

BT5.0 Low Energy Single Mode Class 1 SoC Module

nBlue™ BR-LE5.0-S1A (nRF52840)

- **AT HOME. AT WORK. ON THE ROAD. USING BT5.0 LOW ENERGY WIRELESS TECHNOLOGY MEANS TOTAL FREEDOM FROM THE CONSTRAINTS AND CLUTTER OF WIRES IN YOUR LIFE.**
- FCC, IC, CE, RoHS, and BT5.0 Certified ISM 2.4GHz module supporting BT5.0 high speed mode, long range mode and advertising extensions. Can also support BT5.0 Mesh, 802.15.4 for Thread and Zigbee, ANT or proprietary 2.4Ghz.
- Utilizes the Nordic nRF52840 SoC. 64Mhz ARM® Cortex™ M4F 32-bit processor with FPU, 1MB Flash, 256K RAM, built in DC-DC converter and ARM CryptoCell cryptographic accelerator.
- Programmable output power from -40dBm to +8dBm for short to long range applications.
- Over 1000 meter line of site distance with integrated antenna. External antenna can be connected to RF_OUT pad or through optional u.FL connector (requires moving RF path resistor).
- Can be externally controlled via simple ASCII AT commands over UART, USB and BT5.0, or programmed with custom applications embedded in the module.



FEATURES

- Peripherals: Full-speed USB 2.0 controller, UART (2 or 4 wire with CTS/RTS, 9600 to 921.6K baud), I2C, I2S, SPI (32MHz), QSPI (32MHz), PWM, PDM, AES, 8 channel 12-Bit ADC, comparator, quadrature decoder, temperature sensor, real time counter, watchdog timer, 46 PIOs. Integrated 32kHz crystal.
- Type 2 Near Field Communication (NFC-A) Tag support. (External antenna required.)
- Very low power consumption: *14.8mA at +8dBm TX, 4.6mA RX, 3.4uA sleep, and 0.4uA shutdown.*
- Secure and robust communication link:
 - ✓ FHSS (Frequency Hopping Spread Spectrum)
 - ✓ 24-bit CRC Error correction for guaranteed packet delivery
 - ✓ AES-128 bit encryption using CCM for encryption and authentication of packets.
 - ✓ LE Secure Connections Pairing using the Elliptic-Curve Diffie-Hellman (ECDH) algorithm.

SOFTWARE

- Integrated AT.s command stack for external control via UART or RF, with BT5.0 support, BRSP serial profile, battery (BAS) profile and device information (DIS) profile. BRSP allows the user to stream data over LE similar to the way SPP works on Classic BT devices – now with throughput up to 50kBps.
- Bootloader allows updates to be done Over-the-Air (with no external flash required), over the UART or over USB. Clients should make hardware accommodations for upgrading firmware on custom designs since modules shipped from the factory in tape and reel cannot be guaranteed to contain the latest AT.s firmware. **Be sure to update the AT.s firmware regularly to ensure compliance.** Firmware updates can be found by going to <http://www.blueradios.com/forum/> in the *BR-LE5.0-S1 AT.s Firmware* section.
- Nordic Semiconductor nRF5 SDK available for custom embedded applications. Available embedded BT5.0 Profiles include: ANS, Apple ANCS, BAS, BPS, CSCS, CTS, Nordic DFU, DIS, Eddystone ESCS, GLS, HIDS, HRS, HTS, IAS, IPSP, LBS, LLS, Nordic NUS, RSCS, TPS.

- Also available from Nordic Semiconductor: nRF5 SDK for Mesh for BT5.0 Mesh development and nRF5 SDK for Thread and Zigbee 802.15.4 development.
- BRSP Service Library for nRF5 SDK (Coming Soon) to add BRSP service support to custom embedded applications.
- Apple iOS and Android libraries, as well as a data terminal example application (nBlueTerm - with source code) provided free of charge. nBlueTerm supports connect, disconnect, pairing and sending data over BRSP.

SPECIFICATIONS SUMMARY

Operating Conditions Summary

Item	Specifications
Supply voltage (VDD)	1.7-3.6 V
VDD Supply rise time (0V to 1.7V)	60ms
Supply voltage (VDDH – Optional)	2.5-5.5 V
VDDH Supply rise time (0V to 3V)	1ms
Supply voltage (VBUS - Optional)	4.35-5.5 V
Supply ripple	100 mV Max
Max I/O pin voltage	VDD + .3V, 3.9V Max (Not 5V Tolerant)
Ambient Temperature Range	-40 – 85 °C

Sleep Mode Consumption Summary

TA = 25°C, VDD = 3 V, LDO regulator (Data from nRF52840 Product Specification v1.0)

Item	Specifications
Shutdown Mode (No RAM retention, Wake on Reset)	0.4 μ A
Sleep Mode (No RAM retention, Wake on any event)	0.97 μ A
Sleep Mode (Full RAM retention, Wake on any event)	2.35 μ A
Sleep Mode (No RAM retention, Wake on RTC)	1.5 μ A
Sleep Mode (No RAM retention, Wake on RTC)	3.16 μ A

CPU Current Consumption Summary

TA = 25°C, VDD = 3 V, DCDC regulator enabled (Data from nRF52840 Product Specification v1.0)

Item	Specifications
CPU executing CoreMark (Running from RAM)	2.8 mA
CPU executing CoreMark (Running from Flash)	3.3 mA

Radio Current Consumption Summary

TA = 25°C, VDD = 3.3 V, DCDC regulator enabled (Data from nRF52840 Product Specification v1.0)

Item	Specifications
Radio RX Current (1Mbps BLE Mode)	4.6 mA
Radio RX Current (2Mbps BLE Mode)	5.2 mA
Radio TX Current	
8 dBm	14.8 mA
4 dBm	9.6 mA
0 dBm	4.8 mA
-4 dBm	3.3 mA
-8 dBm	3.1 mA
-12 dBm	3.0 mA
-16 dBm	2.8 mA
-20 dBm	2.7 mA
-40 dBm	2.3 mA

AT.s Current Consumption Summary

TA = 25°C, VDD = 3.3 V, DCDC regulator enabled (Data measured on BR-LE5.0-S1A module running AT.s 5.0.2.0-S1)

Item	Specifications
Shutdown Mode	~0.4 μ A
Sleep Mode	~3.4 μ A
Sleep Mode, Default Advertising at 100ms Interval, 0dB	~140 μ A
Sleep Mode, Default Advertising at 100ms Interval, 8dB	~240 μ A
Idle	~625 μ A
Default Advertising at 100ms Interval, 0dB	~750 μ A
Default Advertising at 100ms Interval, 8dB	~850 μ A

RF Specifications Summary

Item	Specifications
Frequency	2402 – 2480 MHz in 2 MHz steps
Data Rate	2Mbps, 1Mbps, 500kbps, 125kbps
Number of Channels	40: 37 data / 3 advertising (0,12,39)
Receive Sensitivity	-103 (125kbps BLE Mode), -95dBm (1Mbps BLE Mode), -92 (2Mbps BLE Mode)
Output Power	-40 to +8 dBm
Link Budget	Up to 111dB

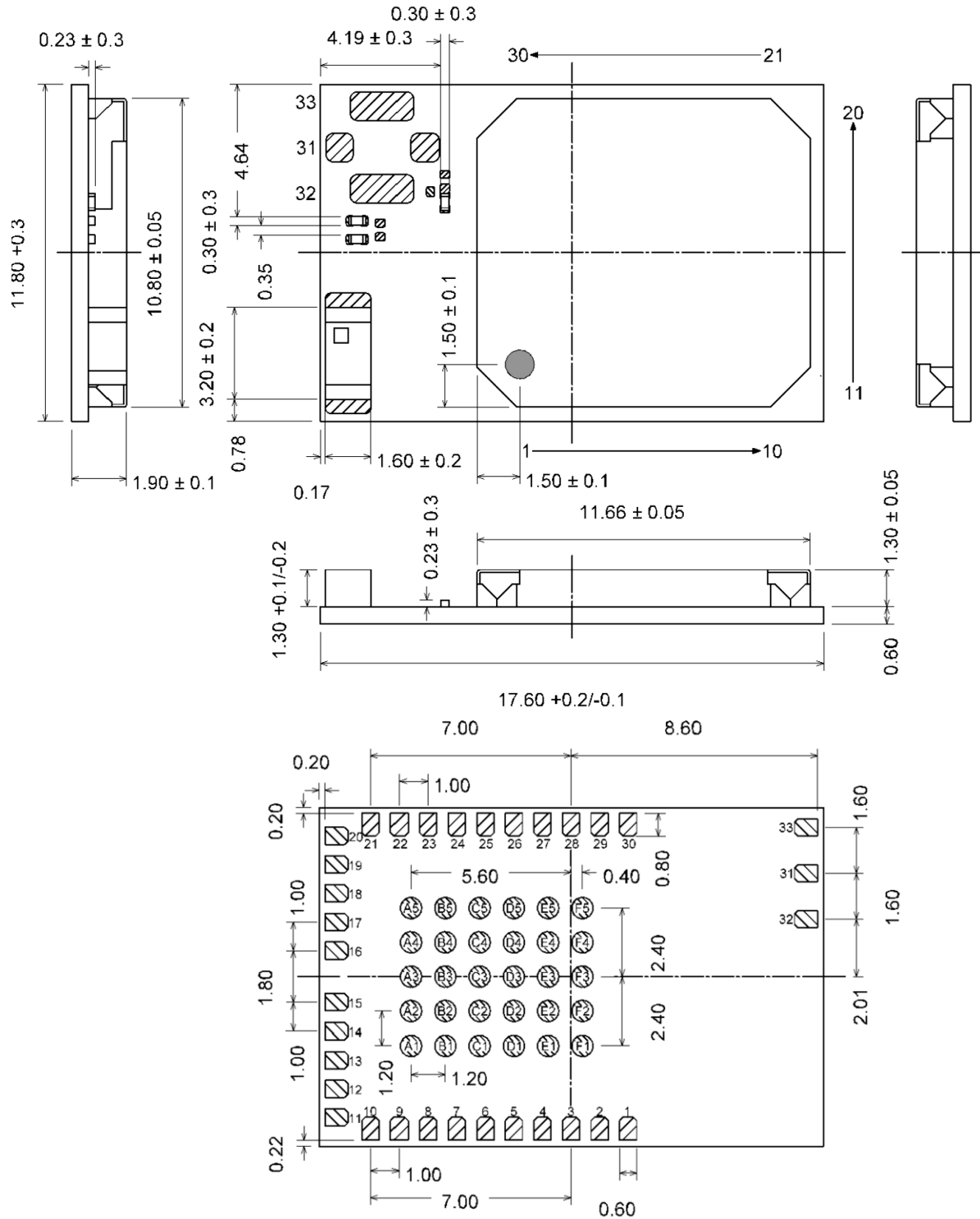
For complete specifications of the nRF52840 see the nRF52840 Product Specification:

https://www.nordicsemi.com/DocLib/Content/Product_Spec/nRF52840/latest/keyfeatures_html5

DIMENSIONS

11.8 x 17.6 x 1.9 mm

Units: mm

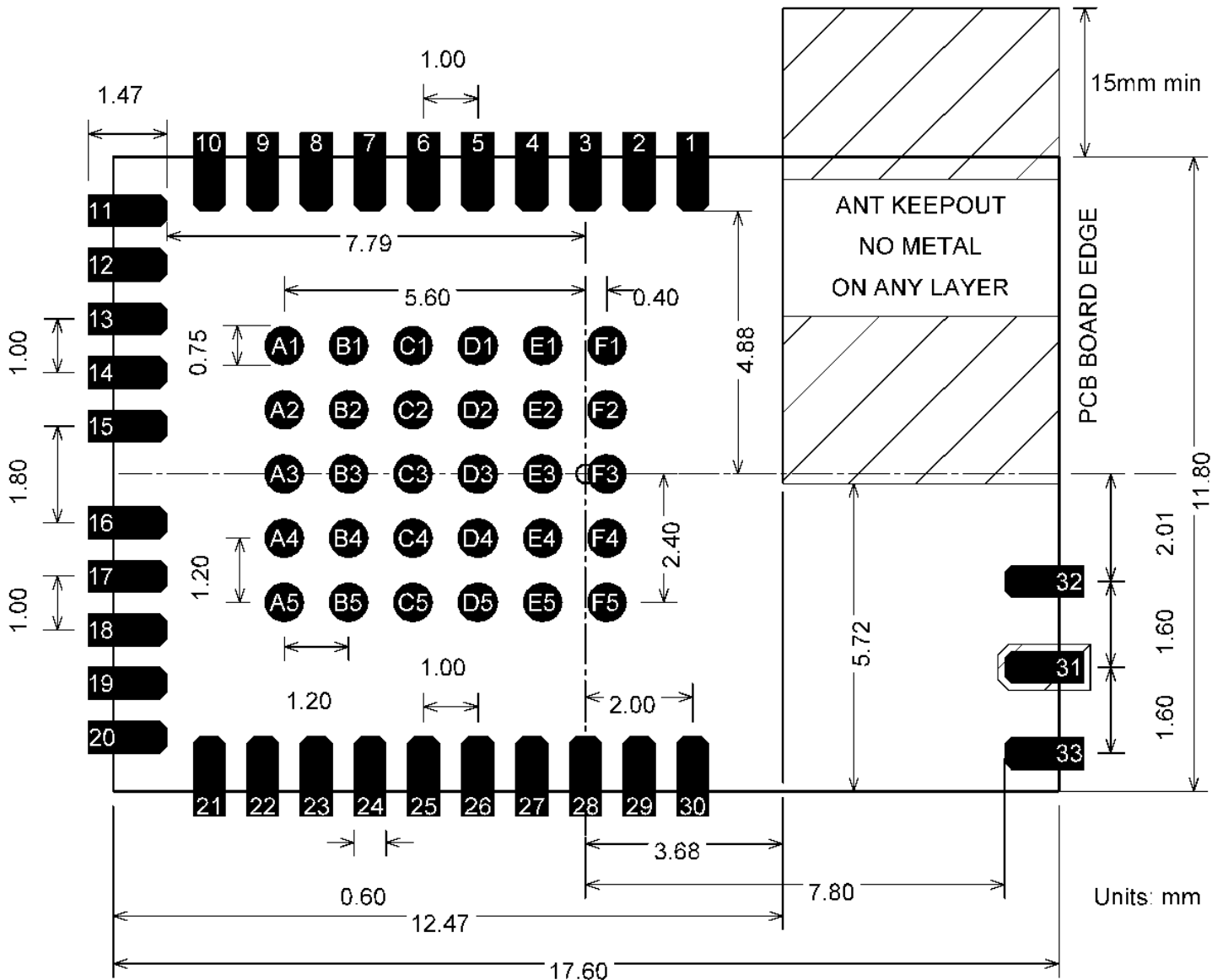


(Bottom view rotated 180° from top view)

STANDARD LAND DIMENSIONS

11.8 x 17.6 mm

Units: mm



RF Ground Plane: The module requires an RF ground plane on the rest of the Printed Circuit Board (PCB) area. This can be located on any layer of the PCB. For best performance, extend the RF ground plane the entire length of the board. Connect all ground pins and do not notch the ground plane around the module. The bottom of the module is grounded so be careful of vias or conductive traces located under the modules that are not soldered masked to prevent shorting. Keep metallic components, connectors, copper traces, internal layers, and ground planes away from the antenna area in 3D space!

PINOUT

Pin	PIO#	Pin Name	Pin	PIO#	Pin Name
1	-	GND	A1	-	GND
2	26	PIO_26	A2	27	PIO_27
3	31	~RESET	A3	25	PIO_25
4	1	PIO_1 (ADC_1)	A4	-	GND
5	10	PIO_10 (ADC_2)	A5	-	* VBUS * (See VBUS Note On Following Page)
6	11	PIO_11 (ADC_4)	B1	29	PIO_29 (ADC_7)
7	12	PIO_12 (ADC_5)	B2	30	PIO_30
8	13	PIO_13 (ADC_3)	B3	31	PIO_31
9	-	** VDD (1.7-3.6V) ** (See IMPORTANT Note Below)	B4	32	PIO_32
10	-	GND	B5	-	USB_DM
11	15	UART_CTS	C1	34	PIO_34
12	16	UART_RTS	C2	35	PIO_35
13	17	UART_TX	C3	36	PIO_36
14	18	UART_RX	C4	-	** VDDH (2.5-5.5V) ** (See IMPORTANT Note Below)
15	19	PIO_19	C5	-	USB_DP
16	20	PIO_20	D1	39	PIO_39
17	21	PIO_21	D2	40	PIO_40
18	22	PIO_22	D3	41	PIO_41
19	14	PIO_14	D4	28	PIO_28
20	-	GND	D5	33	PIO_33
21	0	PIO_0 (ADC_0)	E1	44	PIO_44
22	9	PIO_9 (ADC_6)	E2	45	NFC_2
23	2	PIO_2	E3	46	NFC_1
24	5	PIO_5	E4	37	PIO_37
25	6	PIO_6	E5	38	PIO_38
26	3	PIO_3	F1	42	PIO_42
27	8	PIO_8	F2	43	PIO_43
28	4	PIO_4	F3	23	SWD_CLK (Debug Clock)
29	7	PIO_7	F4	24	SWD_IO (Debug Data)
30	-	GND	F5	-	GND
31	-	RF_OUT			
32	-	RF_GND			
33	-	RF_GND			

POWER MODES

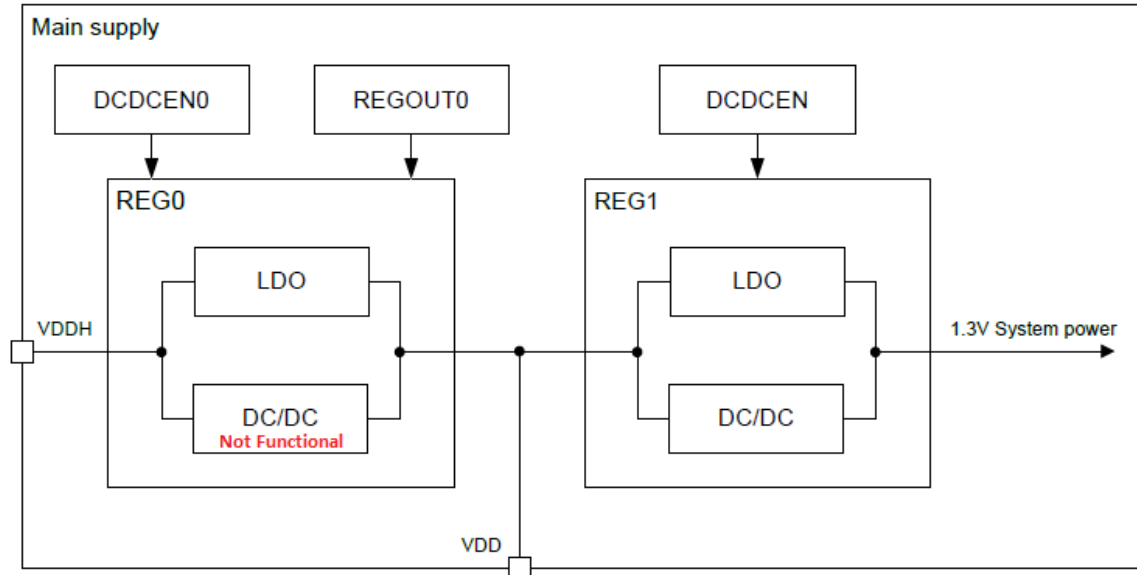
**** IMPORTANT ****: The module can be powered in normal voltage mode (1.7-3.6V) or high voltage mode (2.5-5.5V). In normal voltage mode, 1.7-3.6V must be connected to both VDD and VDDH. In high voltage mode, 2.5-5.5V is connected only to VDDH and in this case VDD will be the output of the internal VDDH regulator (AT.s firmware sets the VDDH output to 3.3V, but the 52840 defaults to 1.8V). In either power mode the voltage on the VDD pin will be the IO voltage, so the IO voltage can never be higher than 3.6V and is never 5V tolerant even when using VDDH. See the Internal Regulator Diagram on the next page for a visual on how the regulators connect.

**** IMPORTANT ****: Due to an issue with Rev 1 of the nRF52840, high voltage mode can only be used under the following conditions: the VDDH internal DCDC converter cannot not enabled (default LDO mode only), no current is drawn from the VDD pin during power up and the VDDH rise time to 3V is < 1ms. This will be fixed in the next nRF52840 revision. See Errata 197 and 202 of the nRF52840 Rev 1 Errata for more info:

http://infocenter.nordicsemi.com/pdf/nRF52840_Rev_1_Errata_v1.1.pdf

*** VBUS *:** To use the BR-LE5.0-S1A as a USB peripheral, 5V must be supplied on the VBUS pin. The VBUS supply is internally regulated to 3.3V, but is only used for the USB signaling interface and USB detection. The rest of the USB peripheral is powered through the main power supply, so power must still be supplied through VDDH or VDD depending on what power mode is being used. When supplying power from a USB source only, VBUS must be connected to VDDH if USB is to be used.

INTERNAL REGULATOR DIAGRAM



Note: The inductors required to use the nRF52840's DC/DC converters are populated inside the module - no external inductors are required. With the AT.s firmware, the REG1 DC/DC is automatically enabled.

BACKWARDS COMPATIBILITY

The BR-LE5.0-S1A footprint is backwards compatible to the BR-LE4.0-S2A footprint with the following exceptions:

- **Power must be connected to the new VDDH pin C4. This is a required change that must be done.** If a single layer board is being used a 7 mil trace can be run in between the other circular pads on the bottom of the module to connect VDD to VDDH when using normal voltage mode.
- The USB pins have been relocated from pins 15-18 to pins A4, A5, B5 and C5. Pins 15-18 are now PIOs.
- The programming/debugging pins have been relocated from pins 28 and 29 to pins F3 and F4.

DEBUGGING

Debugging is done through a two-pin serial wire debug (SWD) interface. A debugger is only needed for programming/debugging a custom application and is not necessary for using the AT.s command set. If a debugger is needed a Segger J-Link can be used, or for a more cost effective option a Nordic PCA10056 nRF52840 development board can be used. The PCA10056 has a J-Link built in and can connect to an external board using its P19 Debug out header.

J-Link: https://shop-us.segger.com/DebugProbe_s/40.htm

PCA10056: <https://www.nordicsemi.com/Software-and-Tools/Development-Kits/nRF52840-DK>

ORDERING INFORMATION

Pricing and ordering information can be found at:

http://www.blueradios.com/orderinfo_new.htm

PART NUMBER

BR-LE5.0-S1A

BT5.0 Low Energy Single Mode with Antenna

STANDARD PACKAGING

Tape and Reel (T&R) 500 piece 340mm x 25mm reel sizes

DEVELOPMENT KIT (BR-EVAL-LE5.0-S1A)

Development kit available containing everything required to set up a connection quickly and evaluate range and performance of the BR-LE5.0-S1A: http://www.blueradios.com/hardware_EVAL-LE5.0-S1A.htm

CUSTOM FIRMWARE

The AT.s command interface can be modified for high volume customers and custom embedded software development is available upon request

ADDITIONAL DOCUMENTATION

Complete Documentation can be found at: <http://www.blueradios.com/forum>.