



Sleeptracker-AI®

Sleep Monitoring System  
(Processor)

Model: STS-60

DATA SHEET



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# GENERAL DESCRIPTION

## PCBA Name

The PCBA of monitoring system will be referred to as “STS-60”.

## Features

- Based on NXP I.MX 8M Nano platform
- Embedded 1x Cortex A53 with 512KB unified L2 cache
- Embedded 1x Cortex M7 with 256KB tightly coupled memory
- 4GB eMMC
- 8Gb DDR3L DRAM
- 1 USB 2.0 port
- 1 Single wire port
- Humidity sensor
- Temperature sensor
- Gas sensor
- Pressure sensor
- IEEE 802.11 a/b/g/n/ac WLAN
- BT4.2+Enhanced Data Rate (EDR)
- Bluetooth 5 support
- 2x Sleep Tracker Sensor interface support
- PCBA size: 92mm\*54mm\*1.2mm

# HARDWARE SPECIFICATION

## General Specifications

Features	Description
Interfaces	Reset Button
	6Pin Connector with USB 2.0, 1 wire and power
	2 x Sleep tracker sensor jack
Main Chipset	CPU: i.MX 8M Nano
	eMMC: 4Gbytes
	DDR3L: 1Gbytes
	WLAN/BT: 88W8987
	PMU: PCA9450B
	Codec: WM8962
	Environment sensor: BME680
<b>CPU</b>	
Cortex®-A53 MPCore platform	Cortex® -A53 processors <ul style="list-style-type: none"> <li>• 32 KB L1 Instruction Cache</li> <li>• 32 KB L1 Data Cache</li> <li>• Media Processing Engine (MPE) with Arm® NEON™ technology supporting the Advanced Single Instruction Multiple Data architecture:</li> <li>• Floating Point Unit (FPU) with support of the Arm® VFPv4-D16 architecture</li> </ul>
	Support of 64-bit Arm®v8-A architecture
	512 KB unified L2 cache
Cortex®-M7 core platform	Low power microcontroller available for customer application: <ul style="list-style-type: none"> <li>• low power standby mode</li> <li>• IoT features including Weave</li> <li>• Manage IR or wireless remote</li> <li>• ML inference applications (enhanced for i.MX 8M Nano)</li> </ul>
	Cortex® M7 CPU: <ul style="list-style-type: none"> <li>• 256 KB tightly coupled memory (TCM)</li> </ul>
On-chip memory	Boot ROM (256 KB)
	On-chip RAM (512 KB + 32 KB)
System debug	Arm® CoreSight™ debug and trace technology

	Trace Port Interface Unit (TPIU) to support off-chip real-time trace
	Embedded Trace FIFO (ETF) with 4 KB internal storage to provide trace buffering
	Unified trace capability for Quad Cortex®-A53 and Cortex®-M7 CPUs
	Cross Triggering Interface (CTI)
	Support for 4-pin (JTAG) debug interface

### DDR3L

	Fully differential clock inputs (CK, CK) operation
	Differential Data Strobe (DQS, DQS)
	On chip DLL align DQ, DQS and DQS transition with CK transition
	DM masks write data-in at the both rising and falling edges of the data strobe
	All addresses and control inputs except data, data strobes and data masks latched on the rising edges of the clock
	Programmable CAS latency 5, 6, 7, 8, 9, 10, 11 and 13 supported
	Programmable additive latency 0, CL-1, and CL-2 supported
	Programmable CAS Write latency (CWL) = 5, 6, 7, 8
	Programmable burst length 4/8 with both nibble sequential and interleave mode
	BL switch on the fly
	8banks
	Average Refresh Cycle (Tcase of 0 oC~ 95 oC)
	- 7.8 μs at 0° C ~ 85 ° C
	- 3.9 μs at 85° C ~ 95 ° C
	Driver strength selected by EMRS
	Dynamic On Die Termination supported
	ZQ calibration supported
	TDQS (Termination Data Strobe) supported (x8 only)
	Write Levelization supported
	8 bit pre-fetch

### eMMC

	Packaged NAND flash memory with e•MMC™ 5.1 interface
	Compliant with e•MMC™ Specification Ver.4.4, 4.41,4.5,5.0 & 5.1

#### Bus mode

- High-speed eMMC™ protocol
- Clock frequency : 0-200MHz.
- Ten-wire bus (clock, 1 bit command, 8 bit data bus) and a hardware reset.

Supports three different data bus widths : 1 bit(default), 4 bits, 8 bits

- Data transfer rate: up to 52Mbyte/s (using 8 parallel data lines at 52 MHz)
- Single data rate : up to 200Mbyte/s @ 200MHz
- Dual data rate : up to 400Mbyte/s @ 200MHz

#### Error free memory access

- Internal error correction code (ECC) to protect data communication
- Internal enhanced data management algorithm
- Solid protection of sudden power failure safe-update operations for data content

#### Security

- Support secure bad block erase commands
- Enhanced write Protection with permanent and partial protection options

#### Quality

- RoHS compliant (for detailed RoHS declaration, please contact your KSI representative.)

Supports Field Firmware Update(FFU)

Enhanced Device Life time

Support Pre EOL information

Optimal Size

Supports Production State Awareness

Supports Power Off Notification for Sleep

Supports HS400

Supports CMD queuing

Supports Cache barrier

Supports Cache Flushing report

RPMB throughput improve

Supports BKOP control

Supports HCI for CMD queuing

Supports Enhanced strobe

Supports secure write protection

## Codec

DAC SNR 98 dB ('A' weighted), THD -84 dB at 48 kHz, 1.8V

ADC SNR 94 dB ('A' weighted), THD -85 dB at 48 kHz, 1.8V

Cirrus Logic 'class W' ultra-low power headphone driver

Up to 31mW per channel output power at 1% THD+N into 16Ω at 1.8V

Ground referenced

Low offset ( $\pm 1.2\text{mV}$ )

Pop and click suppression

Control sequencer for pop-minimized power-up/down

Single register write for default start-up sequence

Two integrated PLLs enable clocking of full audio system

Two-wire I<sup>2</sup>C and 3- or 4-wire SPI serial control interface

Standard sample rates from 8 kHz to 96 kHz

## Environment Sensor

Individual humidity, pressure, and gas sensors can be independently enabled/disabled

Gas sensor

Response time:  
<1S (for new sensors)

Power consumption:  
<0.1 mA in ultra-low power mode

Output data processing:  
Direct index for air quality (IAQ) output

Humidity Sensor

Response time:  
~8S

Accuracy tolerance:  
+/- 3% r.H

Hysteresis:  
+/-1.5% r.H

Pressure Sensor

RMS noise:  
0.12 Pa, equiv. to 1.7cm

Offset temperature coefficient:  
+/-1.3 Pa/K, equiv. to +/-10.9cm at 1° C temperature change

## PMU

Six high-efficiency step-down regulators

- Three 3 A buck regulators with DVS feature and remote sense
- Two 3 A buck regulators

One 3 A buck regulator

Two 2 A buck regulators

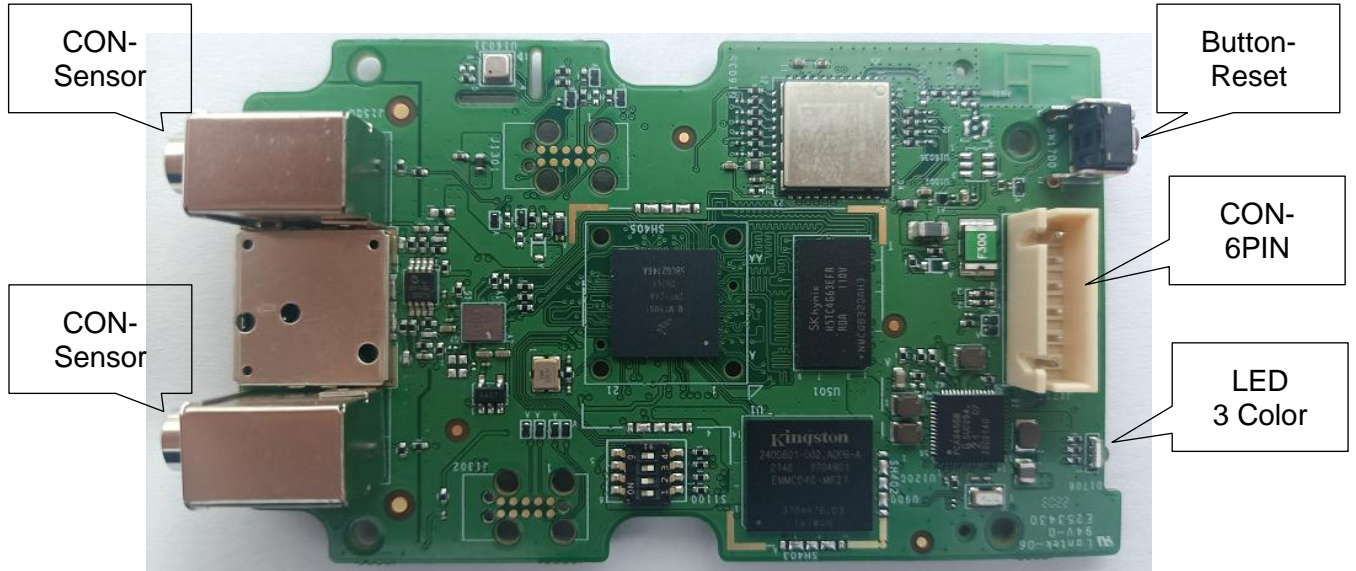


	<p>Five linear regulators</p> <ul style="list-style-type: none"> <li>- Two 10 mA LDOs</li> <li>- One 150 mA LDO</li> <li>- One 200 mA LDO</li> <li>- One 300 mA LDO</li> </ul>
	<p>Support various memory types: DDR4/LPDDR4/DDR3L via system UBOOT configuration, no hardware change required</p>
	<p>400 mA load switch with built-in active discharge resistor</p>
	<p>32.768 kHz crystal oscillator driver and buffer output</p>
	<p>Two channel logic level translator</p>
	<p>Power control IO</p> <ul style="list-style-type: none"> <li>- Power ON/OFF control</li> <li>- Standby/run mode control</li> </ul>
	<p>Fm+ 1 MHz I2C-bus interface</p>
	<p>HVQFN56</p>
<p><b>WLAN</b></p>	
Network Standard	<p>IEEE 802.11 a/b/g/n/ac</p>
Supported Data Rate	<p>IEEE 802.11b Standard Mode: 1, 2, 5.5, 11 Mbps  IEEE 802.11g Standard Mode: 6, 9, 12, 18, 24, 36, 48, 54 Mbps  IEEE 802.11n MCS0-MCS15 PHY rate up to 300Mbps</p>
Modulation	<p>802.11a/g/n/ac: OFDM  802.11b: CCK (11, 5.5Mbps), DQPSK(2Mbps), BPSK(1Mbps)</p>
Antenna Type	<p>Onboard antenna for Wi-Fi/BT transmits and receive  Impedance: 50 ohms</p>
Frequency Range	<p>2.4 GHz ISM Bands 2.412~2.472 GHz  5.15 5.25 GHz (FCC UNII low band) for US/Canada and Europe  5.25 5.35 GHz (FCC UNII middle band) for US/Canada and Europe  5.47 5.725 GHz for Europe  5.725 5.825 GHz (FCC UNII high band) for US/Canada</p>
Operating Channel	<p>802.11b:  USA, Canada and Taiwan 1 ~ 11  Most European Countries 1 ~ 13  802.11g:  USA and Canada 1 ~ 11  Most European Countries 1 ~ 13  802.11n:  USA and Canada 1 ~ 11  Most European Countries 1 ~ 13  802.11a:</p>

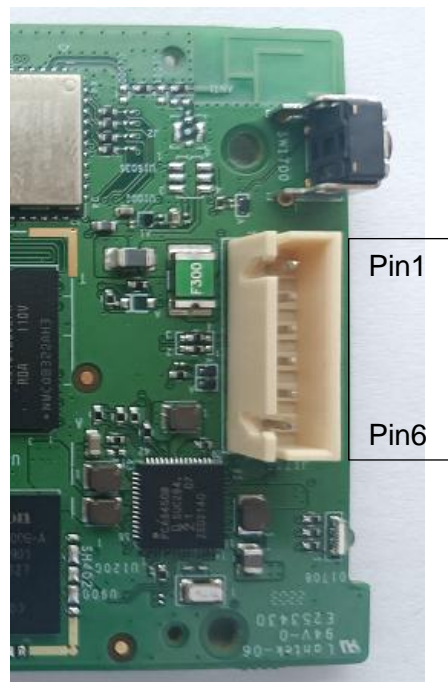
	USA 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120,124, 128, 132, 136, 140, 149, 153, 157, 161, 165
Security	WPA/WPA2 /WPA3 and WE P 64-bit and 128-bit encryption Advanced Encryption Standard (AES) Counter Mode CBC MAC Protocol (CCMP) AES/Galois/Counter Mode Protocol (GCMP) Wired Equivalent Privacy (WEP) Temporal Key Integrity Protocol (TKIP) Advanced Encryption Standard (AES)/Cipher Based Message Authentication Code (CMAC) WLAN Authentication and Privacy Infrastructure (WAPI)
<b>Bluetooth</b>	
Bluetooth Standard	BT4.2+Enhanced Data Rate (EDR) Bluetooth 5 support
Frequency Range	2402MHz~2483MHz
Modulation	Header GFSK Payload 2M: $\pi/4$ DQPSK Payload 3M: 8DPSK
Antenna Type	Onboard antenna for Wi-Fi/BT transmits and receive Impedance: 50 ohms
Temperatures (ambient)	Operates from 0 to 55°C Storage from -10 to 85°C
Humidity (non-condensing)	Operating humidity: 10 ~ 90% RH Storage humidity: 10 ~ 95% RH
OS Compatibility	Linux
PCBA Dimension	92mm x 54mm x 1.2mm

## Interface Definition

Overview



## CON-6Pin Assignment

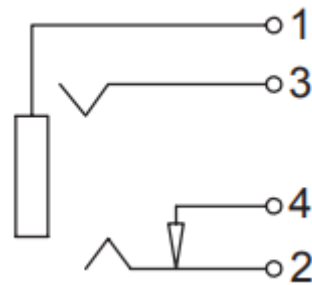


Pin	Assignment	GPIO	Used	Type	Description
1	5V		YES	P	5V power supply
2	USB_D-		YES	I/O	USB port 2.0 data pin data-
3	USB_D+		YES	I/O	USB port 2.0 data pin data+
4	MALE_1WIRE		YES	I/O	Single-wire half-duplex communication
5	ID_AB		Yes	I	Pull-up = Supplier A Pull-down = Supplier B
6	GND		YES	G	Ground

### CON-Sensor Assignment

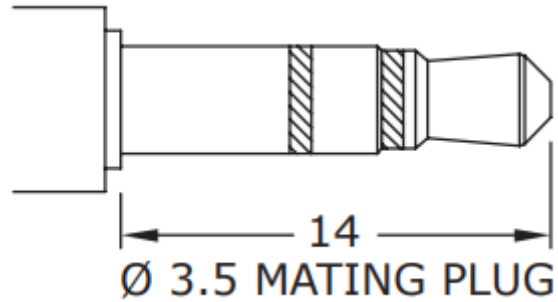
#### 3.5mm audio Jacks

- tip and ring switch



Pin	Name	Assignment	Type	Description
1	Sleeve	GND	G	Ground
2	Tip	3V3OUT	P	Power Pin for detection
3	Ring	SENSOR#_POS	I/O	Sleep tracker sensor data signal
4	Tip Switch	PLUGGED_DETECT#	I/O	Sleep tracker sensor plug in/out detected: High: plug out Low: plug in

**Suggestion Plug:**



## Button Behavior

### Software Reset

- System will be re-start when push this button.

## LED Behavior

- Green (solid) - Tracker is booted up and ready for use. Connected to WiFi.
- Green (blinking) - Tracker is booted up and ready for setup. No WiFi connection has been set up.
- Orange (solid) - Shown during boot up. Please wait ~45 seconds for boot up to complete.
- Orange (blinking) - Sensor is disconnected OR WiFi connection is lost.

## Electronic Specification

### System:

Symbol	Parameter	Min	Typical	Max	Unit	Note
Ts	Storage Temperature	-10		+85	°C	Condition at 5V, 25°C
Tw	Working Temperature	0	+25	+55	°C	

### Power Consumption

USB_5V	Supplied Voltage	4.75	5	5.25	V	
	Supplied Current			1.5	A	

### WLAN:

No.	Item			3.3V		
				Max. (mA)	Avg. (mA)	
1	Power Down			1.0	0.92	
2	Sleep (Not associated with AP)			1.3	1.2	
3	Power Save (2.4G)			49.5	2.4	
4	Power Save (5G)			80.4	2.1	
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit		
				Max. (mA)	Avg. (mA)	Duty (%) (Mean)
2.4	11b@1Mbps	20	16	287	161	67
	11b@11Mbps	20	16	277	163	65
	11g@54Mbps	20	14	191	120	52
	11n@MCS7	40	12	98	57	36
5	11a@6Mbps	20	13	247	143	64
	11a@54Mbps	20	13	198	130	53
	11n@MCS7	40	10	112	74	16
	11ac@MCS0	20	10	217	129	48
	11ac@MCS9	40	9	103	74	42
	11ac@MCS0 NSS1	80	8	212	88	55
	11ac@MCS9 NSS1	80	8	93	76	27
Band (GHz)	Mode	BW(MHz)	Receive			
			Max. (mA)	Avg. (mA)		
2.4	11b@1Mbps	20	57	55		

	11n@MCS7	40	64	63
5	11a@6Mbps	20	71	69
	11ac@MCS8 NSS1	20	73	72
	11ac@MCS9 NSS1	40	85	84
	11ac@MCS9 NSS1	80	98	95

Note:

\* The power consumption is based on 88W8987 test environment, these data for reference only.

(1) WLAN and Bluetooth off (WL\_REG\_ON=LOW, #hciconfig hciX down)

(2) Using normal firmware.

(3) Link AP use ASUS RT AC66U, DTIM = 1, Beacon Interval = 100 ms

(4) WLAN Initial value is too high, in SD-UART mode, BT power save mode is Active, About this issue, Please refer below bring up commend:

```
modprobe cfg80211
```

```
insmod mlan.ko
```

```
insmod sd8987.ko cal_data_cfg=none fw_name=mrsl/sdio8xxx_uart_combo_pxx.bin
```

```
insmod hci_uart.ko ps_mode=1
```

```
hciattach /dev/ttyUSB0 any 115200 flow
```

#### Bluetooth:

No.	Mode	Packet Type	RF Power (dBm)	3.3V	
				Max. (mA)	Avg. (mA)
1	Play Music	A2DP	n/a	21.6	12
2	Transmit	DH5	4	68.9	62.8
3	Receive	3-DH5	n/a	61.4	57.3

Note:

\* The power consumption is based on 88W8987 test environment, these data for reference only.

(1) Using Normal Firmware

(2) Using MFG Firmware

## Radio Specification

### WLAN:

	Band (GHz)	Mode	Min.	Typ.	Max.	Unit
Output Power (Board level limit)	2.4	11b (11Mbps) @ EVM<35%	14	16	18	dBm
		11g (54Mbps) @ EVM <= -27 dB	12	14	16	dBm
		11n (HT20 MCS7) @ EVM <=-28 dB	11	13	15	dBm
		11n (HT40 MCS7) @ EVM <=-28 dB	10	12	14	dBm
	5	11a (54Mbps) @ EVM 27 dB	11	13	15	dBm
		11n (HT20 MCS7) @ EVM <=- 28 dB	8	10	12	dBm
		11n (HT40 MCS7) @ EVM <=-28 dB	8	10	12	dBm
		11ac (VHT20 MCS8)@EVM <=-30 dB	8	10	12	dBm
		11ac (VHT40 MCS9)@EVM <=-32 dB	7	9	11	dBm
		11ac (VHT80 MCS9)@EVM <=-32 dB	6	8	10	dBm
Receiver Sensitivity	2.4	11b (11Mbps)		-87	-84	dBm
		11g (54Mbps)		-73	-70	dBm
		11n (HT20 MCS7)		-69	-66	dBm
		11n (HT40 MCS7)		-67	-64	dBm
	5	11a (54Mbps)		-71	-68	dBm
		11n (HT20 MCS7)		-67	-64	dBm
		11n (HT40 MCS7)		-63	-60	dBm
		11ac (VHT20 MCS8)		-67	-64	dBm
		11ac (VHT40 MCS9)		-59	-56	dBm
		11ac (VHT80 MCS9)		-55	-52	dBm

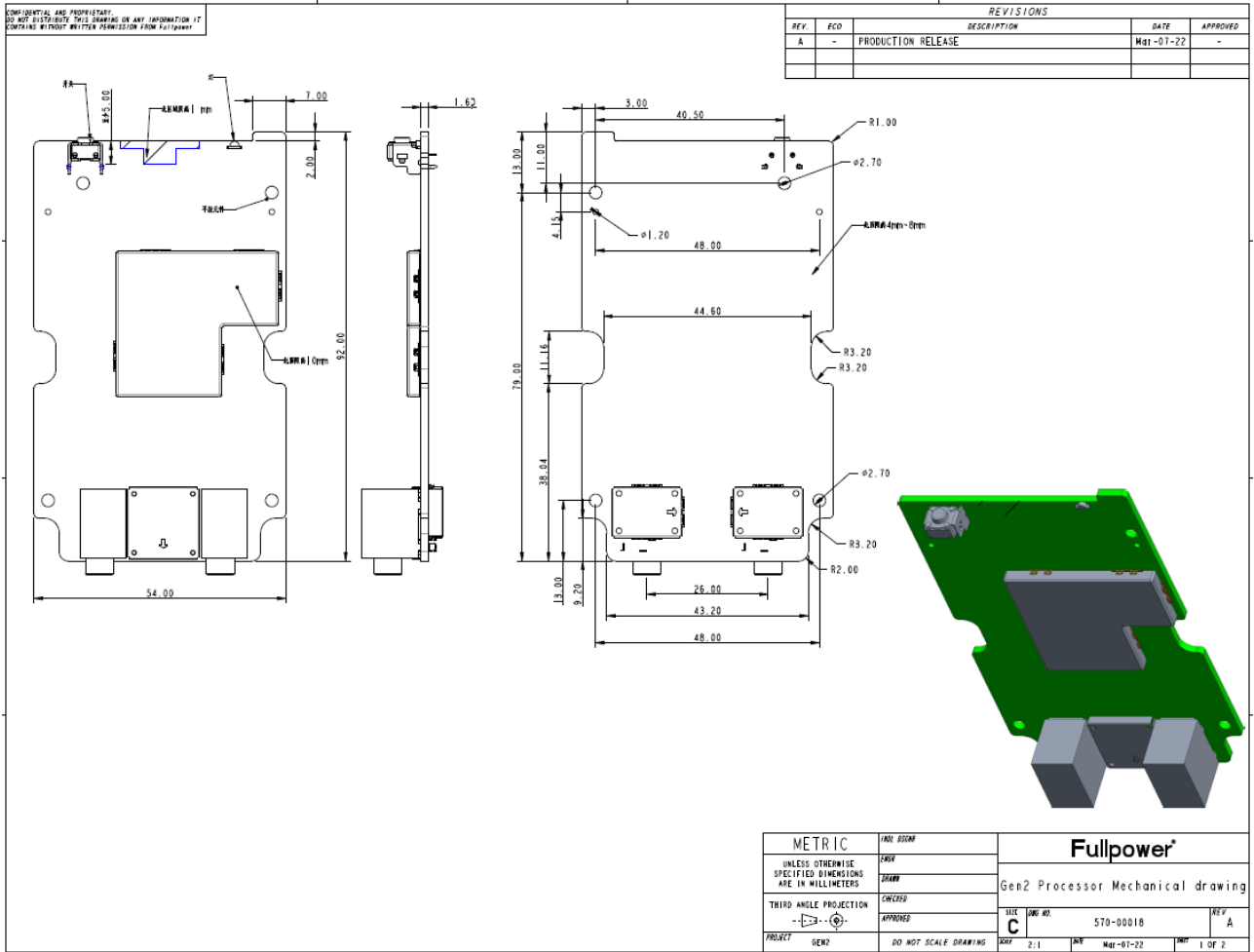
### Bluetooth:

	Mode	Min.	Typ.	Max.	Unit
Output Power	BDR	0	2	4	dBm
	EDR	-4	-1	1	dBm
	Low Energy	0	2	4	dBm
Receiver Sensitivity (BER<0.1%)	GFSK		-88	-86	dBm
	$\pi/4$ -DQPSK		-88	-86	dBm
	8DPSK		-80	-78	dBm

## MECHANICAL AND LABEL SPECIFICATIONS



# Mechanical Drawing



MODEL: STS-60  
 FCC ID : 2AF20-ST560  
 IC: 20700-ST560  
 PN: 800-00023  
 SN: R1202200001  
 MAC: 54EFFEXXXXXX

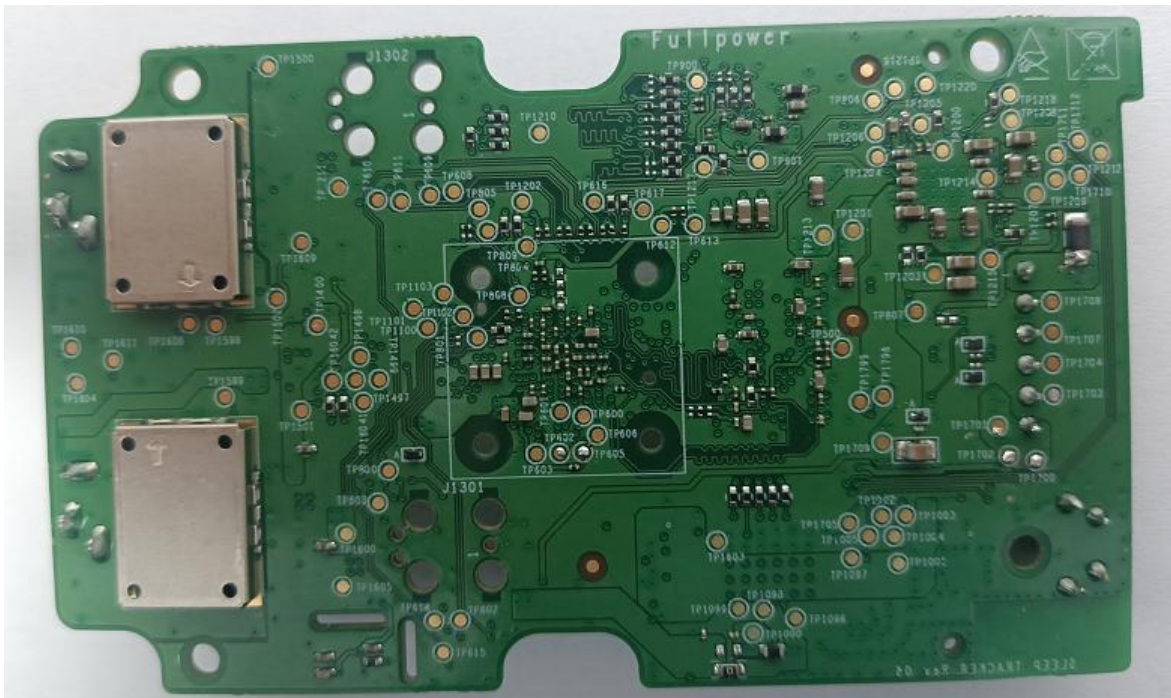
# PRODUCT PHOTO AND CERTIFICATION

## Product Photo

Top view:



Bottom view:



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## User Documentation Suggestion (Regulatory Statement of Compliance)

The following statements of compliance are suggested for end user documentation.

### FCC, ISED Statement of Compliance

§ 15.19 Labeling requirements.

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.

§ 15.21 Information to user.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

§ 15.105 Information to the user.

Note: 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

The modular can be installed or integrated in mobile devices. This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

If the FCC/ISED identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:

Contains FCC ID: 2AF2O-STS60

Contains IC: 20700-STS60

For 5150-5250 frequency band, add below statement for indoor use warning statement on manual, Operations in the 5.15-5.25GHz band are restricted to indoor usage only.

This equipment complies with radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

RSS-Gen Issue 3 December 2010" & "CNR-Gen 3e édition Décembre 2010:

- English:

This device complies with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

- French:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### Summary of requirements

KDB Ref Sect	Requirements of KDB 996369 D03	User Manual Page Number reference
2.2	List of applicable FCC rules	Part 15.247, Part 15.407
2.3	Summarize the specific operational use conditions	Use for mobile and fixed device
2.4	Limited module procedures	N/A
2.5	Trace antenna designs	The PCB antenna cannot Remove, please see the EUT photo
2.6	RF exposure considerations	20cm distance
2.7	Antennas	PCB antenna
2.8	Label and compliance information	The Label with FCC ID and model number
2.9	Information on test modes and additional testing requirements	Stand-alone
2.10	Additional testing, Part 15 Subpart B disclaimer	This module is only FCC authorized for the specific rule part 15.407 listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host product as being Part 15 Subpart B compliant.

### RoHS Information

This product, as well as its components, are in conformity with the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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## REVISION HISTORY

Version	Date	By	Notes
V1	Apr 15, 2022	Mark Christensen	Initial Release
V2	Jul 7, 2022	Mark Christensen	Update label format