Naphome Phase II Manufacturing Specifications

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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 → 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)

Naphome Smart Sleep Device - Modern egg-shaped design with warm ambient lighting

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 I2S MEMS	Far-field, noise- canceling
RGB LEDs	10× WS2812B (Base) / 16× 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

Sensor	Part Number	Interface	Purpose
Sound Level	MEMS Microphone	Analog	Noise monitoring
Display	256×64 OLED (SSD1322)	SPI	Status, time, visual feedback
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
THD	<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
LED Ring	10× WS2812B in ring configuration	16× WS2812B in ring 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

ParameterSpecificationMaterialPC/ABS blend (UL94 V-0)Dimensions~150×150×200mm (TBD)Weight<1.5kg</td>FinishMatte white/black, soft-touch

Assembly Snap-fit + screws (serviceable)

IP Rating IP20 (indoor use)

Acoustic Design

Component	Specification
Speaker Enclosure	Dual acoustic chambers, ported
Mic Array	2-3 mics, 120° spacing, acoustic isolation
Vibration Isolation	Rubber feet, internal damping
Thermal Managemen	t 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	Specification	n 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 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	Specification
Box Material	Recycled cardboard, FSC certified
Box Size	~200×200×250mm
Protection	EPE foam inserts
Accessories	USB-C cable, quick start guide
Labels	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	l arget 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

Power

Category	Components	
MCU & Audio	ESP32-S3, TAS5825M, ND65 speakers	
Sensors	SHTC3, SGP30, VEML7700, PMS5003, MEMS mic	
Lighting	10× WS2812B, diffuser, driver	
Display	256×64 OLED, driver, mounting	
Mechanical	Enclosure, buttons, connectors	

USB-C, battery, power management

Premium SKU Components

Category Components

MCU & 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

FCC Part 15 RF emissions Pre-certified ESP32-S3

module

CE EMC Electromagnetic compatibility Declaration of Conformity

CE LVD Low voltage directive Internal testing

Restriction of hazardous Material declar

substances

Chemical safety

Material declaration

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

ai

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

PhaseDeliverableQuantityEVTEngineering samples 50 unitsDVTDesign validation200 unitsPVTProduction validation500 unitsMPMass production10,000 units

Contact Information

Technical Lead

Daniel McShan

Email: dan@syzygyx.com

Website: https://www.naptick.com

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 componentsPre-production validation at each phase

- Comprehensive testing and quality control
 Experienced manufacturing partners with IoT device experience

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