aconno™

D A T A S H E E T

ACN52840

Fully integrated, ultra-low power, Bluetooth 5 module

2 cm

MA:DE IN GERMANY

aconno

Datasheet
aconno ACN52840 V1.2

The ACN52840 is a fully integrated, ultra-low power, Bluetooth 5 low energy module in a small form factor which features the advanced Nordic Semiconductor nRF52840 SoC.

Its capabilities are tailored for the upcoming demands of sophisticated IoT devices where small size, low power, application performance and radio-range are essential. Unlike many competitors it features a maker-friendly PCB scale package which allows a fast and easy integration without sacrificing access to its advanced peripherals and capabilities.

The ACN52840 features a large number of GPIOs including NFC and USB connectivity. Thanks to an on-board antenna and Bluetooth 5 its RF performance is excellent, allowing up to 1000m range on open field. To provide quick access to the programming interface of the SoC, the module also features a Tag-Connect connector.

Table of Contents

1. Overview and Features

- Based on Nordic Semiconductor's nRF52840 Bluetooth Smart SoC
- 32-bit ARM® Cortex™ M4 high performance 64 MHz processor core with FPU and 1024kB Flash / 256 kB RAM
- ARM® TrustZone® Cryptocell 310 security subsystem
- On-board precision Epson 32 MHz and 32.768 kHz crystal clock sources
- Tag-Connect SWD easy-to-use programming interface
- Up to 28 GPIOs with flexible module pin mapping
- Programmable peripherals for CPU-less operation
- SPI / UART / TWI (I^2C)
- USB 2.0 full speed (12 Mbps) controller
- 200 ksps 14-bit successive approximation ADC with oversampling
- Low power comparator
- I²S and PDM peripherals for Audio
- Quadrature decoder
- RGB LED
- Fully tuned RF on-board antenna for excellent performance and range
- -20 dBm to +8 dBm output power
- Ultra-low power consumption
- Dimensions: 20.2 x 25 x 3 mm
- Temperature Range: -40°C to +85°C
- Wide supply voltage range: 1.7V to 3.6V
- 3V Lithium battery supported
- NFC-A tag for OOB Bluetooth Smart pairing and wakeup on field
- Multiprotocol 2.4 GHz radio

2. Applications

- IoT connected devices
- Bluetooth Smart Sensors
- Home Automation and Control
- Lighting
- Beacons
- Battery driven applications such as wearables

3. Block Diagram

The heart of the ACN52840 module is Nordic's highly integrated nRF52840 Bluetooth 5 SoC which contains a 2.4 GHz transceiver, a 32-bit ARM® Cortex™-M4 CPU with FPU, a 1024 kB flash memory, 256 kB RAM as well as analog and digital peripherals.

It can support BLE, ANT/ANT+ as well as Thread and its meshing capabilities and a range of proprietary 2.4 GHz protocols through so called SoftDevices from Nordic Semiconductor, which can be downloaded freely from Nordic's website.
Ultra-low power consumption and advanced power management enables a battery lifetime up to several years on a coin cell battery. The 20.3 x 25 x 3 mm sized module integrates power supply decoupling capacitors, 32 MHz and 32.768 kHz crystals, load capacitors, a DC-DC converter, a RF matching circuit and an antenna in addition to the wireless SoC.
The module also features a small RGB LED for optical feedback.
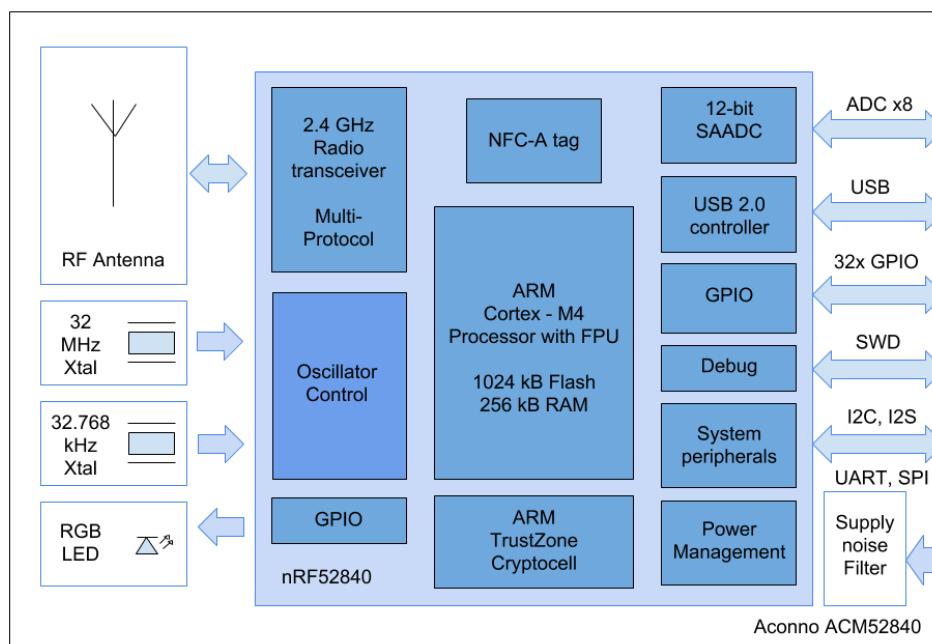
Solely the addition of a suitable DC power source is necessary for BLE and/or ANT connectivity. As a result of its Tag-Connect capabilities, the ease of application is further increased. Sensor applications require additional appropriate sensors.
NFC functionality requires an externally connected antenna.

4. Pin Description

The module uses a user-friendly PCB with surrounding solder pads (1.4 mm pitch) in order to provide flexible, "through hole mounting" for rapid prototyping or, furthermore, a SMD mounting technique for a permanent implementation.
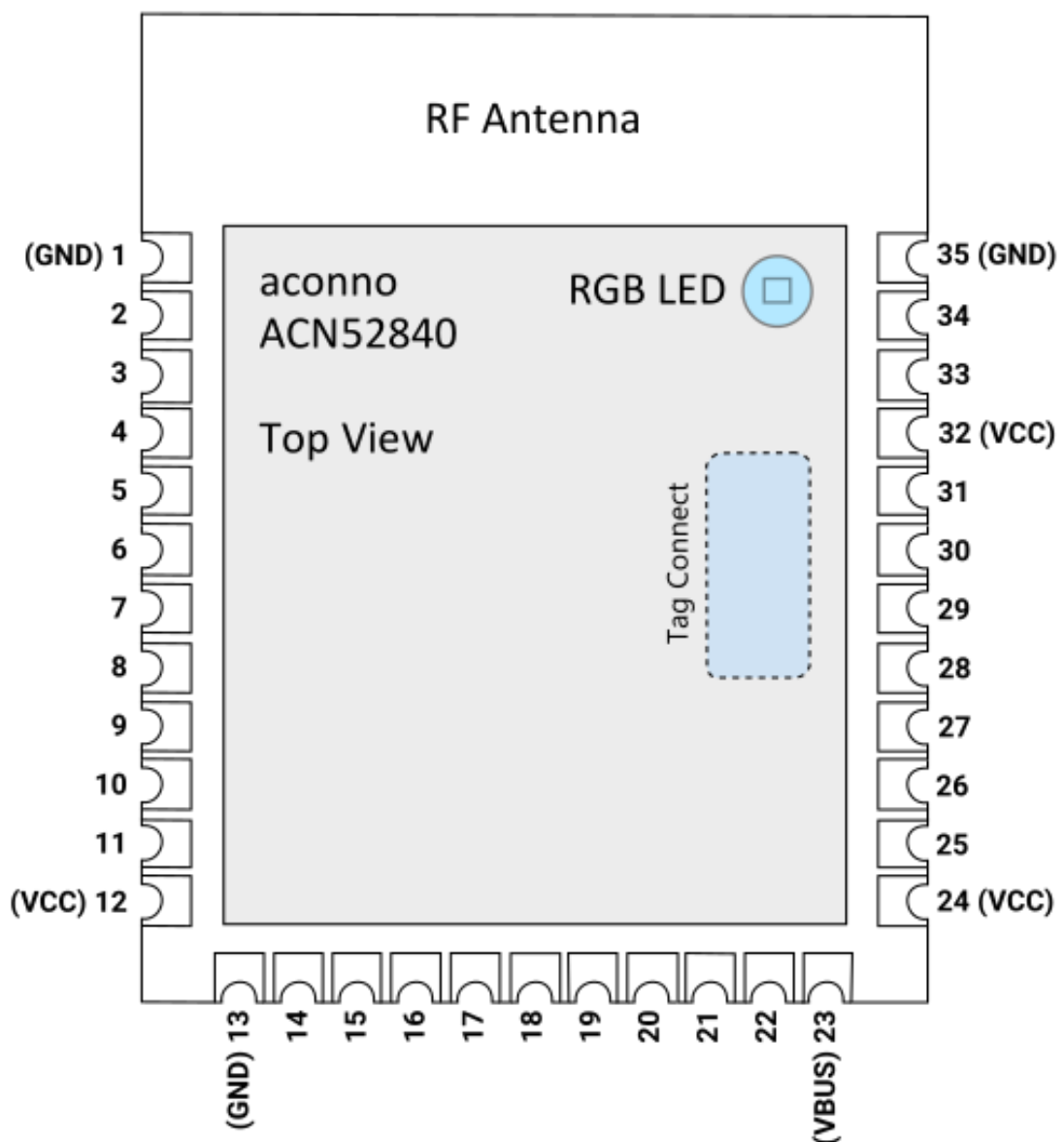
I/O Pins sorted by port name:

Pin	Name	Pin function	Description
1, 13, 35	GND	Ground	Should be connected to the ground potential of the application board
12, 24, 32	VDD	Power	Power supply (1.7 V – 3.6 V)
23	VBUS	Power	USB bus voltage (4.35 V – 5.5 V)
33	SWDIO	Digital I/O Debug	Serial Wire Debug I/O for debugging and programming
34	SWDCLK	Digital Input Debug	Serial wire debug clock input for debugging and programming
31	P0.18 / Reset / SWO	Digital I/O Debug	Reset, serial wire debug output for debugging and programming
5	P0.02 / AIN0	Digital I/0 Analog In	GPIO / Analog Input 0 / standard drive / low frequency
6	P0.03 / AIN1	Digital I/0 Analog In	GPIO / Analog Input 1 / standard drive / low frequency
14	P0.04 / AIN2	Digital I/0 Analog In	GPIO / Analog Input 2
11	P0.05 / AIN3	Digital I/0 Analog In	GPIO / Analog Input 3
17	P0.06	Digital I/O	GPIO
20	P0.08	Digital I/O	GPIO
19	P0.09 / NFC1	Digital I/O NFC	GPIO / Connection to NFC-coil / standard drive / low frequency
18	P0.10 / NFC2	Digital I/O NFC	GPIO / Connection to NFC-coil / standard drive / low frequency
22	P0.12	Digital I/O	GPIO
27	P0.13	Digital I/O	GPIO
28	P0.15	Digital I/O	GPIO
29	P0.17	Digital I/O	GPIO
Pin	Name	Pin function	Description

30	P0.24	Digital I/O	GPIO
15	P0.26	Digital I/O	GPIO
16	P0.27	Digital I/O	GPIO
7	P0.28 / AIN4	Digital I/O Analog In	GPIO / Analog Input 4 / standard drive / low frequency
8	P0.29 / AIN5	Digital I/O Analog In	GPIO / Analog Input 5 / standard drive / low frequency
10	P0.30 / AIN6	Digital I/O Analog In	GPIO / Analog Input 6 / standard drive / low frequency
9	P0.31 / AIN7	Digital I/O Analog In	GPIO / Analog Input 7 / standard drive / low frequency
21	P1.09	Digital I/O	GPIO
2	P1.10	Digital I/O	GPIO / standard drive / low frequency
3	P1.13	Digital I/0	GPIO / standard drive / low frequency
4	P1.15	Digital I/0	GPIO / standard drive / low frequency
25	USB D-	Digital I/0 USB	USB data negative (differential)
26	USB D+	Digital I/0 USB	USB data positive (differential)

5. Module Specifications

The specifications of the aconno ACN52840 module follow those of the nRF52840 SoC. The following high-level parameters are valid for the module.

5.1 Absolute Maximum Ratings

	Min	Typ	Max	Unit
Supply Voltages				
VDD	-0.3		+3.9	V
VBUS	-0.3		+5.8	V
VSS			0	V
I/O Pin Voltage				
$V_{I/O}$, VDD < 3.6V	-0.3		VDD + 0.3	V
$V_{I/O}$, VDD > 3.6V	-0.3		3.9	V
NFC antenna pin current				
$I_{NFC\ 1/2}$			80	mA
Radio				
RF input level			10	dBm
Environmental[1]				
Storage Temperature	-40		+125	°C
Moisture Sensitivity Level			2	
ESD Human Body Model			2	kV
ESD Charged Device Model			750	V

Flash memory[2]				
Endurance	10.000			cycles
Retention	10 years at 40°C			

1) Ratings are accurate for the nRF52840 aQFN™ 73, 7x7 mm package
2) At Endurance and Retention periods are estimated at sea level

5.2 Recommended Operating Conditions

	Min	Typ	Max	Unit
Supply Voltages				
VDD (VDD supply voltage, independent of DCDC enable)	1.7	3.0	3.6	V
VDD_{POR} (VDD supply voltage needed during power-on reset)	1.75			V
VBUS (VBUS USB supply voltage)	4.35	5	5.5	V
Supply rise time [1]				
t_{R_VDD} (0 V to 1.7 V)			60	ms
t_{R_VDDH} (0 V to 3.7 V)			100	ms
Operating Temperature				
T_A	-40	25	85	°C

1) The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

5.3 Current Consumption

The measurements below were taken under following common conditions:

VDD: 3V   **Temperature:** 25°C   **CPU:** WFI / WFE sleep[1]

Regulator: DC/DC   **Peripherals:** All idle   **Clock:** Not running

Cache enabled: Yes

	Min	Typ	Max	Unit
Radio				
8 dBm TX @ 1Mb/s Bluetooth Low Energy mode, Clock = HFXO		16.4		mA
0 dBm TX @ 1Mb/s Bluetooth Low Energy mode, Clock = HFXO		6.4		
-40 dBm TX @ 1Mb/s Bluetooth Low Energy mode, Clock = HFXO		3.83		mA
Radio RX @ 1Mb/s Bluetooth Low Energy mode, Clock = HFXO		6.26		mA
CPU running CoreMark				
CPU running CoreMark @64 MHz from Flash, Clock = HFXO, Regulator = DC/DC		3.3		mA
CPU running CoreMark @ 64 MHz form RAM, Clock = HFXO, Regulator = DC/DC		2.8		mA

1) Waiting for interrupt / Waiting for event sleep mode.

aconno

Ultra-low power				
System ON, No RAM retention, Wake on any event		0.97		µA
System ON, full 256 kB RAM retention, Wake on any event		2.35		µA
System OFF, No RAM retention, Wake on LPCOMP		0.86		µA
System OFF, no RAM retention, wake on reset, 5 V supply on VDDH, REG0 output = 3.3 V		0.95		µA
System OFF, Full 256 kB RAM retention, Wake on reset		1.86		µA
System OFF, No RAM retention, Wake on reset		0.40		µA

5.4 Clock Sources

	Min	Typ	Max	Unit
64 MHz crystal oscillator (HFXO): 32 MHz source crystal Frequency Tolerance			± 30	ppm
Low Frequency crystal oscillator (LFXO): 32.768 kHz source crystal Frequency Tolerance			± 20	ppm
Internal 64 MHz oscillator (HFINT): RC Oscillator		± 1.5	± 8	%
Low frequency RC oscillator (LFRC), Normal mode			± 5	%

5.5 Radio Specifications

	Min	Typ	Max	Unit
Frequency Range	2360		2500	MHz
PLL channel spacing		1		MHz
Output Power	-20		+8	dBm
Receiver sensitivity, 2 Mbps BLE ideal transmitter, packet length <= 37 bytes			-92.0 dBm	
Receiver sensitivity, 125 kbps BLE mode			-103.0 dBm	
Data Rate	125		2000	kbps
RSSI Range with valid accuracy	-90		-20	dBm
RSSI Resolution		1		dBm

5.6 GPIO Specifications

|	Min	Typ	Max	Unit
Input High Voltage	0.7 * VDD	-	VDD	V
Input Low Voltage	VSS	-	0.3 * VDD	V
Drive current at VDD – 0.4 V, standard drive, VDD ≥ 1.7 V	1	2	4	mA
Drive current at VDD – 0.4 V, high drive, VDD ≥ 2.7 V	6	9	14	mA
Sink Current at VSS + 0.4 V, standard drive, VDD ≥ 1.7 V	1	2	4	mA
Sink Current at VSS + 0.4 V, high drive, VDD ≥ 2.7 V	6	10	15	mA
Pull Up Resistance	11	13	16	kOhm
Pull Down Resistance	11	13	16	kOhm

6. Electrical Schematic
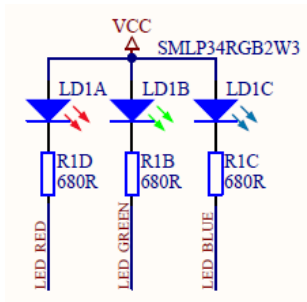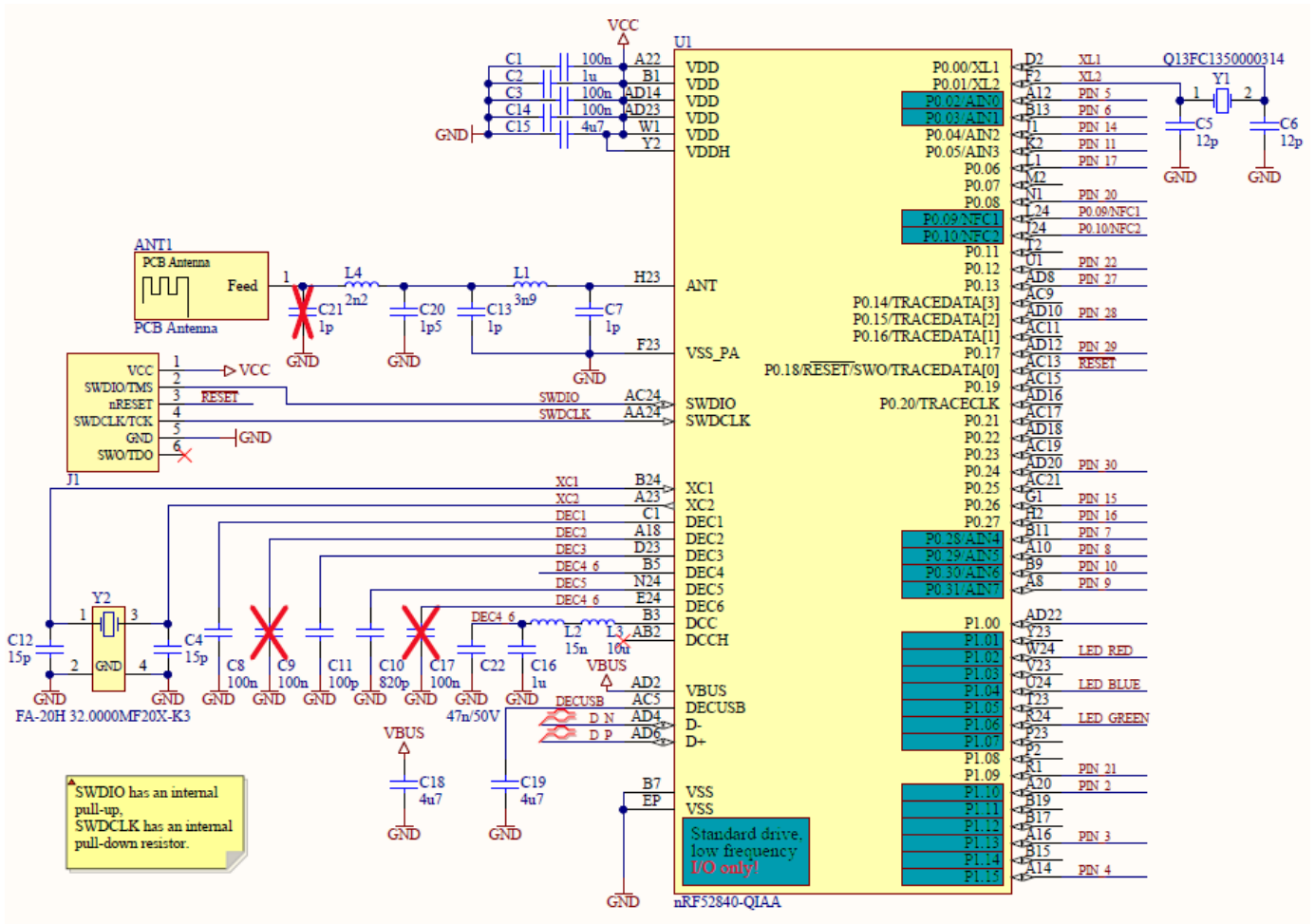
7. Mechanical Outlines

All measurements are in mm.

Tolerances are ±0.2mm.
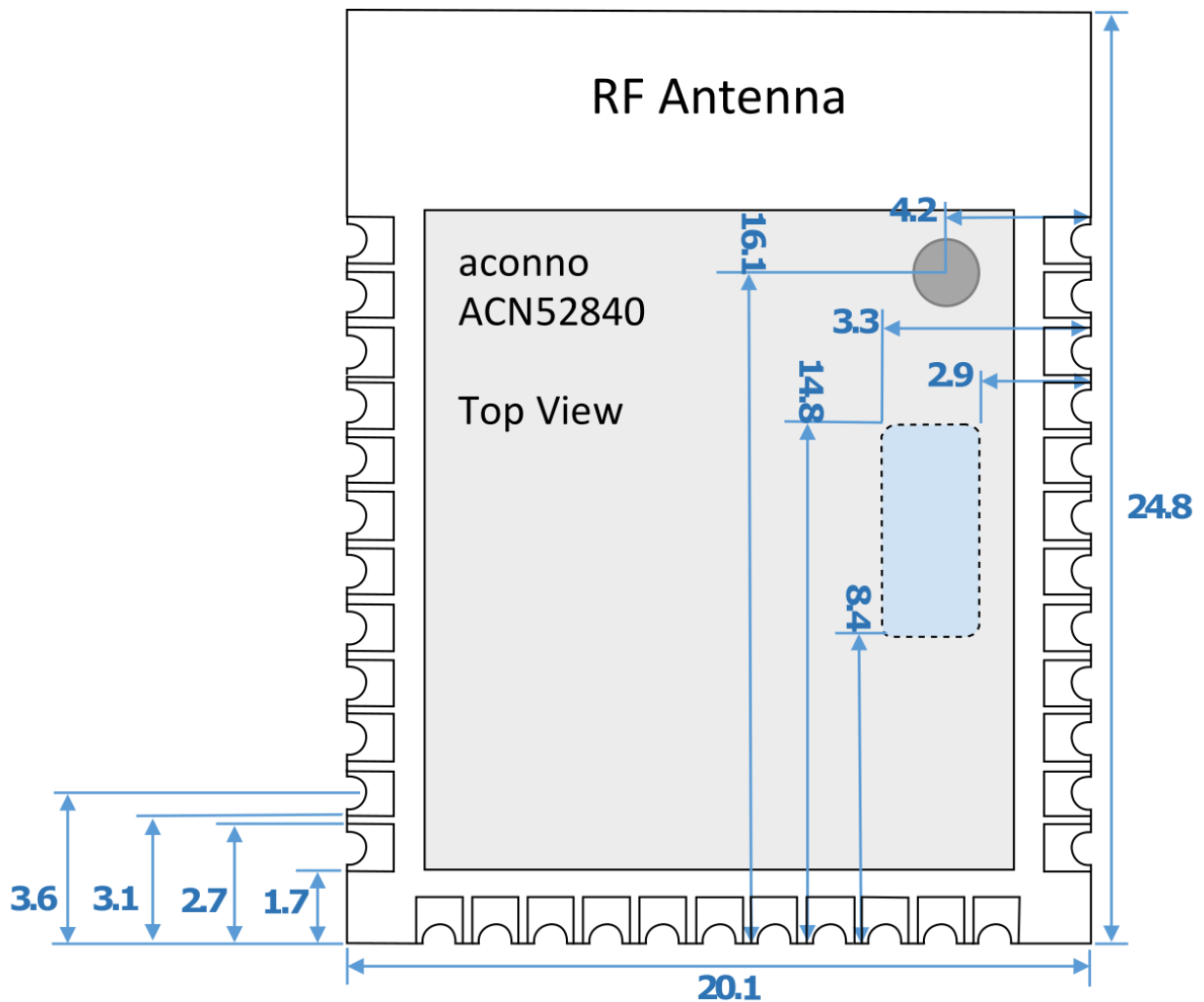
7.1 Marking on metal shielding

aconno

Model No: ACN52840
FCC ID: 2AL2N-ACN52840
IC ID: 22709-ACN52840

Manufacturer: aconno GmbH
Made in Germany

CE   RoHS COMPLIANT

8. Firmware

The ACN52840 module can be used for various applications, it supports an extensive array of protocols. For Bluetooth LE applications the Bluetooth stack and other functionality is provided by the S140 SoftDevice.

A SoftDevice is a binary image provided and certified by Nordic Semiconductor to comply with the Bluetooth Specifications. The SoftDevice runs along with the application. Using a standardized interface and APIs, the application can configure and run the Bluetooth or another stack.

Considering that the ACN52840 supports multiple protocols, several SoftDevices are available:

SoftDevice	
S132	BLE Concurrent Peripheral + Central
S212 (1)	ANT Protocol Stack
S312 (2)	ANT and BLE
S140	Bluetooth 5

(1) S212 ANT Protocol Stack is available directly from ANT: www.thisisant.com

(2) S312 Softdevice is now under supervision of ANT and may be downloaded directly at their webpage: www.thisisant.com

8.1   S140 Bluetooth 5 SoftDevice

The S140 SoftDevice is a Bluetooth low energy Central and Peripheral protocol stack solution. The S140 SoftDevice supports up to twenty connections with an additional observer and a broadcaster role all running concurrently.
The S140 SoftDevice integrates a Bluetooth low energy Controller and Host and provides a full and flexible API for building Bluetooth low energy nRF52 System on Chip (SoC) solutions.

- Bluetooth 5.0 compliant low energy single-mode protocol stack suitable for Bluetooth low energy products
  - Concurrent central, observer, peripheral, and broadcaster roles with up to 20 concurrent connections along with one Observer and one Broadcaster
  - Configurable number of connections and connection properties
  - Configurable attribute table size
  - Custom UUID support
  - Link layer supporting LE 1M PHY and LE 2M PHY
  - LL Privacy
  - ATT and SM protocols
  - LE Data Packet Length Extension
  - L2CAP with LE Credit-based Flow Control
  - LE Secure Connections pairing model
  - GATT and GAP APIs
  - GATT Client and Server
  - Configurable ATT MTU
- Complementary nRF5 SDK including *Bluetooth* profiles and example applications
- Master Boot Record for over-the-air device firmware update
  - SoftDevice, application, and bootloader can be updated separately
- Memory isolation between the application and the protocol stack for robustness and security
- Thread-safe supervisor-call based API
- Asynchronous, event-driven behavior
- No RTOS dependency
  - Any RTOS can be used
- No link-time dependencies
  - Standard ARM® Cortex®-M4 project configuration for application development
- Support for concurrent and non-concurrent multiprotocol operation
  - Concurrent with the *Bluetooth* stack using Radio Timeslot API
  - Alternate protocol stack in application space
- Support for control of external Power Amplifiers and Low Noise Amplifiers
- Quality of Service (QoS) feature for channel monitoring

8.2   S132 BLE SoftDevice

The S132 SoftDevice is used to create a full Single Mode BLE solution and has the following features:

- Bluetooth 4.2 compliant low energy single-mode protocol stack suitable for Bluetooth Smart products
    - Concurrent Central, Observer, Peripheral, and Broadcaster roles with up to:
        - Three connections as a central
        - One connection as a peripheral
        - Observer
        - Broadcaster
    - Link layer
    - L2CAP, ATT, and SM protocols
    - GATT and GAP APIs
    - GATT Client and Server
- Memory isolation between application and protocol stack for robustness and security
- Thread-safe supervisor-call based API
- Asynchronous, event-driven behavior
- No RTOS dependency (any RTOS can be used)
- No link-time dependencies
    - Standard ARM® Cortex™ M4F project configuration for application development
- Support for concurrent and non-concurrent multiprotocol operation
    - Concurrent with the Bluetooth stack using concurrent multiprotocol timeslot API
    - Alternate protocol stack in application space

8.3   S212 ANT SoftDevice

The S212 is a fully ANT compliant stack enabling customers to create mesh networks with extremely low power. ANT and ANT/Bluetooth Smart combo SoftDevices for the nRF52 series are obtained directly from ANT.

For more information on this please contact: ANTstacks@thisisant.com

A few features of the ANT stack and its capabilities:
- Advanced ANT stack
  - Simple to complex network topologies:
    - Peer-to-peer, Star, Tree, Star-to-star and more
  - Up to 15 logical channels, each with configurable:
    - Channel type, ID and period
    - Networks
  - Broadcast, Acknowledged, and Burst Data modes
  - Device search, pairing and proximity support
  - Enhanced ANT features:
    - Advanced Burst Transfer mode (up to 60 kbps)
    - Up to 15 channels encryption (AES-128) support
    - Additional networks – up to 8
    - Event Filtering and Selective Data Updates
    - Asynchronous Transmission
    - Fast Channel Initiation
- Built-in NVM access and radio coexistence management
- Memory isolation between application and protocol stack for robustness and security
- Thread-safe supervisor-call based API
- Asynchronous, event-driven behavior
- No RTOS dependency (any RTOS can be used)
- No link-time dependencies
  - Standard ARM® Cortex™ M4F project configuration for application development
- Support for concurrent and non-concurrent multiprotocol operation
  - Concurrent multiprotocol timeslot API
  - Alternate protocol stack in application space

9. Programming / Flashing with Tag Connect

Since the ACN52840 incorporates a Tag-Connect connector allowing fast debugging and drag & drop programming together with our ACNPROG programmer (available separately). There are two ways of programming the module with our programmer:
Using drag & drop in your OS or within a programming suite.

Without a programming suite, it is still possible to create your firmware e.g. using the mbed online developing tool. After you have created the compiled binary *.hex file, simply put it into the "DAP Link" called mass storage device and the download to the module begins immediately. During the programming process, the mass storage device will shortly disappear. When it shows up again, the programming process is finished and your module is ready to go.
For programming, inside a programming suite please refer to the manual of this software.
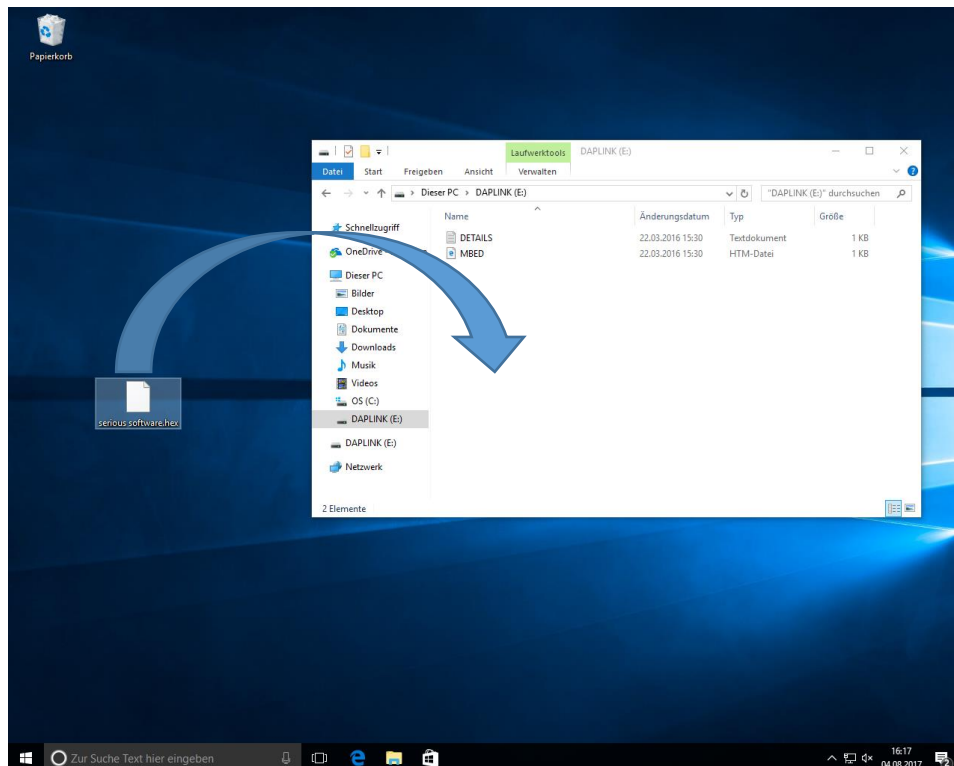
10. Certification

10.1 FCC (USA)

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

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

FCC ID: 2AL2N-ACN52840

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) This device and its antenna(s) must not be co-located with any other transmitters except in accordance with FCC multi-transmitter product procedures. Referring to the multi-transmitter policy, multiple-transmitter(s) and module(s) can be operated simultaneously without C2P.

3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following "Contains FCC ID: **2AL2N-ACN52840**". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

10.2 IC (Canada)

RSS-Gen Issue 4 December 2014 & CNR-Gen 4e Décembre 2014:

- English:

This device complies with Industry Canada license-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 radio électrique subi, même si le brouillage est susceptible d'encompromettre le fonctionnement.

The final end product must be labeled in a visible area with the following: "Contain IC ID: **IC: 22709-ACN52840**"

11. Revision History

Here you will find the current and the previous version of the document you are now reading. Also, the web-site for your device is listed. Be sure to check it after your purchase for the latest available updates and examples.

Revision	Changes	Modified page #
1.0	Initial release	all
1.1	Updated specs	4
1.2	Updated specs	9, 10, 11, 22
1.3	Updated specs, FCC-IC IDs	13, 23, 24, 25

12. Contact Information

aconno GmbH
Volmerswerther Strasse 80-86
40221 Dusseldorf
Germany

Tel.: + 49 211 93 07 78 09
Fax.: +49 211 94 21 66 62

www.aconno.de
info@aconno.de