



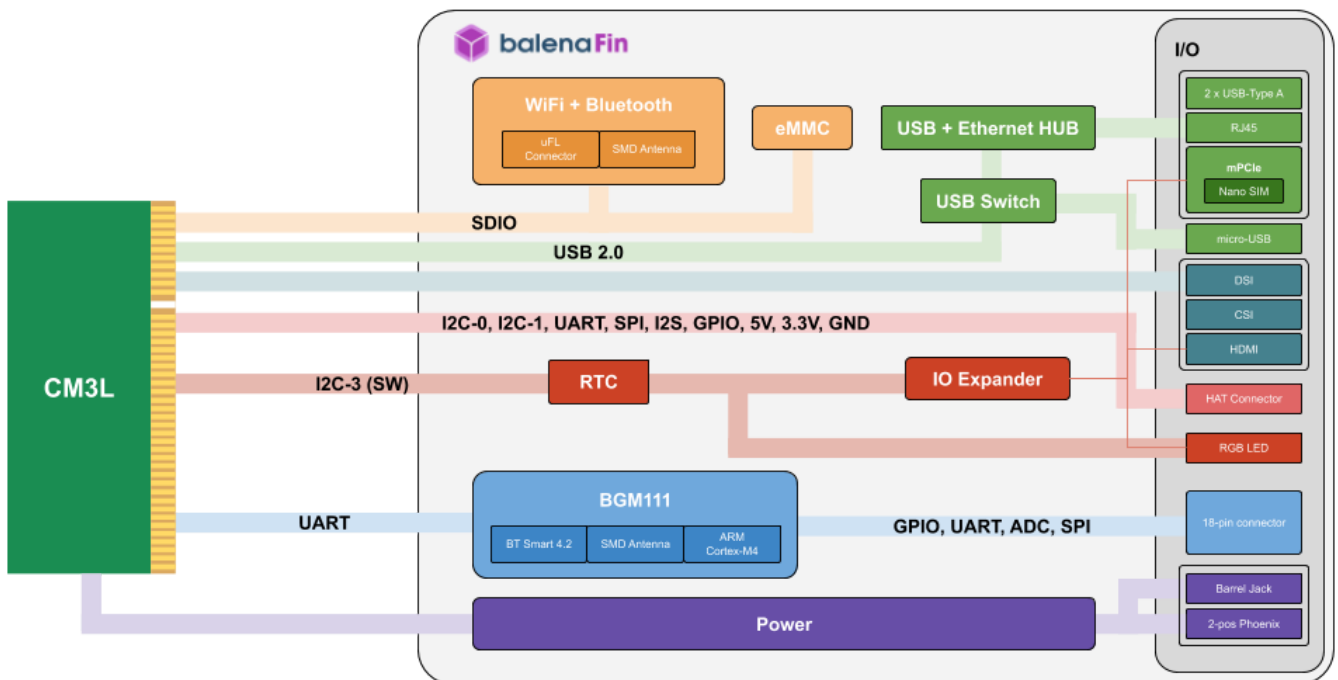
balenaFin v1.1 data sheet

The balenaFin is a carrier board for the Raspberry Pi Compute Module 3 Lite and Compute Module 3+ Lite^[1] hardened for field deployment.

The balenaFin includes 8/16/32/64 GB of on-board industrial eMMC depending on the model, has dual-band connectivity for both 2.4 and 5GHz WiFi networks, can be connected to an external antenna for WiFi and Bluetooth, and can accept a wide range of DC power input via either the barrel jack or 2-position phoenix connector.

Low power mode and real time applications are supported through the integrated BGM111^[2] microcontroller.

- Key features**
- Raspberry Pi Compute Module 3+ Lite compatible
 - On-board industrial eMMC (8-16-32-64GB options)
 - 6V to 30V input voltage range
 - BGM111 - 32-bit ARM® Cortex M4 co-processor
 - Dual-band 802.11ac/a/b/g/n 2.4 & 5GHz WiFi + Bluetooth 4.2
 - Extended -20°C to +70°C temperature range
 - PoE compatibility (via external HAT)
 - Dimmable RGB LED
 - Mini PCI Express subset socket (with nano-SIM card reader)
 - RTC with dedicated coin-cell Battery.
 - I/O -> Ethernet, 3xUSB, DSI (convertible to CSI), CSI, HDMI
 - Fully HAT compatible



[1] Technical documentation available at: <https://www.raspberrypi.org/documentation/hardware/computemodule>

[2] Technical documentation available at: https://www.silabs.com/documents/public/data-sheets/BGM111_datasheet.pdf

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Revision history

V0.0.1

- Date: 13/02/2019
- Author: Carlo María Curinga
- First draft

V0.0.2

- Date: 21/02/2019
- Author: Carlo María Curinga
- First release

V0.0.3

- Date: 22/02/2019
- Author: Carlo María Curinga
- Update temperature range lower value

V0.0.4

- Date: 06/06/2019
- Author: Nicolas Tzovanis
- Fixed HAT Header pinout for pin 13

V0.0.5

- Date: 24/06/2019
- Author: Nicolas Tzovanis
- Improved description of USB header

Highlighted features list

Wireless Features

- Dual-band (2.4GHz and 5GHz) WiFi
- Bluetooth 4.2 (with BLE support)

Co-processor

- Bluetooth 4.2 Compliant
- Integrated antenna
- Range: up to 200 meters
- 32-bit ARM® Cortex®-M4 core at 40MHz
- Flash memory: 256 kB
- RAM: 32 kB

Software

- balenaOS compatible
- Raspbian compatible (configurable through Device Tree)

Hardware interfaces

- 2 x USB 2.0 Type A
- 1 x USB 2.0 Pin header
- RJ45
- HDMI
- SIM Card slot
- Fully compatible HAT interface
- CSI port
- DSI port (convertible to second CSI port)

Electrical characteristics

- 6V to 30V input power via power connectors (internally regulated)
- 5V input through HAT interface
- -25°C to +70°C

Dimensions

- 90 x 90 mm

Availability and support

Availability of balenaFin in either the current version or a compatible later revision is guaranteed until at least January 2024.

Ordering information

Part number	Description
FIN0110-S08	8GB on-board eMMC
FIN0110-S16	16GB on-board eMMC
FIN0110-S32	32GB on-board eMMC
FIN0110-S64	64GB on-board eMMC

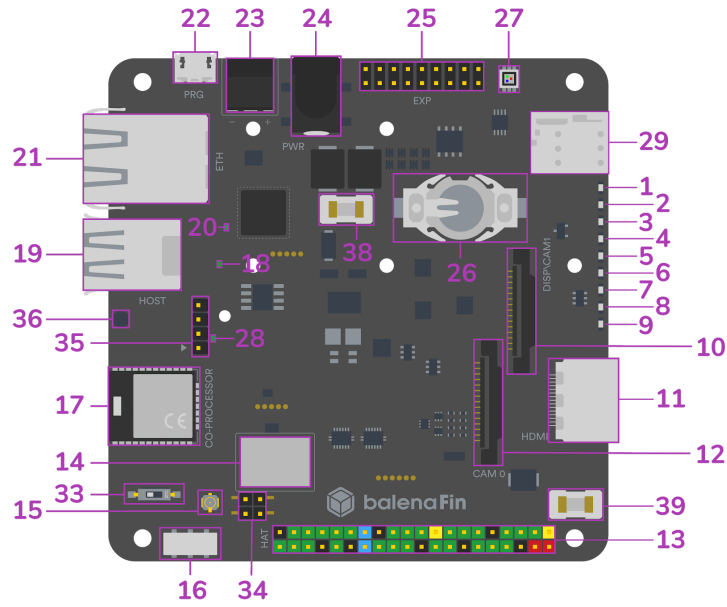
General specifications

Parameter	Minimum	Typical	Maximum	Conditions
Power input via power connectors	6V	-	30V	12.5W
Power input via HAT connectors	5V	5V	5V	12.5W
Operation temperature	-25 celsius	-	+70 celsius	

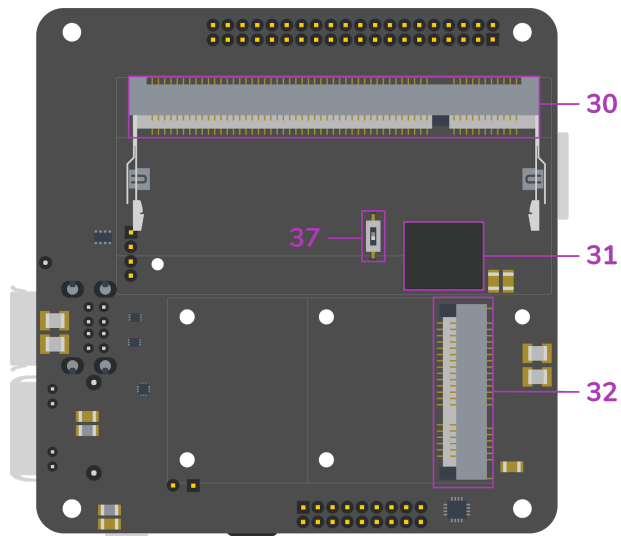
Pinout

Port mapping

Top View



Bottom View



#	Name	Description
Status LEDs		
1	5V Status LED	Indicates 5V current flow ^[1]
2	3V3 Status LED	Indicates 3.3V available. ^[1]
3	ACT Status LED	CM3L activity LED. Equivalent to the green “ACT” LED on the RPi 3 Model B. ^[1]
4	SPD Status LED	Ethernet Speed LED. ^[1]
5	FDX Status LED	Ethernet Full-Duplex indicator ^[1]
6	LNK Status LED	Ethernet Link/Activity LED ^[1]
7	PAN Status LED	Indicates PAN network activity on mPCIE card ^[1]
8	LAN Status LED	Indicates LAN network activity on mPCIE card ^[1]
9	WAN Status LED	Indicates WAN network activity on mPCIE card ^[1]
Graphic ports		
10	DSI/CSI connector	RPi MIPI connector. Configurable as secondary CSI via the DSI/CAM1 switch (37)
11	HDMI	Full-size HDMI Type A with CEC support
12	CSI connector	Standard full-size Raspberry Pi Camera (cam0) connector
37	DSI/CAM1 switch	Toggles DSI/CSI (10) connector between CSI and cam1 ^[1]
HAT		
13	HAT connector	40-pin Raspberry Pi HAT (Hardware Attached on Top) standard connector
Wifi/Bluetooth		
14	WiFi/BT combo chip	802.11ac/a/b/g/n 2.4 & 5GHz WiFi + Bluetooth 4.2
15	WiFi/BT uFL antenna connector	If the RF switch (33) is set on the external position, the antenna attached to this connector will become the main radio antenna for the WiFi/BT combo chip (14)
16	WiFi/BT SMD antenna	Embedded high-performance SMD antenna for 2.4 and 5GHz.
33	Antenna switch	Switches wireless module’s (14) internal (default) and external antenna. ^[1]
Co-processor		
17	Co-processor	Silicon Labs BGM111 MCU
25	Co-processor I/O	14-pin header exposing: 8 x GPIO / ADC, 1 x SPI, 1 x I2C, 1 x Debug UART
USB		
18	USB1 Status LED	The green LED on when enough current flowing on the top USB port. ^[1]
19	USB	2 x USB Type-A
20	USB2 Status LED	The green LED on when enough current flowing on the top USB port. ^[1]
21	Ethernet	10/100 ethernet RJ45 connector
22	PRG	micro-USB connector that allows flashing of the eMMC from a host computer ^[1]
32	mPCIE	Mini PCI Express socket
29	nano-SIM socket	Nano-SIM card slot connected to the mPCIE socket (32)
35	USB 2.0 4-pin header	Exposes a USB 2.0 port via male headers. ^[1]
Power		
23	Phoenix power in	Industry standard 2-POS Phoenix type connector for 6-24V input power
24	Barrel Jack power in	2.1 / 5.5 mm barrel jack type connector for 6-24V input power
26	RTC coin-cell socket	CR122 type coin-cell battery socket for RTC backup battery
34	PoE HAT headers	Exposes PoE voltage from RJ45 (21) port for external PoE HATs ^[1]
36	GND probe interface	Exposes a GND probe interface for easy debugging
38	POWER IN Fuse	3A 125VAC/VDC fuse - MPN: 0154003.DR. Applies to (23) and (24)
39	HAT 5V Fuse	3A 125VAC/VDC fuse - MPN: 0154003.DR
Raspberry Pi Compute Module		
30	CM3L socket	SODIMM-200 socket for the Raspberry Pi Compute Module 3/3+ Lite
31	eMMC	8/16/32/64 GB class 5.1 industrial eMMC. Acts as main storage for the CM3L (30).

[1] Usage instructions on “Hardware interfaces” section

HAT connector pinout (13)

Pin #	Name	Notes/Description
1	3V3	3.3V rail, shared with CM
3	I2C1_SDA	Compute Module I2C1 Data
5	I2C1_SCL	Compute Module I2C1 Clock
7	GPIO4	Compute Module GPIO_4
9	GND	Ground
11	GPIO17	Compute Module GPIO_17
13	GPIO27	Compute Module GPIO_27
15	GPIO22	Compute Module GPIO_22
17	3V3	3.3V rail, shared with CM
19	GPIO10	Compute Module GPIO_10
21	GPIO9	Compute Module GPIO_9
23	GPIO11	Compute Module GPIO_11
25	GND	Ground
27	I2C0_SDA	Compute Module I2C0 Data
29	GPIO5	Compute Module GPIO_5
31	GPIO6	Compute Module GPIO_6
33	GPIO13	Compute Module GPIO_13
35	GPIO19	Compute Module GPIO_19
37	GPIO26	Compute Module GPIO_26
39	GND	Ground

Pin #	Name	Notes/Description
2	5V	5V rail, from regulator
4	5V	5V rail, from regulator
6	GND	Ground
8	GPIO14	Compute Module GPIO_14
10	GPIO15	Compute Module GPIO_15
12	GPIO18	Compute Module GPIO_18
14	GND	Ground
16	GPIO23	Compute Module GPIO_23
18	GPIO24	Compute Module GPIO_24
20	GND	Ground
22	GPIO25	Compute Module GPIO_25
24	GPIO8	Compute Module GPIO_8
26	GPIO7	Compute Module GPIO_7
28	I2C0_SCL	Compute Module I2C0 Clock
30	GND	Ground
32	GPIO12	Compute Module GPIO_12
34	GND	Ground
36	GPIO16	Compute Module GPIO_16
38	GPIO20	Compute Module GPIO_20
40	GPIO21	Compute Module GPIO_21

Co-processor connector pinout (25)

Pin #	Name	Notes/Description
1	MCU_GPIO0	Co-processor GPIO_0
3	MCU_GPIO1	Co-processor GPIO_1
5	MCU_GPIO2	Co-processor GPIO_2
7	MCU_GPIO3	Co-processor GPIO_3
9	MCU_GPIO4	Co-processor GPIO_4
11	MCU_GPIO5	Co-processor GPIO_5
13	MCU_GPIO6	Co-processor GPIO_6
15	MCU_GPIO7	Co-processor GPIO_7
17	GND	Ground

Pin #	Name	Notes/Description
2	3V3	3.3V rail, from regulator
4	SPI_MCU_CS-CON_EXT	
6	SPI_MCU_CS-SCLK_EXT	
8	SPI_MCU_CS-MOSI_EXT	
10	SPI_MCU_CS-MISO_EXT	
12	DBG_uP-RX_DEV-TX_EXT	
14	DBG_uP-TX_DEV-RX_EXT	
16	MCU_GPIO8	Co-processor GPIO_8
18	MCU_GPIO9	Co-processor GPIO_9

Hardware interfaces

Status indication LEDs

Status LEDs					
#	Name	Color	On (no-blink)	Off	Blinking
1	5V LED	Red	5V rail is up	5V rail is down	N/A
2	3V3 LED	Red	3.3V rail is up	3.3V rail is down	N/A
3	ACT LED	Green	USB Boot (flashing) mode	eMMC is inactive	eMMC is active
4	SPD LED	Yellow	100-Mbps mode	10-Mbps mode	N/A
5	FDX LED	Green	Full-Duplex ethernet	Half-Duplex ethernet	N/A
6	LNK LED	Green	Ethernet link established	Ethernet link not established	Ethernet port is active
7	PAN LED	Green	Depends on mPCIe module	Depends on mPCIe module	Depends on mPCIe module
8	LAN LED	Green	Depends on mPCIe module	Depends on mPCIe module	Depends on mPCIe module
9	WAN LED	Green	Depends on mPCIe module	Depends on mPCIe module	Depends on mPCIe module
18	USB1 LED	Green	Top USB powered on	Top USB powered off	N/A
20	USB2 LED	Green	Bottom USB powered on	Bottom USB powered off	N/A
N/A	Ethernet LED	Yellow	100-Mbps mode	10-Mbps mode	N/A
N/A	Ethernet LED	Green	Ethernet link established	Ethernet link not established	Ethernet port is active

CSI/DSI selection switch [37]

Switches the full-size Raspberry Pi MIPI connector (10) between Display or secondary Camera (Cam1) mode.

When set to “DISP”, the full-size Raspberry Pi MIPI connector [10] will expose the DSI (Disp1) interface. When set to “CAM1” the full-size Raspberry Pi MIPI connector [10] will expose the secondary CSI (Cam1) interface

WARNING: Only use the switch when the balenaFin is completely powered off and no cables are connected.

Internal/External antenna selection switch [33]

Switches the embedded WiFi/Bluetooth module [14] between the internal (PCB) and external antennas.

When set to “INT”, the WiFi/Bluetooth module will use the embedded (PCB) antenna. When set to “EXT”, the WiFi/Bluetooth module will use any antenna connected to the uFL connector [15]

WARNING: Only use the switch when the balenaFin is completely powered off and no cables are connected.

PRG port [22]

This port is used to flash the on-board eMMC with a bootable image/OS. When a host is connected to the PRG port, the balenaFin will enter a flashing mode exposing its eMMC as mass-storage device. More information on how to use the programming port can be found on the getting started guide at: <https://www.balena.io/fin/1.1/docs/getting-started/>

Note: The balenaFin can only be booted into flash mode via this port.

Note: When using the PRG port, make sure no other power cable is connected to either the Phoenix[23] nor the Barrel Jack [24] power ports.

USB Header [35]

Standard 0.1" header that exposes a 2.0 USB port.

Pinout		
Pin #	Name	Notes/Description
1	VCC	+5 VDC
2	D-	Data -
3	D+	Data +
4	GND	Ground

Note: Pin 1 is the one closest to the co-processor[17] and pin 4 is the one closest to the USB Type-A port [19].

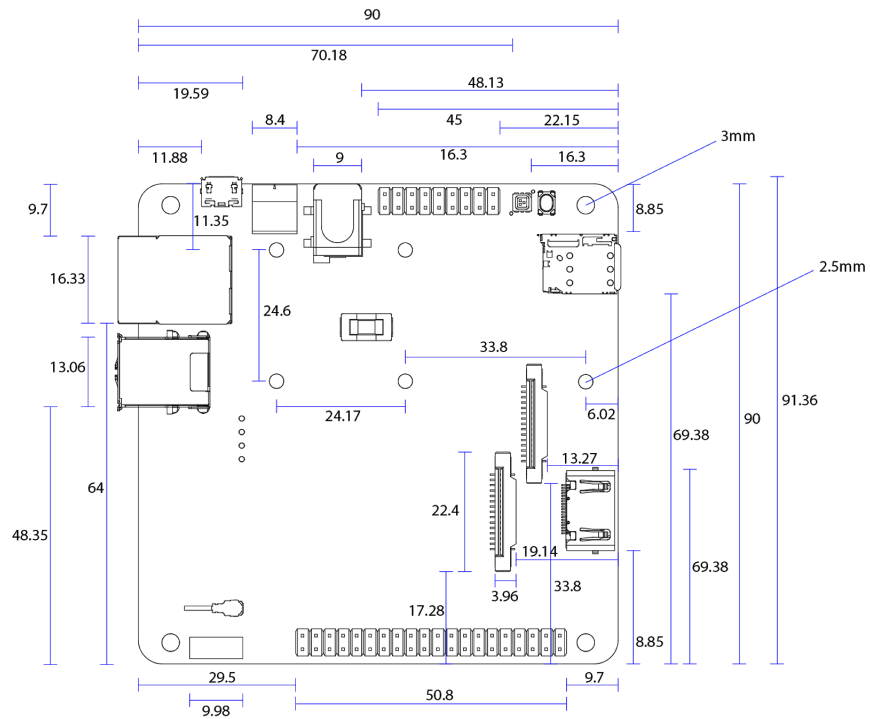
PoE header [34]

The PoE header is a standard 0.1" header that adds PoE support to the balenaFin via an external HAT. The balenaFin is compatible with all the PoE HATs that are compatible with the Raspberry Pi 3B+.

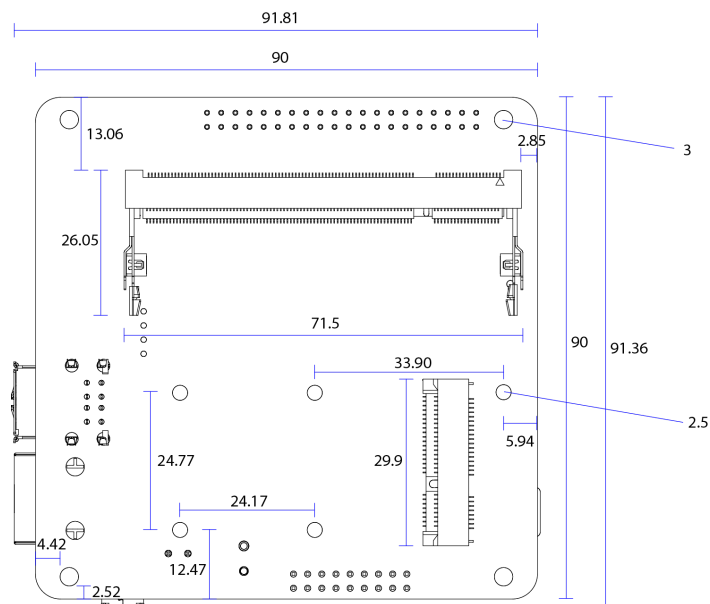
Note: some PoE HATs do not follow the official Raspberry Pi HAT specifications and might have components that collide with components on the balenaFin.

Mechanical Specifications (mm)

Top view



Bottom view



Radio specifications

Frequency range

Description	Min.	Typ.	Max	Units
11b / 11g / 11n-2GHz (HT20) / 11n-2GHz (HT40)	2412	-	2472	MHz
11a / 11n-5GHz (20TH) / 11n-5GHz (40TH) / 11ac	5180	-	5825	MHz
BT/BLE main	2402	-	2480	MHz
BLE secondary (co-processor)	2400	-	2483.5	MHz

TX output power

Description	Min.	Typ.	Max	Units
11b / 11g / 11n-2GHz (HT20) / 11n-2GHz (HT40)	10/10/10	12/12/12	14/14/14	dBm
11a / 11n-5GHz (20TH) / 11n-5GHz (40TH) / 11ac	10/10/8/6	12/12/10/ 8	14/14/12/10	dBm
BT/BLE main	-6	0	4	dBm
BLE secondary (co-processor)	-26	-	8	dBm

RX sensitivity

Description	Min.	Typ.	Max	Units
11b / 11g / 11n-2GHz (HT20) / 11n-2GHz (HT40)	-	-78/-73/-69/-66	-76/-65/-64/-61	dBm
11a / 11n-5GHz (20TH) / 11n-5GHz (40TH) / 11ac	-	-71/-68/-65/-57	-65/-64/-61/-51	dBm
BT/BLE main	-	-86/-86	-70/-70	dBm
BLE secondary (co-processor)	-	-55.2/-47.2	-	dBm

Certifications

Certifications overview

Certification	Country / Region	Identifier(s)
CE	Europe	TBD
FCC	USA	FCC ID: 2APW6FIN0110-CM2
IC	Canada	TBD
MIC	Japan	TBD
RCM	Australia	TBD
OFCA	Hong Kong	TBD

Laboratory test results and DoC available at www.balena.io/fin

FCC

Compliance statement

This device complies with Part 15 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: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Non-modification Warning

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

RF Exposure Statement

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the IC radiofrequency (RF) Exposure rules. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.

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.

OEM responsibilities to comply with FCC regulations

The balenaFin Module has been certified for integration into products only by OEM integrators under the following conditions:

- The antenna(s) must be installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and all persons at all times.
- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

As long as the conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Note: In the event that this condition cannot be met (for certain configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.