■ Naphome Phase II Manufacturing **Specifications**

Document Version: 1.0 Date: October 2025

Target Volume: 10,000 units

BOM Target: \$40 (Base) / \$55 (Premium)

Product: Naphome Smart Sleep Device

Architecture: ESP32-S3 + Cloud AI + Custom Audio/Lighting

Manufacturing: Full turnkey production (PCB → Assembly → Housing → QA)

Certification: FCC/CE compliant using pre-certified ESP32-S3 module

⚠ Product Overview

The Naphome is a premium smart sleep companion that combines: -Voice AI (cloud-based speech recognition and response) - Premium Audio (ND65/ND90 stereo speakers with passive radiators) - **Dynamic RGB Lighting** (circadian lighting with 10-16 WS2812B LEDs) - **Environmental Sensing** (6 sensors for bedroom optimization) -**IoT Control** (IR blaster for AC/TV control)

■ Technical Specifications

Core Hardware Requirements

Component	Specification	Notes
MCU	ESP32-S3-WROOM-1 (8MB PSRAM)	Pre-certified module (FCC/CE)
Audio Amplifier	TAS5825M (I2S, 2×20W)	TI digital amplifier
Speakers	ND65 (Base) / ND90 (Premium) + Passive Radiators	Dual acoustic chambers
Microphones	2-3× Digital I ² S MEMS	Far-field, noise- canceling
RGB LEDs	10x WS2812B (Base) / 16x WS2812B (Premium) in ring configuration	Addressable, 5V
Display	256×64 OLED (SSD1322 or equivalent)	SPI interface, 3.3V
Power	USB-C PD 12V + Li-ion backup	2-3 hours battery runtime
Connectivity	Wi-Fi 2.4GHz + BLE	Dual-band support

Sensor Suite (6 Total)

Sensor	Part Number	Interface	Purpose
Temperature/Humidit	y SHTC3	I ² C	Environmental monitoring
VOC/CO ₂	SGP30 (Base) / SCD41 (Premium)	I ² C	Air quality
Ambient Light	VEML7700	I ² C	Circadian lighting control
PM2.5 Air Quality	PMS5003	UART	Air quality monitoring
Sound Level	MEMS Microphone	Analog	Noise monitoring

Sensor	Part Number	Interface	Purpose
	0EC. C4 OLED (CCD4000) CD		Status, time, visual

Display 256×64 OLED (SSD1322) SPI Status, time, visual feedback

Custom IR LED + Driver GPIO IoT device control

Audio Specifications

IR Transmitter

Parameter Base SKU Premium SKU

Drivers ND65 + Passive Radiators ND90 + Passive Radiators

 Frequency Response
 60Hz - 20kHz
 50Hz - 20kHz

 THD
 <1% @ 1W</td>
 <0.5% @ 1W</td>

 Sensitivity
 85dB @ 1W/1m
 88dB @ 1W/1m

 Power Handling
 2×10W RMS
 2×20W RMS

Acoustic Design Dual chamber, ported Dual chamber, tuned

LED Ring

10× WS2812B in ring configuration

16× WS2812B in ring configuration

RGB Lighting Specifications

Parameter Base SKU Premium SKU

 LED Count
 10× WS2812B
 16× WS2812B

 Power
 5V, 0.3W per LED
 5V, 0.3W per LED

Diffusion Frosted acrylic dome Enhanced diffuser + light pipe

Control ESP32-S3 PWM ESP32-S3 PWM

Configuration Ring layout around device

perimeter

Features Circadian lighting, visual Enhanced diffusion, color accuracy

Ring layout with enhanced spacing

feedback

⚠ Nechanical Specifications

Enclosure Requirements

Parameter Specification

Material PC/ABS blend (UL94 V-0)

Dimensions ~150×150×200mm (TBD)

Weight <1.5kg

Finish Matte white/black, soft-touch

Assembly Snap-fit + screws (serviceable)

IP Rating IP20 (indoor use)

Acoustic Design

Component Specification

Speaker Enclosure Dual acoustic chambers, ported
2-3 mics, 120° spacing, acoustic

Mic Array 2-3 mics, isolation

Vibration Isolation Rubber feet, internal damping **Thermal Management** Passive cooling, thermal pads

Connectors & Controls

Component Specification
Power Input USB-C PD (12V, 3A)

Component **Specification** Touch Controls 3x capacitive touch buttons

Volume Control Rotary encoder (360°, detented)

256×64 OLED (status, time, **Display**

feedback)

Status LEDs Power, Wi-Fi, RGB feedback Reset Button Recessed, factory reset

⚠ PCB Specifications

Board Requirements

Parameter Specification

Layers 4-layer PCB Thickness 1.6mm

Material FR4, Tg 150°C **Finish** HASL or ENIG Size ~80×100mm (TBD) Assembly SMT + selective hand assembly

Component Placement

Zone Components **MCU Zone** ESP32-S3, crystal, flash, PSRAM Audio Zone TAS5825M, audio connectors, filtering Sensor Zone I²C sensors, level shifters, pull-ups Display Zone OLED display, SPI interface, level shifters

USB-C controller, buck/boost, battery **Power Zone**

management

Interface

Connectors, buttons, LEDs Zone

Power Management

Rail	Voltage	Current	Components
VBUS	12V (USB-C PD)	3A	Input from USB-C
VCC_3V3	3.3V	1A	ESP32-S3, sensors
VCC_5V	5V	2A	RGB LEDs, audio amp
VCC_3V3_DISP	3.3V	100mA	OLED display
VBAT	3.7V	2A	Li-ion battery

■ Testing & Quality Assurance

Electrical Testing

Test	Speci	fication	Method
Power Consumption	<15W @ 12V		Digital multimeter
Display Brightness	100-300 cd/m ²		Luminance meter
Audio THD	<1% @ 1W		Audio analyzer
Wi-Fi Range	>30m @ 2.4GHz		RF chamber
Battery Runtime	>2 hours		Load testing

Test Specification Method
Sensor Accuracy ±2% (temp), ±5% (humidity) Calibrated references

Acoustic Testing

Test **Specification** Method Frequency 60Hz-20kHz (Base), 50Hz-20kHz (Premium) Anechoic chamber Response Wake Word >95% @ 3m, 60dB ambient Controlled environment Detection Microphone -26dBV @ 1kHz Audio analyzer Sensitivity Audio Latency <100ms (cloud round-trip) Network testing

Environmental Testing

Test	Condition	Duration	Pass Criteria
Temperature	-10°C to +50°C	24h	Full functionality
Humidity	10% to 90% RH	24h	No condensation
Vibration	5-500Hz, 1g	2h	No mechanical failure
Drop Test	1m onto concrete	3 drops	Cosmetic damage only

RGB Lighting Testing

Test	Specification	Method
Color Accuracy	CRI >90	Spectrophotometer
Brightness	100-1000 lux @ 1m	Lux meter
Diffusion	Uniform light distribution	Visual inspection
Power Consumption	1 <3W @ full brightness	Power meter

Display Testing

Test	Specification	Method
Resolution	256×64 pixels	Visual inspection
Contrast Ratio	>1000:1	Contrast meter
Viewing Angle	>160° horizontal, >120° vertical	Goniometer
Response Time	<1ms	Oscilloscope
Power Consumption	<50mW @ full brightness	Power meter

Packaging Requirements

Component Specification

Box Material Recycled cardboard, FSC certified

Box Size ~200×200×250mm **Protection** EPE foam inserts

Accessories USB-C cable, quick start guide FCC/CE marks, model number,

serial

Documentation

Document Language Content Quick Start Guide English Setup, Wi-Fi, basic usage **User Manual English** Full feature documentation Warnings, disposal, Safety Information English compliance

Warranty Card English 1-year limited warranty

■ Manufacturing Process

Production Flow

- 1. PCB Assembly
 - SMT placement (pick & place)Reflow soldering

 - AOI inspection
- ICT testingAudio Assembly

 - Speaker mountingAcoustic chamber assembly
 - Microphone array installation
 - Audio testing
- 3. Sensor Integration
 - Sensor mountingCable routing

 - Calibration
 - Functional testing
- 4. Final Assembly
 - PCB installation
 - Enclosure assembly
 - Button/control installation
 - Final testing
- 5. Quality Control
 - Électrical testing
 - Acoustic testing
 - Environmental testing
 - Packaging

Yield Targets

Stage	Target Yield	Action if Below
PCB Assembly	>98%	Rework/replace
Audio Assembly	>95%	Recalibrate
Final Assembly	>97%	Process improvement
Final Testing	>99%	Root cause analysis

■ Cost Targets & BOM

Base SKU BOM Target: \$40

Category	Cost	Components
MCU & Audio	\$15	ESP32-S3, TAS5825M, ND65 speakers
Sensors	\$8	SHTC3, SGP30, VEML7700, PMS5003, MEMS mic
Lighting	\$5	10× WS2812B, diffuser, driver
Display	\$2	256×64 OLED, driver, mounting
Mechanical	\$8	Enclosure, buttons, connectors
Power	\$4	USB-C, battery, power management

Category Cost Components

Total \$40

Premium SKU BOM Target: \$55

Category Cost Components

MCU & \$20 ESP32-S3, TAS5825M, ND90 speakers

Sensors \$12 SHTC3, SGP30, SCD41, VEML7700, PMS5003, MEMS mic

Lighting \$8 16× WS2812B, enhanced diffuser, light pipe

Display \$2 256×64 OLED, driver, mounting **Mechanical** \$10 Enhanced enclosure, premium buttons

Power \$5 Enhanced power management

Total \$55

⚠ Compliance & Certification

Required Certifications

Standard	Scope	Method
FCC Part 15	RF emissions	Pre-certified ESP32-S3 module
CE EMC	Electromagnetic compatibility	Declaration of Conformity
CE LVD	Low voltage directive	Internal testing
RoHS	Restriction of hazardous substances	Material declaration
REACH	Chemical safety	Material declaration

Testing Requirements

Test	Standard	Pass Criteria
RF Emissions	FCC Part 15 Class B	< FCC limits
RF Immunity	IEC 61000-4-3	No degradation
ESD	IEC 61000-4-2	±8kV contact, ±15kV air
Surge	IEC 61000-4-5	±2kV differential

⚠ Timeline & Milestones

Phase II Production Timeline

Milestone	Duration	Deliverables
Tooling	8 weeks	Injection molds, test fixtures
EVT	4 weeks	Engineering validation units
DVT	6 weeks	Design validation, acoustic tuning
PVT	4 weeks	500-unit pilot run
MP	16 weeks	10,000 units production

Key Deliverables

Phase Deliverable Quantity
EVT Engineering samples 50 units

PhaseDeliverableQuantityDVTDesign validation200 unitsPVTProduction validation500 unitsMPMass production10,000 units

⚠ Contact Information

Technical Lead

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Services: Hardware design, firmware development, manufacturing liaison

■ Notes & Assumptions

Key Assumptions

- ESP32-S3-WROOM-1 module is pre-certified (FCC/CE)
- 10,000 unit minimum order quantity
- 12-month production timeline
- Standard payment terms (30% deposit, 70% on delivery)
- 1-year warranty on all components

Risk Mitigation

- · Multiple supplier options for critical components
- Pre-production validation at each phase
- Comprehensive testing and quality control
- Experienced manufacturing partners with IoT device experience

Document Status: Ready for manufacturer review and quotation **Next Steps:** RFQ distribution, NDA execution, technical discussions