HST -300 Module for Bluetooth 5 LE

The **HST-300** is a line of powerful, highly flexible, ultra-low power *Bluetooth* Smart modules based on the nRF52832 SoC from Nordic Semiconductor. With an ARM® Cortex™ M4F CPU, embedded 2.4GHz transceiver, and integrated antenna, they provide a complete RF solution with no additional RF design, allowing faster time to market. Providing full use of the nRF52832's capabilities and peripherals, the **HST-300** can power the most demanding applications, all while simplifying designs and reducing BOM costs. With an internal DC-DC converter and intelligent power control, the **HST-300** provide class-leading power efficiency, enabling ultra-low power sensitive applications. Regulatory pre-approvals reduce the burden to enter the market.

NOTE: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.

RF warning statement:

The device has been evaluated to meet general RF exposure requirement.The Device can be used in portable exposure condition without restricition.

The device has been evaluated to meet general RF exposure requirement.To maintain compliance with RSS-102---Radio Frequency (RF) Exposure guidelines, this equipment Should be installed and operated with a minimum distance of 20cm between the radiator and your body.

1. Features

- Based on the Nordic nRF52832 SoC
- Bluetooth 5 2M LE + Advertisement Extensions
- Complete RF solution with integrated antenna (**HST-300**) or U.FL connector Integrated DC-DC converter
- No external components required
- ARM® Cortex™-M4F 32-bit processor
- Serial Wire Debug (SWD)
- Nordic SoftDevice ready
- Over-the-Air (OTA) firmware updates
- 512kB embedded flash memory
- 64kB RAM
- 32 General Purpose I/O Pins
- 12-bit/200KSPS ADC
- -40C to +85C Temperature Range

2. Applications

- App-cessories
- Beacons – iBeacon™, AltBeacon, Eddystone, etc.
- Low-Power Sensors

- Three SPI Master/Slave (8 Mbps)
- Low power comparator
- Temperature sensor
- Random Number Generator
- Two 2-wire Master/Slave (I2C compatible)
- I2S audio interface
- UART (w/ CTS/RTS and DMA)
- 20 channel CPU independent Programmable Peripheral Interconnect (PPI)
- Quadrature Demodulator (QDEC)
- 128-bit AES HW encryption
- 5 x 32bit, 3 x 24bit Real Timer Counters (RTC)
- NFC-A tag interface for OOB pairing
- **HST-300** Dimensions: 14.5 x 10.5 x 1.9mm

- Lighting Products
- Fitness devices
- Wearables

3. Ordering Information

Part Number	Description
HST-300	**HST-300** module, Rev A, Tape & Reel, 1000 piece multiples
HST-300	**HST-300** Evaluation Kit with Segger J-Link programmer w/antennas

Table 1 – Ordering Part Numbers

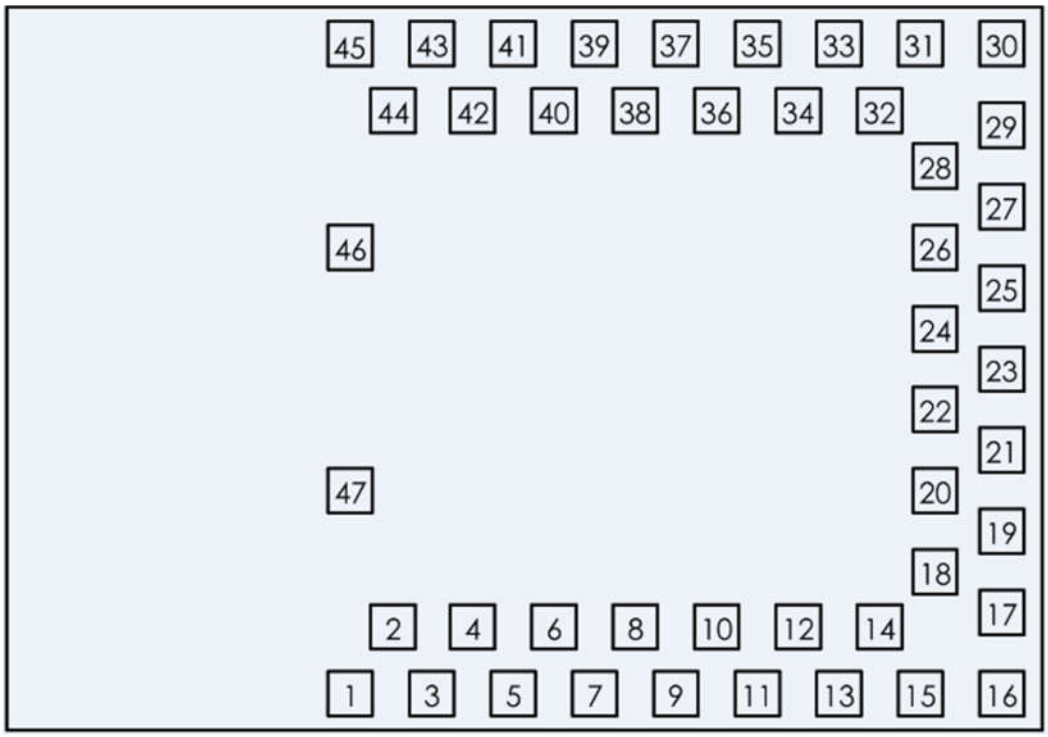
4. Quick Specifications

Bluetooth		
Version	5.0 Concurrent Central & Peripheral (S132), 2M LE + Advertisement Extensions	
Security	AES-128	
LE connections	Concurrent central, observer, peripheral, and broadcaster roles with up to twenty concurrent connections along with one Observer and one Broadcaster (S132)	
Radio		
Frequency	2.360GHz to 2.500GHz	
Modulations	GFSK at 1 Mbps, 2 Mbps data rates	
Transmit power	+4 dBm	
Receiver sensitivity	**HST-300**: -96 dBm (BLE mode) BMD-350: -94 dBm (BLE mode)	
Antenna	**HST-300**: Integrated	
Current Consumption		
TX only @ +4 dBm, 0 dBm @ 3V, DCDC enabled	7.5 mA, 5.3 mA	
TX only @ +4 dBm, 0 dBm	16.6 mA, 11.6 mA	
RX only @ 1 Mbps @ 3V, DCDC enabled	5.4 mA	
RX only @ 1 Mbps	11.7 mA	
CPU @ 64MHz from flash, from RAM	7.4 mA, 6.7 mA	
CPU @ 64MHz from flash, from RAM @ 3V, DCDC	3.7 mA, 3.3 mA	
System Off, On	0.3 µA, 1.2 µA	
Additional current for RAM retention	30 nA / 4KB block	
Dimensions		
HST-300	Length Width Height	14.5 mm ± 0.3mm 10.5 mm ± 0.3mm 1.9 mm ± 0.1mm
Hardware		
Interfaces	SPI Master/Slave x 3 UART Two-Wire Master/Slave (I2C) x 2 GPIO x 32	I2S PWM PDM
Power supply	1.7V to 3.6V	
Temperature Range	-40C to +85°C	
Certifications		

Table 2 – Quick Specifications

5. Pin Descriptions

5.1 HST-300



Pin description

Pin	Name	Direction	Description
6	P0.25	In/Out	GPIO[2]
7	P0.26	In/Out	GPIO[2]
8	P0.27	In/Out	GPIO[2]
9	P0.28	In/Out	GPIO/AIN4[2]
10	P0.29	In/Out	GPIO/AIN5[2]
11	P0.30	In/Out	GPIO/AIN6[2]
12	P0.31	In/Out	GPIO/AIN7[2]
13	P0.00	In/Out	GPIO/XTAL1 (32.768kHz)
14	P0.01	In/Out	GPIO/XTAL2 (32.768kHz)
15	P0.02	In/Out	GPIO/AIN0
19	P0.03	In/Out	GPIO/AIN1
20	P0.04	In/Out	GPIO/AIN2
21	P0.05	In/Out	GPIO/AIN3
22	P0.06	In/Out	GPIO
23	P0.07	In/Out	GPIO
24	P0.08	In/Out	GPIO

25	P0.09	In/Out	GPIO/NFC1
26	P0.10	In/Out	GPIO/NFC2
27	P0.11	In/Out	GPIO
28	P0.12	In/Out	GPIO
31	P0.13	In/Out	GPIO
32	P0.14	In/Out	GPIO/TRACEDATA[3]
33	P0.15	In/Out	GPIO/TRACEDATA[2]
Pin	**Name**	**Direction**	**Description**
34	P0.16	In/Out	GPIO/TRACEDATA[1]
35	P0.17	In/Out	GPIO
36	P0.18	In/Out	GPIO/TRACEDATA[0]/SWO
37	P0.19	In/Out	GPIO
38	P0.20	In/Out	GPIO/TRACECLK
39	P0.21	In/Out	GPIO/$\overline{\text{RESET}}$
40	P0.22	In/Out	GPIO[2]
41	P0.23	In/Out	GPIO[2]
42	P0.24	In/Out	GPIO[2]
43	SWCLK	In	SWD Clock
44	SWDIO	In/Out	SWD IO
17	VCC	Power	+1.7V to +3.6V[1]
1, 2, 3, 4, 5, 16, 18, 29, 30, 45, 46, 47	GND	Power	Electrical Ground

Note 1: An internal 4.7µF bulk capacitor is included on the module. However, it is good design practice to add additional bulk capacitance as required for your application, i.e. those with heavy GPIO usage and/or current draw.

Note 2: These pins are in close proximity to the nRF52 radio power supply and antenna pins. Radio performance parameters, such as sensitivity, may be affected by high frequency digital I/O with large sink/source current on these pins. Nordic recommends using only low frequency, low-drive functions when possible.

Table 3 – HST-300 Pin Descriptions

6. Electrical Specifications

6.1 Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
V_{CC_MAX}	Voltage on supply pin	-0.3	3.9	V
V_{IO_MAX}	Voltage on GPIO pins (V_{CC} > 3.6V)	-0.3	3.9	V
V_{IO_MAX}	Voltage on GPIO pins (V_{CC} ≤ 3.6V)	-0.3	V_{CC} + 0.3V	V

T_S	Storage Temperature Range	-40	125	°C

Table 7 – Absolute Maximum Ratings

6.2 Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Operating supply voltage	1.7	3.0	3.6	V
T_{R_VCC}	Supply rise time (0V to 1.7V)	-	-	60	ms
T_A	Operating Ambient Temperature Range	-40	25	85	°C

Table 8 – Operating Conditions

6.3 General Purpose I/O

The general purpose I/O is organized as one port enabling access and control of the 32 available GPIO pins through one port. Each GPIO can be accessed individually with the following user configurable features:

- Input/output direction
- Output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on all pins
- All pins can be used by the PPI task/event system; the maximum number of pins that can be interfaced through the PPI at the same time is limited by the number of GPIOTE channels
- All pins can be individually configured to carry serial interface or quadrature demodulator signals Page

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IH}	Input High Voltage	0.7 x V_{CC}	-	V_{CC}	V
V_{IL}	Input Low Voltage	V_{SS}	-	0.3 x V_{CC}	V
V_{OH}	Output High Voltage	V_{CC} – 0.4	-	V_{CC}	V
V_{OL}	Output Low Voltage	V_{SS}	-	V_{SS} + 0.4	V
R_{PU}	Pull-up Resistance	11	13	16	kΩ
R_{PD}	Pull-down Resistance	11	13	16	kΩ

Table 9 – GPIO

6.4 Module RESET

GPIO pin P0.21 may be used for a hardware reset. In order to utilize P0.21 as a hardware reset, the UICR registers PSELRESET[0] and PSELRESET[1] must be set alike, to the value of 0x7FFFFF15. When P0.21 is programmed as $\overline{\text{RESET}}$, the internal pull-up is automatically enabled. Rigado and Nordic example applications and development kits program P0.21 as $\overline{\text{RESET}}$.

6.5 Debug & Programming

The HST-300 supports the two pin Serial Wire Debug (SWD) interface and offers flexible and powerful mechanism for non-intrusive debugging of program code. Breakpoints, single stepping, and instruction trace capture of code execution flow are part of this support.

6.6 Clocks

The HST-300 Series requires two clocks, a high frequency clock and a low frequency clock.

The high frequency clock is provided on-module by a high-accuracy 32-MHz crystal as required by the nRF52832 for radio operation.

The low frequency clock can be provided internally by an RC oscillator or synthesized from the fast clock; or externally by a 32.768 kHz crystal. An external crystal provides the lowest power consumption and greatest accuracy. Using the internal RC oscillator with calibration provides acceptable performance for BLE applications at a reduced cost and slight increase in power consumption. Note: the ANT protocol requires the use of an external crystal.

32.768 kHz Crystal (LFXO)

Symbol	Parameter	Typ.	Max.	Unit
F_{NOM_LFXO}	Crystal frequency	32.768	-	kHz
$F_{TOL_LFXO_BLE}$	Frequency tolerance, BLE applications	-	±250	ppm
C_{L_LFXO}	Load Capacitance	-	12.5	pF
C_{0_LFXO}	Shunt Capacitance	-	2	pF
R_{S_LFXO}	Equivalent series resistance	-	100	kΩ
				Page
C_{pin}	Input Capacitance on XL1 & XL2 pads	4	-	pF

Table 10 – 32.768 kHz Crystal

32.768 kHz Oscillator Comparison

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{LFXO}	Current for 32.768kHz Crystal Oscillator	-	0.25	-	µA
I_{LFRC}	Current for 32.768kHz RC Oscillator	-	0.6	1	µA
I_{LFSYNT}	Current for 32.768kHz Synthesized Oscillator	-	100	-	µA
$f_{TOL_LFXO_BLE}$	Frequency Tolerance, 32.768kHz Crystal Oscillator (BLE Stack)[1]	-	-	±250	ppm
$f_{TOL_LFXO_ANT}$	Frequency Tolerance, 32.768kHz Crystal Oscillator (ANT Stack)[1]	-	-	±50	ppm
f_{TOL_LFRC}	Frequency Tolerance, 32.768kHz RC Oscillator	-	-	±2	%
$f_{TOL_CAL_LFRC}$	Frequency tolerance, 32.768kHz RC after calibration	-	-	±250	ppm
f_{TOL_LFSYNT}	Frequency Tolerance, 32.768kHz Synthesized Oscillator	-	-	±48	ppm
Note 1: $f_{TOL_LFXO_BLE}$ and $f_{TOL_LFXO_ANT}$ are the max allowed for BLE and ANT applications. Actual tolerance depends on the crystal used.					

Table 11 – 32.768 k

The module meet the requirement of FCC Part 15.247

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

Remind end customers to FCC ID label on the final system must be labeled with “Contains FCC ID: 2AW5Y300” or “Contains transmitter module FCC ID: 2AW5Y300”.

Contact ShenZhen High Speed Technology Co.,Ltd will provide stand-alone modular transmitter test mode. Additional testing and certification may be necessary when multiple modules are used in a host.

To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Supplier’s Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements. Since this may depend on the details of how the module is integrated with the host, ShenZhen High Speed Technology Co.,Ltd shall provide guidance to the host manufacturer for compliance with the Part 15B requirements.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance.This module certified that complies with RF exposure requirement under mobile or fixed condition, this module is to be installed only in mobile or fixed applications. A separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and difference antenna configurations.This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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.
NOTE 1: This product 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 product 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 product 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.
NOTE 2: Any changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
NOTE 3: Any modifications made to the module will void the Grant of Certification, this module is limited to OEM installation only and must not be sold to end-users, end-user has no manual instructions to remove or install the device, only software or operating procedure shall be placed in the end-user operating manual of final products.
NOTE 4: The module may be operated only with the antenna with which it is authorized. Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator.