■ Naphome Phase II Manufacturing Specifications

Document Version: 1.0 Date: October 2025

Target Volume: 10,000 units

Executive Summary

Product: Naphome Smart Sleep Device

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

Manufacturing: Full turnkey production (PCB \rightarrow Assembly \rightarrow Housing \rightarrow 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/Humidity	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
Display	256×64 OLED (SSD1322)	SPI	Status, time, visual feedback

Sensor **Part Number** Interface **Purpose** IR Transmitter Custom IR LED + Driver **GPIO** IoT device control

Audio Specifications

Parameter Base SKU Premium SKU Drivers ND65 + Passive Radiators ND90 + Passive Radiators **Frequency Response** 60Hz - 20kHz 50Hz - 20kHz <1% @ 1W <0.5% @ 1W Sensitivity 85dB @ 1W/1m 88dB @ 1W/1m **Power Handling** 2×10W RMS 2×20W RMS **Acoustic Design** Dual chamber, ported Dual chamber, tuned 10× WS2812B in ring **LED Ring** 16× WS2812B in ring configuration configuration

RGB Lighting Specifications

Parameter	Base SKU	Premium SKU
LED Count	10× WS2812B	16x 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	Ring layout with enhanced spacing
Features	Circadian lighting, visual feedback	Enhanced diffusion, color accuracy

Mechanical 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

Snap-fit + screws **Assembly** (serviceable) **IP Rating** IP20 (indoor use)

Acoustic Design

Component **Specification Speaker Enclosure** Dual acoustic chambers, ported 2-3 mics, 120° spacing, acoustic Mic Array isolation **Vibration Isolation** Rubber feet, internal damping Thermal Management Passive cooling, thermal pads

Connectors & Controls

Component **Specification Power Input** USB-C PD (12V, 3A) Touch Controls 3x capacitive touch buttons Volume Control Rotary encoder (360°, detented) Component **Specification**

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

Acoustic Testing

Test	Specification	Method
Frequency Response	60Hz-20kHz (Base), 50Hz-20kHz (Premium)	Anechoic chamber
Wake Word Detection	>95% @ 3m, 60dB ambient	Controlled environment
Microphone Sensitivity	-26dBV @ 1kHz	Audio analyzer
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 & Labeling

Packaging Requirements

Component

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Box Material	Recycled cardboard, FSC certified
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Specification

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

Accessories USB-C cable, quick start guide

FCC/CE marks, model number,

Documentation

Document	Language	Content
Quick Start Guide	English	Setup, Wi-Fi, basic usage

Document Language Content **User Manual** English

Full feature documentation

Warnings, disposal, Safety Information English compliance

1-year limited warranty **Warranty Card** English

⚠ Manufacturing Process

Production Flow

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

 - AOI inspection
 - ICT testing
- 2. Audio Assembly

 - Speaker mountingAcoustic chamber assembly
 - Microphone array installationAudio testing
- 3. Sensor Integration
 - Sensor mounting
 - Cable routing
 - Calibration
 - Functional testing
- 4. Final Assembly
 - PCB installation
 - Enclosure assembly
 - Button/control installation
 - Final testing
- 5. Quality Control
 Electrical 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

BOM Components

Base SKU Components

Components
ESP32-S3, TAS5825M, ND65 speakers
SHTC3, SGP30, VEML7700, PMS5003, MEMS mic
10x WS2812B, diffuser, driver
256×64 OLED, driver, mounting
Enclosure, buttons, connectors
USB-C, battery, power management

Premium SKU Components

Category Components

MCU & Audio ESP32-S3, TAS5825M, ND90 speakers

Sensors SHTC3, SGP30, SCD41, VEML7700, PMS5003, MEMS mic

Lighting 16× WS2812B, enhanced diffuser, light pipe

Display 256×64 OLED, driver, mounting **Mechanical** Enhanced enclosure, premium buttons

Power Enhanced power management

Compliance & Certification

Required Certifications

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

Chemical safety

Material declaration

Testing Requirements

REACH

Test Standard Pass Criteria

RF Emissions BFCC Part 15 Class < FCC limits

RF Immunity IEC 61000-4-3 No degradation
ESD IEC 61000-4-2 ±8kV contact, ±15kV

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Surge IEC 61000-4-5 ±2kV differential

⚠ Timeline & Milestones

Phase II Production Timeline

MilestoneDurationDeliverablesTooling8 weeksInjection molds, test fixturesEVT4 weeksEngineering 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

PhaseDeliverableQuantityEVTEngineering samples 50 unitsDVTDesign 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