMATION FOR THE END USER

IMPORTANT INFORMATION:

- This product is intended for professional use in controlled environments
- Unauthorized modifications will invalidate the warranty and certifications
- For technical assistance, contact authorized service centers only
- Recycling must be carried out in accordance with local WEEE regulations