Document Type	Datasheet
Product ID:	BLNFN100001 (20173009)
Product Name	BalenaFin
Product Description	RaspberryPi CM3 carrier board
Product Version	1.1.0
Manufacturer Part Number	FIN0110-SX (where X is the storage size: 8/16/32/64)
Document Version	0.0.8
Author	Carlo Maria Curinga
State (Draft/Proposed/Approved)	Approved

Revision history

Date (dd/mm/yyyy)	Version	Author	Description
13/02/2019	0.0.1	Carlo Curinga	First draft
21/02/2019	0.0.2	Carlo Curinga	First release
22/02/2019	0.0.3	Carlo Curinga	Update minimum temperature value
06/06/2019	0.0.4	Nicolas Tzovanis	Fixed HAT Header pinout for pin 13
24/06/2019	0.0.5	Nicolas Tzovanis	Improved description of USB header
26/06/2020	0.0.6	Alex Bucknall	Added BGM111 Port Reference
14/10/2021	0.0.7	Nicolas Tzovanis	Added information for IEC report
11/01/2022	0.0.8	Alex Bucknall	Corrected balenaFin voltage range
01/04/2022	0.0.9	Konstantinos Mouzakis	Corrected coin cell battery type

1. Introduction

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.

For more information about the Raspberry Pi Compute Module please refer to the following links:

- Datasheet: https://www.raspberrypi.org/documentation/hardware/computemodule/datasheet.md
- Schematics: https://www.raspberrypi.org/documentation/hardware/computemodule/schematics.md

2. Continuity of supply

Availability of balenaFin in either the current version or a compatible later revision is guaranteed, on commercially reasonable basis, until January 2024.

2.1 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

3. BalenaFin images and mapping

Top	Bottom
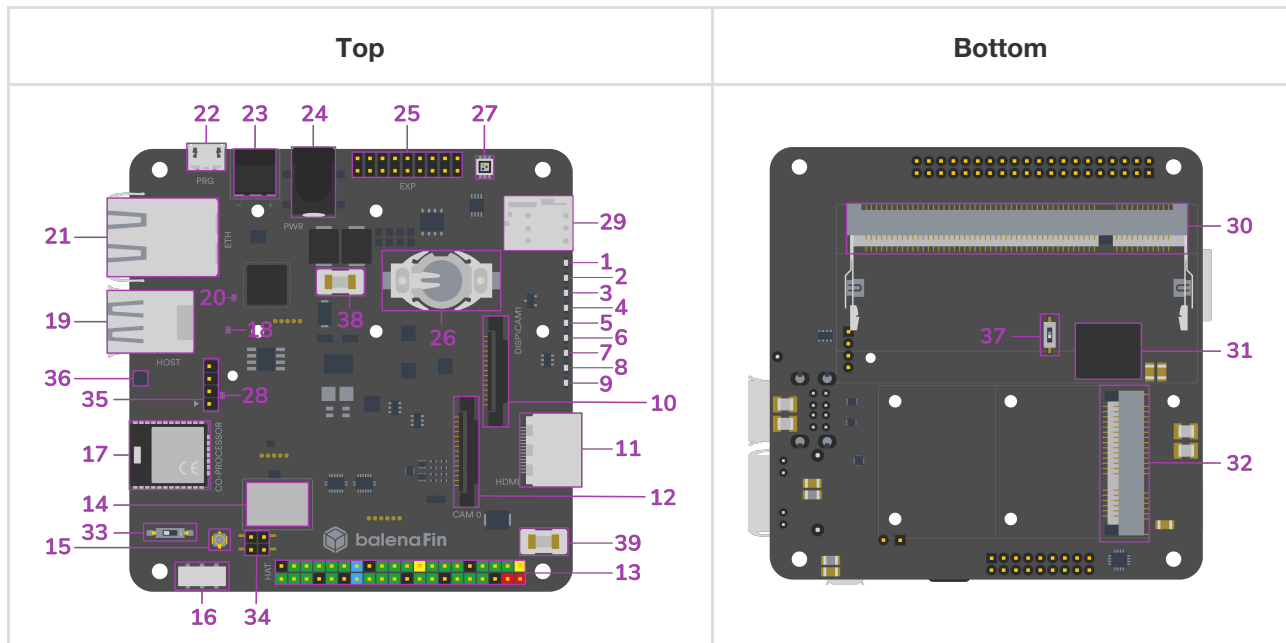
#	Name	Notes/Description
1	5V Status LED	Indicates 5V current flow
2	3V3 Status LED	Indicates 3.3V current flow; this is the same as the red LED on the Raspberry Pi 3 Model B
3	ACT Status LED	CM3L Activity LED; this is the same as the green LED on the Raspberry Pi 3 Model B
4	SPD Status LED	Ethernet Speed LED; off when in 10-Mbps mode, on when in 100-Mbps mode
5	FDX Status LED	Ethernet Full-Duplex indicator
6	LNK Status LED	Ethernet Link/Activity LED
7	PAN Status LED	If supported by the mPCIE (32) card connected, indicates PAN network activity
8	LAN Status LED	If supported by the mPCIE (32) card connected, indicates LAN network activity
9	WAN	If supported by the mPCIE (32) card connected, indicates WAN network

	Status LED	activity
10	DSI/CAM1 connector	Standard full-size Raspberry Pi MIPI connector that can be configured as Display or secondary Camera (cam1) connector; selection is made 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
13	HAT connector	40-pin Raspberry Pi HAT (Hardware Attached on Top) standard connector
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 embedded antenna	Embedded high-performance SMD antenna covering both 2.4 and 5GHz frequencies; it is the default antenna selected for the WiFi/BT combo chip (14)
17	Co-processor	Silicon Labs BGM111 MCU
18	USB1 ON Status LED	The green LED stays on as long as there is enough current flowing on the top USB port; when this LED is off, it means a fault or under-voltage is happening on the top USB port
19	USB	2 x USB Type-A
20	USB2 ON Status LED	The green LED stays on as long as there is enough current flowing on the bottom USB port; when this LED is off, it means a fault or under-voltage is happening on the bottom USB port
21	Ethernet	10/100 ethernet RJ45 connector
22	PRG port	micro-USB programming port). **balenaFin can only be booted into flash mode via this port**
23	Phoenix power in	Industry standard 2-POS Phoenix type connector for 6-30V input power; polarity is denoted on PCB silkscreen

24	Barrel Jack power in	2.1 / 5.5 mm barrel jack type connector for 6-30V input power. Positive polarity (Positive tip, Negative sleeve) - Denoted by symbol on the bottom PCB silkscreen.
25	Co-Processor I/O connector	8 x GPIO / ADC, 1 x SPI, 1 x I2C, 1 x Debug UART
26	CR1225 RTC coin-cell battery socket	This allows the embedded RTC to keep track of time while the device is powered off
27	RGB LED	Connected to a PCA9633 controller that allows standard linux sysfs LED control
28	USB3 ON Status LED	The green LED stays on as long as there is enough current flowing on the 4-pin header USB port; when this LED is off, it means a fault or under-voltage is happening on the 4-pin header USB port
29	nano-SIM socket	This allows the use of a wide portfolio of cellular modems via the mPCIe socket (32)
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 - main storage for the CM3L (30). Positioned under the CM3L (30)
32	mPCIe	Mini PCI Express socket
33	Antenna switch	Internal/external antenna selection switch
34	PoE HAT headers	exposes the incoming voltage from the RJ45 (21) port for PoE HATs
35	USB 2.0 4-pin header	Exposes a USB 2.0 interface via male pin headers.
36	GND probe interface	Exposes a GND probe interface for easy debugging
37	DSI/CAM1 switch	Switches the full-size Raspberry Pi MIPI connector (10) between Display or secondary Camera (cam1) mode

38	POWER IN Fuse (on 23 & 24)	3A 125VAC/VDC fuse - MPN: 0154003.DR
39	HAT 5V Fuse	3A 125VAC/VDC fuse - MPN: 0154003.DR

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. 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" pin header exposing a 2.0 USB interface.

Pin number	Name	Description

1	VCC	+5V DC supply
2	D-	USB data -
3	D+	USB 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.

3.1 HAT connector pinout

Pin #	Name	Notes/Description	Pin #	Name	Notes/Description
1	3V3	3.3V rail, shared with CM	2	5V	5V rail, from regulator
3	I2C1_SDA	Compute Module I2C1 Data	4	5V	5V rail, from regulator
5	I2C1_SCL	Compute Module I2C1 Clock	6	GND	Ground
7	GPIO4	Compute Module GPIO_4	8	GPIO14	Compute Module GPIO_14
9	GND	Ground	10	GPIO15	Compute Module GPIO_15
11	GPIO17	Compute Module GPIO_17	12	GPIO18	Compute Module GPIO_18
13	GPIO27	Compute Module GPIO_27	14	GND	Ground
15	GPIO22	Compute Module GPIO_22	16	GPIO23	Compute Module GPIO_23
17	3V3	3.3V rail, shared with CM	18	GPIO24	Compute Module GPIO_24
19	GPIO10	Compute Module GPIO_10	20	GND	Ground
21	GPIO9	Compute Module GPIO_9	22	GPIO25	Compute Module GPIO_25
23	GPIO11	Compute Module GPIO_11	24	GPIO8	Compute Module GPIO_8
25	GND	Ground	26	GPIO7	Compute Module GPIO_7
27	I2C0_SDA	Compute Module I2C0 Data	28	I2C0_SCL	Compute Module I2C0 Clock

29	GPIO5	Compute Module GPIO_5	30	GND	Ground
31	GPIO6	Compute Module GPIO_6	32	GPIO12	Compute Module GPIO_12
33	GPIO13	Compute Module GPIO_13	34	GND	Ground
35	GPIO19	Compute Module GPIO_19	36	GPIO16	Compute Module GPIO_16
37	GPIO26	Compute Module GPIO_26	38	GPIO20	Compute Module GPIO_20
39	GND	Ground	40	GPIO21	Compute Module GPIO_21

3.2 Silicon Labs BGM111 connector pinout

Pin #	Name	BGM111	Notes
1	MCU_GPIO0	PD14	Co-processor GPIO_0
2	3V3	3V3	3.3V rail, from regulator
3	MCU_GPIO1	PA2	Co-processor GPIO_1
4	SPI_MCU_CS-CON_EXT	PB13	
5	MCU_GPIO2	PA3	Co-processor GPIO_2
6	SPI_MCU_CS-SCLK_EXT	PC8	
7	MCU_GPIO3	PA4	Co-processor GPIO_3
8	SPI_MCU_CS-MOSI_EXT	PC6	
9	MCU_GPIO4	PA5	Co-processor GPIO_4
10	SPI_MCU_CS-MISO_EXT	PC7	
11	MCU_GPIO5	PB11	Co-processor GPIO_5
12	DBG_uP-RX_DEV-TX_EXT	PA1	
13	MCU_GPIO6	PF6	Co-processor GPIO_6
14	DBG_uP-TX_DEV-RX_EXT	PA0	
15	MCU_GPIO7	PF7	Co-processor GPIO_7
16	MCU_GPIO8	PD15	Co-processor GPIO_8
17	GND	GND	Ground
18	MCU_GPIO9	PD13	Co-processor GPIO_9

3.2.1 Silicon Labs BGM111 internal pinout

Name	BGM111	Notes
PW_ON_5V	PC9	5V Power Rail for the Compute Module
PW_ON_3V3	PF5	3V3 Power Rail for the Compute Module
SW_I2C_SDA_ON	PC10	Internal I2C1 SDA (shared with Compute Module)
SW_I2C_SCL_ON	PC11	Internal I2C1 SCL (shared with Compute Module)
ARTIK-TX_CM3-RX	PF3	BGM111 TX to Compute Module RX (UART)
ARTIK-RX_CM3-TX	PF2	BGM111 RX to Compute Module TX (UART)
SWDIO_MCU	PF1	BGM111 Serial Wire Debug (IO)
SWCLK_MCU	PF0	BGM111 Serial Wire Debug (Clock)

4. Block diagram

balenaFin

- WiFi + Bluetooth
  - uFL Connector
  - SMD Antenna
- eMMC
- USB & Ethernet HUB
- CM3L
- RTC
- BGM111
  - BT Smart 4.2
  - SMD Antenna
  - ARM Cortex-M4
- IO Expander
- Power

SDIO

USB 2.0

I2C-0, I2C-1, UART, SPI, I2S, GPIO, 5V, 3.3V, GND

UART0 / SWDIO

I2C-3 (SW)

GPIO, UART, ADC, SPI

I/O
- USB Type A (x2)
- RJ45
- mPCIe
  - Nano SIM
- DSI
- CSI
- HDMI
- 40-pin HAT Connector
- RGB LED
- 18-pin Connector
- 5.5/2.1 Barrel Jack
- 2-pos Phoenix
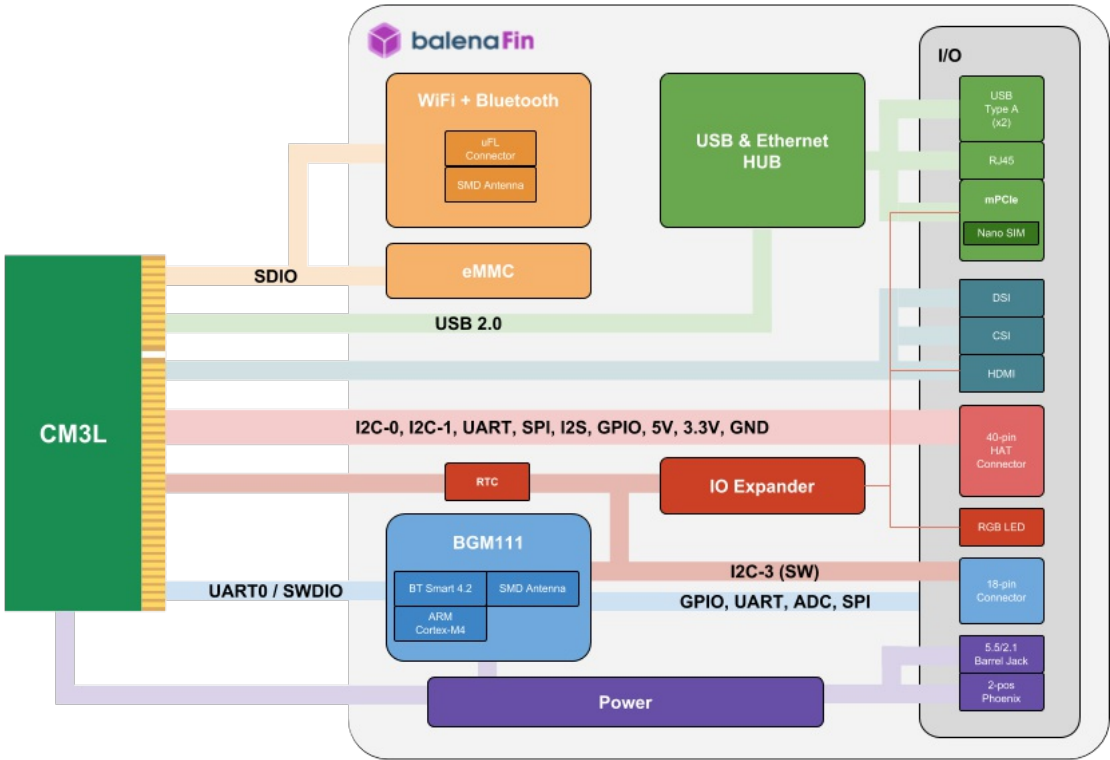
5. Mechanical specifications (mm)

Top	Bottom
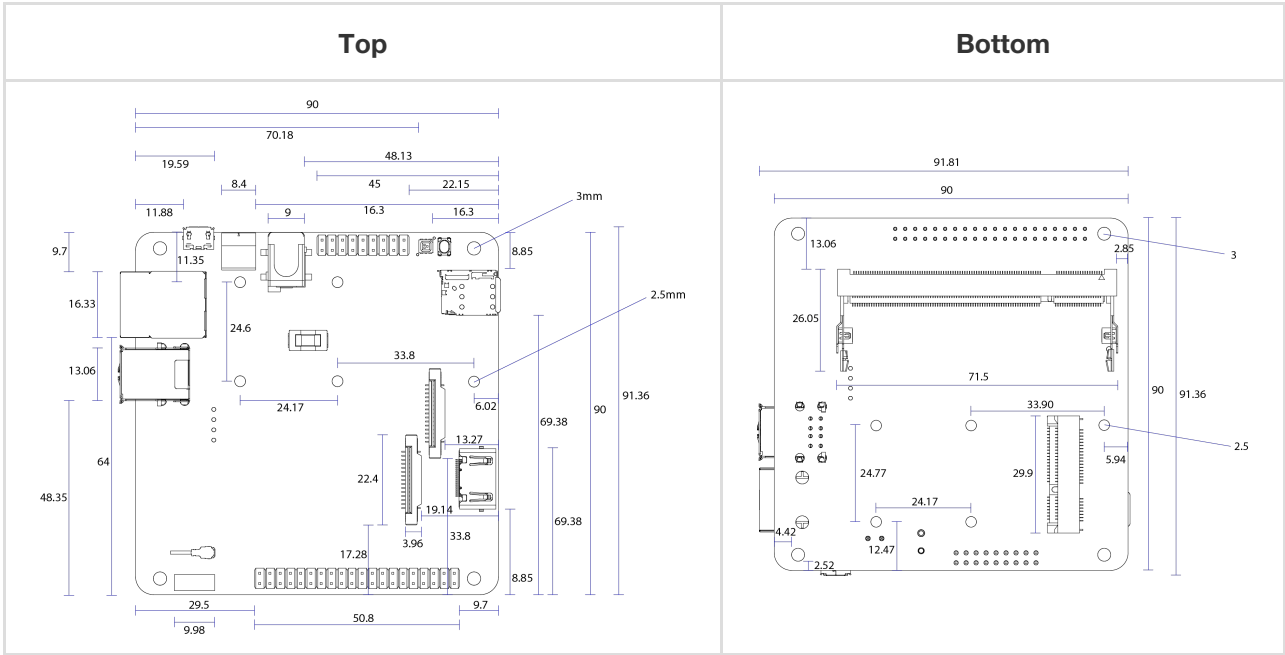
6. General specifications

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

NOTE: The board cannot be powered from the microUSB [PRG] port. This power input can only be used for flashing the internal eMMC.

7. Radio specifications

7.1 Frequency range

Description	Min.	Typ.	Max.	Unit
11b / g / n (HT20/HT40)	2412	-	2472	MHz
11a / ac (HT80)	5180	-	5825	MHz
BT / BLE (main)	2402	-	2480	MHz
BT / BLE (secondary, co-processor)	2400	-	2483.5	MHz

7.2 TX Output Power

Description	Min.	Typ.	Max.	Unit
11b/11g/11n-2G(20TH/40TH)	10 / 10 / 10	12 / 12 / 12	14/ 14/ 14	dBm
11a/11n-5G20TH/40TH/11ac	10 / 10 / 8 / 6	12 / 12 / 10 / 8	14 / 14 / 12 / 10	dBm
BT / BLE (main)	-6	0	4	dBm
BT / BLE (secondary, co-processor)	-26	-	8	dBm

7.3 RX Sensitivity

Description	Min.	Typ.	Max.	Unit
11b/11g/11n-2G(20TH/40TH)	-	-87/-73/-69/-66	-76 / -65 / -64/-61	dBm
11a/11n-5G(20TH/40TH)/11ac	-	-71/-68/-65/-57	-65 / -64/-61 /-51	dBm
BT / BLE (main)	-	-86/-86	-70 / -70	dBm
BT / BLE (secondary, co-processor)	-	-55.2/-47.2	-	dBm

8. Certification

Certification	Country / Region	Identifier(s)
RoHS	N/A	N/A
CE	Europe	RE-18071303
FCC	USA	2APW6-FIN0110-CM2
IC	Canada	24038-BLNFN100001
MIC	Japan	R-208-180131

8.1 Labelling

The end product must be labeled, in a visible area, with the following:

- *Contains FCC ID: 2APW6-FIN0110-CM2 IC: 24038-BLNFN100001*
- *Contains FCC ID: QOQBGM111 IC: 5123A-BGM111*

8.2 Regulatory Insert

8.1.1 FCC Compliance Statement (USA)

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 B 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.

Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles les radioélectriques (RF) de la FCC lignes directrices d'exposition dans et d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'IC. Cet équipement doitêtre installé et utilisé en gardant une distance de 20 cm ou plus entre le dispositif rayonnant et le corps

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.

8.1.2 Canadian DOC Compliance Statement

Cet appareil numerique de la classe B est conforme a la norme NMB-003 du Canada. This Class B digital apparatus complies with Canadian ICES-003.

Industry Canada (IC) Warning

Le present appareil est conforme aux CNR d Industrie Canada applicables aux appareils radio exempts de licence. L exploitation est autorisee aux deux conditions suivantes : (1) appareil ne doit pas produire de brouillage, et (2) l utilisateur de l appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible n compromettre le fonctionnement.

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., 2) This device must accept any interference, including interference that may cause undesired operation of the device.