

AURIA FS2345

Internet radio/DAB/FM/Bluetooth audio module

DATASHEET

CONFIDENTIAL NDA

REVISED

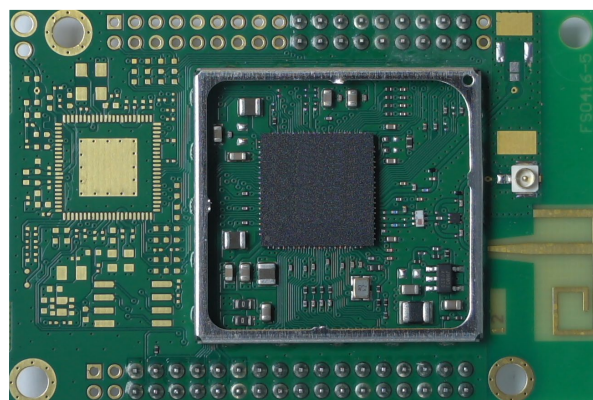
General description

Frontier AURIA FS2345 is a cutting-edge audio module designed to power the next generation of Bluetooth and Wi-Fi audio products. With a focus on delivering the highest quality Hi-Res audio, Bluetooth audio synchronisation across multiple speakers, low power consumption, portability and high security/privacy. AURIA has been designed and engineered to allow brands to create a whole new portfolio of products to compete in established markets and to enter new and emerging audio markets.

AURIA offers simple and straightforward integration into various audio products. The turnkey module, customisable SDK, rich I/O, comprehensive documentation and local technical support provided by our team allow for new products to be quickly bought to market with minimal development cost.

Key features

- Bluetooth LE Audio LC3 codec.
- Support for Auracast, highly dependable audio sync for multiple devices
- Hi-Res audio support
- OKTIV iOS/Android app control
- Built-in audio DSP
- Spotify Connect
- AirPlay 2 with multiroom
- One touch party mode / stereo pair support
- Pre-set favourite button support
- RoHS compliant



Connectivity

- Dual-core ARM A32 @ 1.2Ghz
- Integrated RAM and Flash memory
- Bluetooth 5.2 low energy (LE) audio
- Wi-Fi 6 (802.11ax) dual band
- I²S digital audio output
- DAC/ADC for analogue audio I/O
- I/O - IC2, SPI, UART, IR GPIO, GPADC
- Onboard Wi-Fi Bluetooth printed PIFA antenna
- External Wi-Fi/Bluetooth diversity antenna.

Ordering information

Part	Description
FS2345	Wi-Fi, Bluetooth

Further options are described in Section 6: Hardware options.

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Revision History

DCS	Revision number	Date	Document maturity	Description
FSM	1	October 2023	Preliminary	First release.
	2	February 2024	Revised	Rev 5 board update
	3	August 2024	Revised	Feature complete
	4	November 2024	Revised	Performance figures updated
	5	January 2025	Revised	FCC/IC statements

Document maturity key

Initial	Initial data, all subject to change.
Preliminary	Preliminary data; minor details may be missing or subject to change.
Complete	All sections complete.
Revised	Additions/corrections incorporated.
Obsolete	Document refers to a discontinued or soon-to-be-discontinued product. Withdrawn from external distribution.

Feedback

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Include the following information:

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- Document number: TECHPUBS-1816952510-3851 Rev 5
- Document date:13/01/2025
- Section number and heading if referring to a specific part of the document

1 Introduction

Figure 1 shows a block diagram of AURIA.

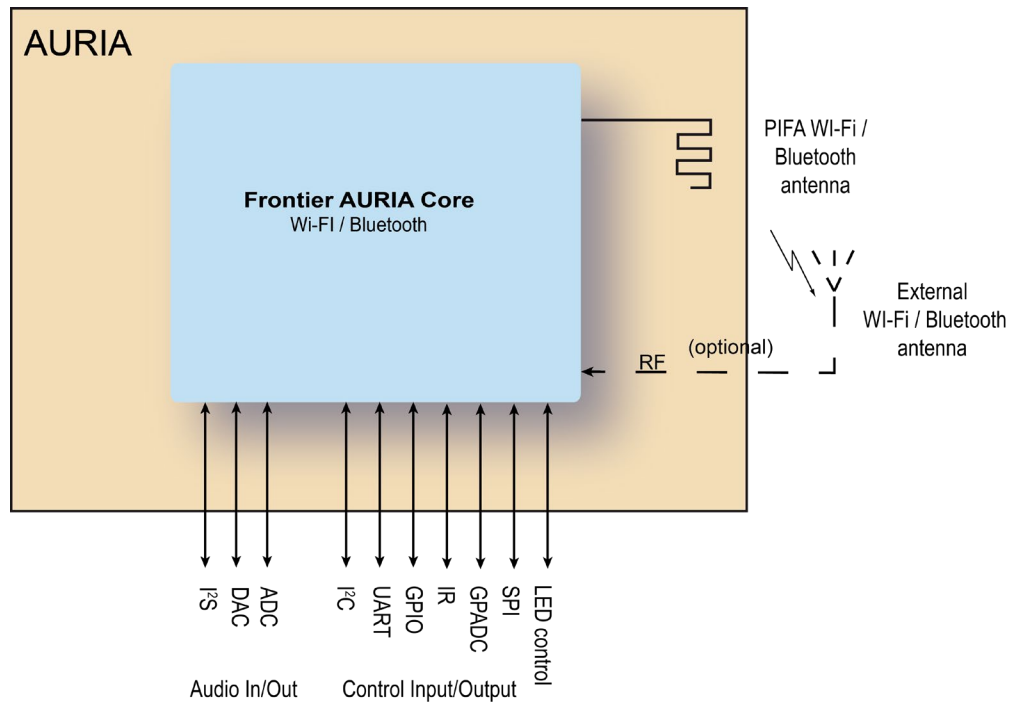


Figure 1: Block diagram

The Frontier AURIA Core application processor is based around dual core ARM architecture. This processor is well suited to running application code. Receiver manufacturers may add application code on top of the core processing to produce complete products.

- AURIA is 58mm x 39mm in size.
- On-module Bluetooth 5.2 and Wi-Fi 6 (up to 802.11ax 20MHz).
- Dual row pin out.
- 5V supply.
- On-module Wi-Fi/BT PIFA plus IPEX connector (diversity).

Stereo audio outputs can be provided as analogue audio (line level), or as I2S digital data.

AURIA features an on-board Wi-Fi/Bluetooth antenna of advanced design providing a highly optimised, efficient, yet broadband dual band element. This provides a low-cost, convenient end-product design, however, if required the on-board antenna can be switched out and a customer's own antenna used instead.

2 Applications

Targeted at Smart radio and wireless speaker applications AURIA is a non-electrical and non-footprint compatible, feature enhanced migration for applications using Venice X or new designs requiring a module with Bluetooth LE, Auracast, AirPlay and Spotify audio features.

This chapter presents a typical application using AURIA.

2.1 Example application

Figure 2 shows AURIA in a typical example application, functioning as the main system controller in a Wi-Fi/Bluetooth audio unit.

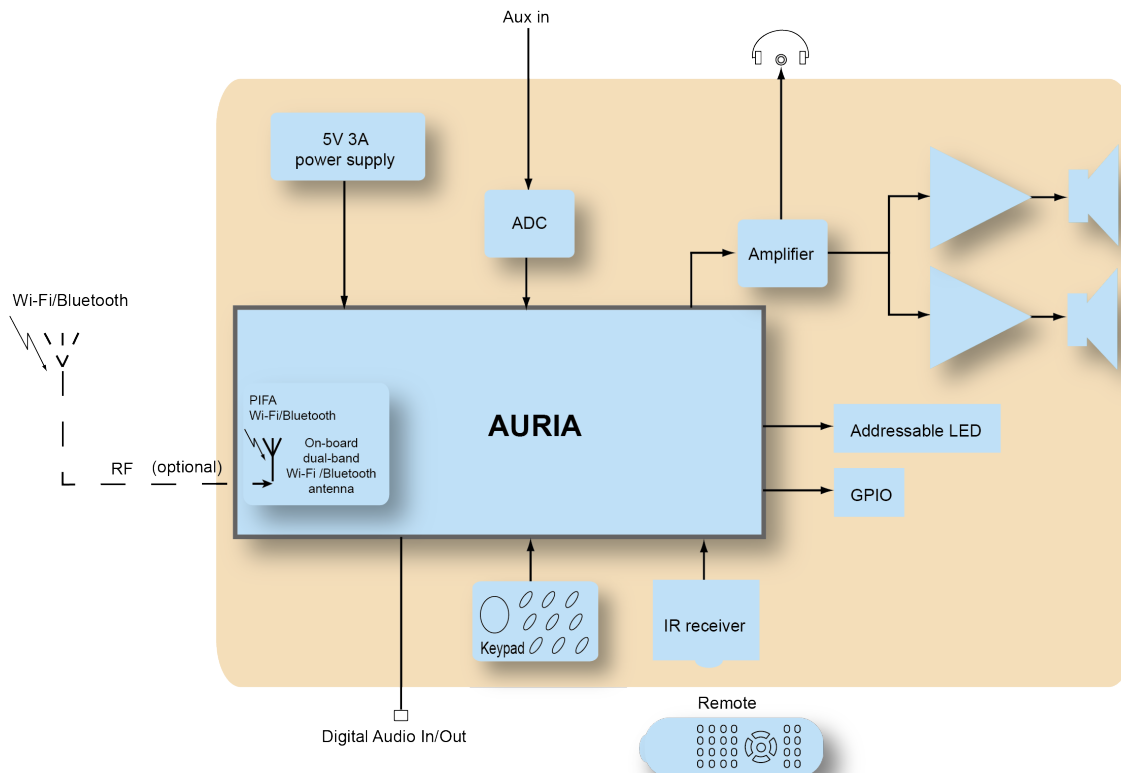


Figure 2: Example application diagram

3 Hardware interfaces

This chapter describes the hardware interfaces of AURIA.

Figure 3 shows the module's connector locations. Note the PIFA antenna or J5 external antenna are a hardware build option where only one can be selected.

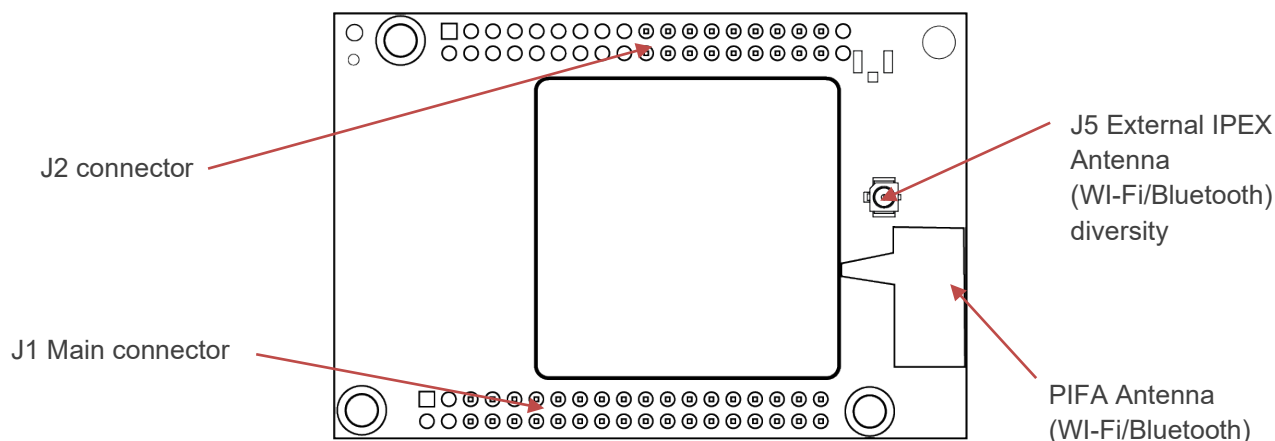


Figure 3: Connector locations (top view with screening can shown)

3.1 Connectors

3.1.1 J1 main connector

The main connector, 34-way (17x2) 2.00 mm pitch dual in line, carries all I/O signals and power supplies (space available for 38-way (19x2) for future development).

Pin no.	Pin name	Primary function	Secondary function
J1.1		Reserved	
J1.2		Reserved	
J1.3		Reserved	
J1.4		Reserved	
J1.5	5V_INPUT	5V power input	
J1.6	REG_ENABLE	5V regulator enable (pulled up on module - leave floating if not used)	
J1.7	PB24_UART_LOG_TX	Debug Log – not available in final product software	UD_DIS*
J1.8	PB23_UART_LOG_RX	Debug Log – not available in final product software	
J1.9	POR_n_1	DAB/FM reset	
J1.10	CHIP_EN	Main processor reset	
J1.11	ID_USB	USB	
J1.12	VBUS_OTG_USB	USB	

Pin no.	Pin name	Primary function	Secondary function
J1.13	USB_HSDP	USB	
J1.14	USB_HSDM	USB	
J1.15	3.3V	Reserved leave floating	
J1.16	GND		
J1.17	PA0_ADC0	ADC_Light sensor	
J1.18	PA1_ADC1	ADC_keypad A	
J1.19	PA3	Addressable LED controller line	
J1.20	PA2_ADC2	ADC_keypad B	GPIO_3v3
J1.21	PA4_IRRX	IR data input	
J1.22	PA5	GPIO OLED_RST/PWM_backlight	GPIO_3v3
J1.23	PA6	POWER on HOLD	
J1.24	PA7	GPIO HP detect	
J1.25	VBAT_MEAS	ADC Batt voltage	
J1.26	PA8	GPIO Standby	
J1.27	PB21	GPIO HP Mute	BOOT_SEL*
J1.28	GND		
J1.29	PB22	GPIO_Mute	TM_DIS*
J1.30	PA9_SPI1_MOSI	SPI-Data out_Display	GPIO_3v3
J1.31	PA10_SPI1_MISO	GPIO_Display_RS	GPIO_3v3
J1.32	PA11_SPI1_CLK	SPI-CLK_Display	GPIO_3v3
J1.33	PA12_SPI1_CS	SPI-CS_Display	GPIO_3v3
J1.34	GND		
J1.35	PA13	GPIO_3v3	UART0_RXD
J1.36	PA14	GPIO_3v3	UART0_TXD
J1.37	PB26	I2C_1	
J1.38	PB28	I2C_1	

Table 1: J1 pin assignments

* Boot config pins – must be allowed to float high at power-on during boot up.

Note: Typically only 34 pins will be fitted. The extra 4 are reserved for development use.

3.1.2 J2 Secondary connector

J J2 is 18-way (9x2), 2.00mm pitch pin header (space available for 38-way (19x2) for future development).

Pin no.	Pin name	Primary function	Secondary function
J2.1		Reserved	
J2.2		Reserved	
J2.3		Reserved	
J2.4		Reserved	
J2.5		Reserved	
J2.6		Reserved	
J2.7		Reserved	
J2.8		Reserved	
J2.9		Reserved	
J2.10		Reserved	
J2.11		Reserved	
J2.12		Reserved	
J2.13		Reserved	
J2.14		Reserved	
J2.15		Reserved	
J2.16		Reserved	
J2.17		Reserved	
J2.18		Reserved	
J2.19	PB13	I2S_DIN1	GPIO_3v3
J2.20	PB12	I2S_DIN0	GPIO_3v3
J2.21	PB7	I2S_MCLK	GPIO_3v3
J2.22	PB11	I2S_DOUT1	GPIO_3v3
J2.23	PB9	I2S_WS	GPIO_3v3
J2.24	PB8	I2S_BCLK	GPIO_3v3
J2.25	GND	GND	
J2.26	PB10	I2S_DOUT0	GPIO_3v3

Pin no.	Pin name	Primary function	Secondary function
J2.27	PB5	Analog audio out R+ (single ended output)	
J2.28	GND		
J2.29	PB3	Analog audio out R- (differential)	
J2.30	PB6	Analog audio out L+ (single ended output)	
J2.31	GND		
J2.32	PB4	Analog audio out L- (differential)	
J2.33	PA20	Analog A audio in L (single ended)	
J2.34	PA22	Analog A audio in R (single ended)	
J2.35	PA24	GPIO_1v8	
J2.36	PA25	GPIO_1v8	
J2.37		Reserved	
J2.38		Reserved	

Table 2: AURIA pin out (J2)

* Boot config pins – must be allowed to float high at power on during boot up.

Note: Typically only 18 pins will be fitted. The extra 20 are reserved for development use.

3.1.3 J5 Wi-Fi/Bluetooth antenna connector

The module supports 1x1 Wi-Fi diversity operation with 1 IPEX connector or coaxial solder points (J5) and the on-board PIFA antenna. The Wi-Fi/Bluetooth connections have an input impedance of 50 Ω .

Option	PIFA	RF1 (J5) IPEX
On board single PIFA antenna	√	-
Off board single external antenna	-	√
Diversity PIFA and single external antenna	√	√

Table 3: AURIA pin out (J5)

3.2 MAC addresses

AURIA is provided with four MAC addresses:

- Wi-Fi Station mode
- Wi-Fi SoftAP mode
- Bluetooth
- Spare

A printed label provides the MAC address for Wi-Fi Station mode. The ethernet MAC address can be determined by incrementing the number on the label, as shown in Table 4.

MAC address type	Increment from MAC address on label	Example
Wi-Fi Station mode (on label)	0	002261097244
Wi-Fi SoftAP	+1	002261097245
Bluetooth	+2	002261097246
Spare	+3	002261097247

Table 4: Determining AURIA MAC addresses

3.3 Serial Peripheral Interface (SPI)

AURIA supports one SPI compatible interface. This interface can be used to control a peripheral device such as a display.

3.4 Serial interface for external module

Serial interface for Slave unit. If required to be a UART/I2S slave device then pins below can be used for control .

Pin no.	Pin name	Primary function	Secondary function
J1.35	PA13	GPIO_3v3	UART0_RXD
J1.36	PA14	GPIO_3v3	UART0_TXD

Table 5 Serial interface for Slave/Bridge

3.5 Digital audio output (I2S)

Digital audio out/in is provided by the pins listed in Table 6 I2S interface connections.

Pin no.	Pin name	Primary function	Secondary function
J2.20	PB12	I2S_DIN0	GPIO_3v3
J2.21	PB7	I2S_MCLK	GPIO_3v3
J2.22	PB11	I2S_DOUT1	GPIO_3v3
J2.23	PB9	I2S_WS	GPIO_3v3
J2.24	PB8	I2S_BCLK	GPIO_3v3
J2.25	GND	GND	
J2.26	PB10	I2S_DOUT0	GPIO_3v3

Table 6 I2S interface connections

3.6 Analogue audio output

Audio outputs are available from AURIA. This can drive either line level (10kohm load) or Headphone level (16ohm load). The SNR of this output in single ended mode is better the 90dB.

Output can be differential or single ended mode.

Pin no.	Pin no.	Primary function	Secondary function
J2.27	PB5	Analog audio out R+ (single ended output)	
J2.28	GND		
J2.29	PB3	Analog audio out R- (differential)	
J2.30	PB6	Analog audio out L+ (single ended output)	
J2.31	GND		
J2.32	PB4	Analog audio out L- (differential)	

Table 7 analogue audio output connections

3.7 Analogue audio input

Stereo Audio line inputs are available to AURIA (Note: Analogue input must be AC coupled). The SNR of these inputs is expected to be better the 90dB.

Input is configured as single ended.

Pin no.	Pin no.	Primary function	Secondary function
J2.31	GND		
J2.33	PA20	Analog A audio in L (single ended)	
J2.34	PA22	Analog A audio in R (single ended)	

Table 8 analogue audio input connections

3.8 Module Controls

Digital signals for control of application hardware are provided on the main connector. Seven GPIOs are available to provide the following typical functions.

- Power hold on/off (when running on batteries).
- Battery detection.
- Audio PA power on/off.
- Hardware mute.

Pin no.	Pin name	Primary function	Secondary function
J1.23	PA6	POWER on HOLD	
J1.24	PA7	GPIO HP detect	
J1.26	PA8	GPIO Standby	
J1.27	PB21	GPIO HP Mute	BOOT_SEL *
J1.29	PB22	GPIO_Mute	TM_DIS*
J2.35	PA24	GPIO_1v8	
J2.36	PA25	GPIO_1v8	

Table 9 Audio control input

*Trap pins: should be high at power on for normal operation.

3.9 User Interface

To reduce the number of I/O required and ease the PCB tracking, ADC keypad detection is used. This uses one ADC (ACD1) on the AURIA and allows up to 8 keys. The ADC is rated to 1.8V maximum, refer to application information for implementation guidance.

This configuration does not allow detection of simultaneous button presses. If two keys (on the same ADC) are pressed simultaneously, an undefined key press may be registered. Therefore, the most important key functions (Mode, Select, Standby and Scan) should be assigned to lowest part of resistor chain, as they cannot be generated by any other keypad combination.

3.10 I2C interface

Pin no.	Pin name	Primary function	Secondary function
J1.37	PB26	I2C_1	
J1.38	PB28	I2C_1	

Table 10 I2C connections

3.11 BOOT pins

Boot configuration pins must not be pulled down during power up. They should be allowed to float high at power up. This is usually the case if they are connected to CMOS inputs of devices powered on at the same time as AURIA, but should be verified. After the device has booted they can be used for normal functions.

Pin no.	Pin name	Primary function	Secondary function
J1.7	PB24_UART_LOG_TX	Debug Log – not available in final product software	UD_DIS
J1.27	PB21	GPIO HP Mute	BOOT_SEL
J1.29	PB22	GPIO_Mute	TM_DIS

Table 11: BOOT configuration pins

3.12 Infrared remote

An Infrared Remote (IR) interface line is provided on the main interface connector.

Pin number	Pin name	Pin description
J1.21	PA4_IRRX	IR data input

Table 12: Infrared remote signals

4 Power supplies

The module is powered by a single 5 Volt external supply rail. This power supply should have a 2A peak current, and 1A continuous rating. There are DC/DC converters on the module to generate all the other supply rails needed.

For reliable operation, the supply should be clean, with ripple below 50 mVpp. AURIA includes some supply filtering on its DC supply lines, but any noise on these supplies will affect performance.

The voltage rails must be regulated with bulk decoupling, to cope with the burst requirements of the Wi-Fi Transceiver and to reduce noise and ripple. The capacitors and regulators should be mounted as close as possible to J1.

For best performance, the system PCB should include a solid ground plane. If this is not possible, the PCB should use large power tracks, with the ground connections from each regulator and smoothing capacitor joining close to the module.

4.1 Power-on Reset

The Frontier AURIA has its own POR circuit.

4.2 System standby power

AURIA's standby mode meets the EU Ecodesign requirements for products with standby and off mode:

- 2W under network connected standby.

5 Software

Frontier Smart Technologies provides modules pre-installed with software for reference applications, which can be configured to customer requirements. AURIA is supplied with Frontier Smart Technologies' CA1.x. Please contact Frontier Smart Technologies for further information.

6 Hardware options

AURIA has been designed specifically for use in high-performance, cost-efficient wireless speakers, soundbars and advanced audio systems, and supports several combinations of network audio capability.

6.1 Wi-Fi/Bluetooth connectivity

For Wi-Fi/Bluetooth connectivity, AURIA supports the following interfaces:

- On-board PIFA antenna for Wi-Fi/Bluetooth main antenna
- 1 x external Wi-Fi/Bluetooth antenna connection

6.2 Wi-Fi Band

AURIA supports both Wi-Fi bands:

- Dual band 2.4 GHz (20MHz) and 5 GHz (20MHz)

6.3 Bluetooth

AURIA supports Bluetooth 5.2 technology (BDR, EDR and LE)

6.4 Audio output options

AURIA supports analogue audio output from the on-board DAC, or digital audio output via the I2S interface.

7 Performance characteristics

7.1 Introduction

AURIA supports Wi-Fi 6 connectivity.

The figures in the following sections are for conditions:

- TA = 25°C

7.2 Wi-Fi performance

AURIA supports the mandatory modes required by Wi-Fi 6 (802.11b, 802.11g, 802.11a, 802.11ax and 802.11n) plus some optional modes, as listed in the tables in the following subsection. The maximum transmit power of the Wi-Fi module with its on-board PIFA antenna will not exceed >20dBm (23dBm UNII-1 band) Effective Isotropic Radiated Power (EIRP), in order to meet European regulatory requirements:

AURIA supports the 2.4 GHz and 5 GHz Wi-Fi frequency bands.

7.2.1 2.4GHz Wi-Fi performance

Maximum allowable external antenna gain: $\leq 2.21\text{dBi}$ (2400MHz – 2483.5MHz)

AURIA onboard PIFA measured antenna gain: $\leq 1.86\text{dBi}$ (2400MHz – 2483.5MHz)

Note: Conducted Tx powers are set to work with the maximum antenna gain of 2.5dBi, if external antenna gain is greater than the values specified in section 9.6.2, then extra testing may be required, refer to section 9.6.2 for antenna details.

- ISM (2.400...2.4835GHz) channel: 1,2,3,4,5,6,7,8,9,10,11 (FCC region)
- ISM (2.400...2.4835GHz) channel: 1,2,3,4,5,6,7,8,9,10,11,12,13 (World Wide region)

Parameter	Test Condition	Typ ^a	Max ^b	Units
Transmitter power	At 50Ω port (conducted, RMS) ^d	13.5	16	dBm
	2.5dBi PIFA antenna (radiated) ^c	16	18.5	dBm EIRP
Receive sensitivity (conducted)	BPSK, 1 Mbps, 10% PER	-97	-	dBm
	CCK, 11Mbps, 10% PER	-88	-	dBm

Table 13: 2.4GHz Wi-Fi 802.11b performance parameters

- a Typical values are quoted for typical supply voltages at ambient temperature.
- b Maximum values are quoted over the operating range (TA = 0°C to 70°C) and supply voltage +/- 5%.
- c All radiated values performed using a AURIA reference system
- d Maximum peak conducted power < 30dBm

Parameter	Test Condition	Typ ^a	Max ^b	Units
Transmitter Power	At 50Ω port (conducted, RMS) ^d	15	17.5	dBm
	2.5 dBi PIFA antenna (radiated) ^c	17.5	20	dBm EIRP
Receive sensitivity (conducted)	BPSK, R=1/2, 6 Mbps, 10% PER	-93	-	dBm
	64-QAM, R=3/4, 54Mbps, 10% PER	-75	-	dBm

Table 14: 2.4GHz Wi-Fi 802.11g performance parameters

- a. Typical values are quoted for typical supply voltages at ambient temperature.
- b. Maximum values are quoted over the operating range (TA = 0°C to 70°C) and supply voltage +/- 5%.
- c. All radiated values performed using a AURIA reference system.
- d. Maximum peak conducted power < 30dBm

Parameter	Test Condition	Typ ^a	Max ^b	Units
Transmitter Power	At 50Ω port (conducted, RMS) ^d	15	17.5	dBm
	2.5 dBi PIFA antenna (radiated) ^c	17.5	20	dBm EIRP
Receive sensitivity (conducted)	MCS0 (6.5Mbps), 10% PER	-93	-	dBm
	MCS7 (65Mbps), 10% PER	-74	-	dBm

Table 15: 2.4GHz Wi-Fi 802.11n (20MHz) performance parameters

- a. Typical values are quoted for typical supply voltages at ambient temperature.
- b. Maximum values are quoted over the operating range (TA = 0°C to 70°C) and supply voltage +/- 5%.
- c. All radiated values performed using a AURIA reference system.
- d. Maximum peak conducted power < 30dBm

7.2.2 5GHz Wi-Fi performance

Maximum allowable external antenna gain: $\leq 3.42\text{dBi}$ (5150MHz – 5350MHz, 5725MHz – 5850MHz)
 $\leq 4.54\text{dBi}$ (5470MHz – 5725MHz)

AURIA onboard PIFA measured antenna gain: $\leq 3.02\text{dBi}$ (5150MHz – 5875MHz)

Note: Conducted Tx powers are set to work with the maximum antenna gain of 3.5dBi (5150MHz – 5350MHz, 5725MHz – 5850MHz) and 4.6dBi (5470MHz – 5725MHz), if external antenna gain is greater than the values specified in section 9.6.2, extra testing may be required, refer to section 9.6.2 for antenna details.

- UNII-1 (5.150...5.250GHz) 20MHz channel: 36, 40, 44, 48
- UNII-2a (5.250...5.350GHz) 20MHz channel: 52, 56, 60, 64
- UNII-2c (5.470...5.725GHz) 20MHz channel:
100,104,108,112,116,120,124,128,132,136,140 (World Wide)
- UNII-2c (5.470...5.725GHz) 20MHz channel:
100,104,108,112,116,132,136,140 (Canada)
- UNII-3 (5.725...5.850GHz) 20MHz channel: 149,153,157,161,165
- UNII-4 (5.850...5.925GHz) 20MHz channel: 169,173 – Not currently supported.

Parameter	Test Condition	Typ ^a	Max ^b	Units
Transmitter Power	At 50Ω port (conducted, RMS) UNII-1	15	18	dBm
	At 50Ω port (conducted, RMS) UNII-2a	13	16	
	At 50Ω port (conducted, RMS) UNII-2c	12	15	
	At 50Ω port (conducted, RMS) UNII-3	8	11	
	3.5 dBi PIFA antenna (radiated) ^c UNII-1	18.5	23	dBm EIRP
	3.5 dBi PIFA antenna (radiated) ^c UNII-2a	16.5	20	
	3.5 dBi PIFA antenna (radiated) ^c UNII-2c	15.5	19	
	3.5 dBi PIFA antenna (radiated) ^c UNII-3	11.5	14	
Receive sensitivity (conducted)	BPSK, R=1/2, 6 Mbps, 10% PER	-92	-	dBm
	64-QAM, R=3/4, 54Mbps, 10% PER	-74	-	dBm

Table 16: 10% PER 5GHz Wi-Fi 802.11a performance parameters

- Typical values are quoted for typical supply voltages at ambient temperature.
- Maximum values are quoted over the operating range (TA = 0°C to 70°C) and supply voltage +/- 5%.
- All radiated values performed using a AURIA reference system.

Parameter	Test Condition	Typ ^a	Max ^b	Units
Transmitter Power	At 50Ω port (conducted, RMS) UNII-1	15	18	dBm
	At 50Ω port (conducted, RMS) UNII-2a	13	16	
	At 50Ω port (conducted, RMS) UNII-2c	12	15	
	At 50Ω port (conducted, RMS) UNII-3	8	11	
	3.5 dBi PIFA antenna (radiated) ^c UNII-1	18.5	23	dBm EIRP
	3.5 dBi PIFA antenna (radiated) ^c UNII-2a	16.5	20	
	3.5 dBi PIFA antenna (radiated) ^c UNII-2c	15.5	19	
	3.5 dBi PIFA antenna (radiated) ^c UNII-3	11.5	14	
	MCS0 (6.5Mbps), 10% PER	-92	-	dBm
	MCS7 (65Mbps), 10% PER	-73	-	
	MCS8 (78Mbps), 10% PER	-69	-	

Table 17: 5GHz Wi-Fi 802.11n/ac (20MHz) performance parameters

- Typical values are quoted for typical supply voltages at ambient temperature.
- Maximum values are quoted over the operating range (TA = 0°C to 70°C) and supply voltage +/- 5%.
- All radiated values performed using a AURIA reference system.

7.2.3 Bluetooth Performance

AURIA can support Bluetooth 4.2, 5.0, 5.2 and LE.

Table 18 gives the Estimated Bluetooth BDR, EDR and LE performance for the AURIA module.

Parameter	Test Condition	Typ ^a	Max ^b	Units
Transmitter Power	At 50Ω port (conducted, RMS) - BDR, LE	5.5	7.5	dBm
	At 50Ω port (conducted, RMS) - EDR	4.5	7.5	dBm
	2.5 dBi PIFA antenna (radiated) ^c - BDR, LE	8	10	dBm EIRP
	2.5 dBi PIFA antenna (radiated) ^c - EDR	7	10	dBm EIRP
Receive sensitivity Basic Data rate (BDR)	1DH1 (1Mbps)	-94	-	dBm
Receive sensitivity Enhanced Data rate (EDR)	2DH1 (2Mbps)	-94	-	
	3DH1 (3Mbps)	-88	-	
Receive sensitivity Low-Energy (LE)	1LE	-98	-	
	2LE	-95	-	

Table 18: AURIA Bluetooth performance parameters

- a. Typical values are quoted for typical supply voltages at ambient temperature.
- b. Maximum values are quoted over the operating range (TA = 0°C to 70°C) and supply voltage +/- 5%.
- c. All radiated values performed using an AURIA reference system.

7.3 Audio specification

The audio output is DC coupled from AURIA. If AC coupling is required, then add series capacitors to the platform.

Parameter	Min	Typ	Max	Units	Comments
Load resistance	3.0	10	-	kΩ	To mid-rail or AC coupled
Signal level	-	0.4	-	VRMS	into 10 kΩ 0dBFS
THD (full scale DAB)	-	0.02	0.05	%	THD full scale 1kHz
SNR	87	90	-	dB	DAB mode

Table 19: Audio performance (TA = 25 °C, supply voltage = 5V)

8 Electrical specification

8.1 Absolute maximum ratings

All figures are stated for a temperature of 25 °C.

Caution Exceeding these values may damage the module.

Parameter	Min	Typ	Max	Units	Comments
5 Volt supply rail	3.6	5.0	5.5	V	
Operating temperature	0		TBD	°C	
Storage temperature	-40		+85		
Humidity	TBD		TBD	%	Non-condensing
Other inputs	TBD		TBD	V	
Aux ADC inputs	TBD		TBD	V	
Outputs	TBD		TBD	mA	

Table 20: Maximum operating conditions

8.2 Typical operating conditions

Table 21 shows the power supply voltage ranges.

Parameter	Test Condition	Symbol	Min	Typ	Max	Units
5 Volt supply rail	-	VDD5V	4.5	5	5.3	Volts

Table 21: Typical operating conditions

8.3 Power consumption

Table 22 shows typical power consumption; this depends on the operating mode, data rates and module variant (see 6 Hardware options page 18). These figures include GPIO driving current to the display, but not the display backlight, the current for which is supplied externally to the module. Maximum power supply requirements are shown in 4 Power supplies, page 16.

Mode/State	Wi-Fi Active	Bluetooth active	Average Current @5V (mA)	Power (mW)
Standby	Yes	No	60	298
Power on - idle	µAP Active	No	94	470
Power on - idle (Wi-Fi connected)	Yes	No	59	297
Spotify over Wi-Fi	Yes	No	106	529
Airplay over Wi-Fi	Yes	No	109	543
Bluetooth Classic	Yes	Yes	81	407

Mode/State	Wi-Fi Active	Bluetooth active	Average Current @5V (mA)	Power (mW)
Spotify -> BMS	Yes	Yes	145	724
Spotify -> BMR	Yes	Yes	97	484
Aux in -> BMS	Yes	Yes	105	524
Aux in -> BMR	Yes	Yes	79	393

Table 22: Typical Power Consumption

9 Mechanical specification

9.1 Physical specification

AURIA is a single-sided assembly built on a 4-layer printed circuit board. A mandatory screening can is provided.

The module has two connectors: One (up to) 38 way (19x2) and one 36 way (18x2), both 2.00mm pitch pin headers.

In the diagrams shown in this chapter, dimensions are stated in mm. Tolerances are:

Linear: ± 0.1 mm

Angles: $\pm 0.5^\circ$

unless otherwise stated.

Connector pin length and carrier tolerance are ± 0.3 mm.

9.2 Physical layout

The following image show the dimensions of the AURIA module in mm.

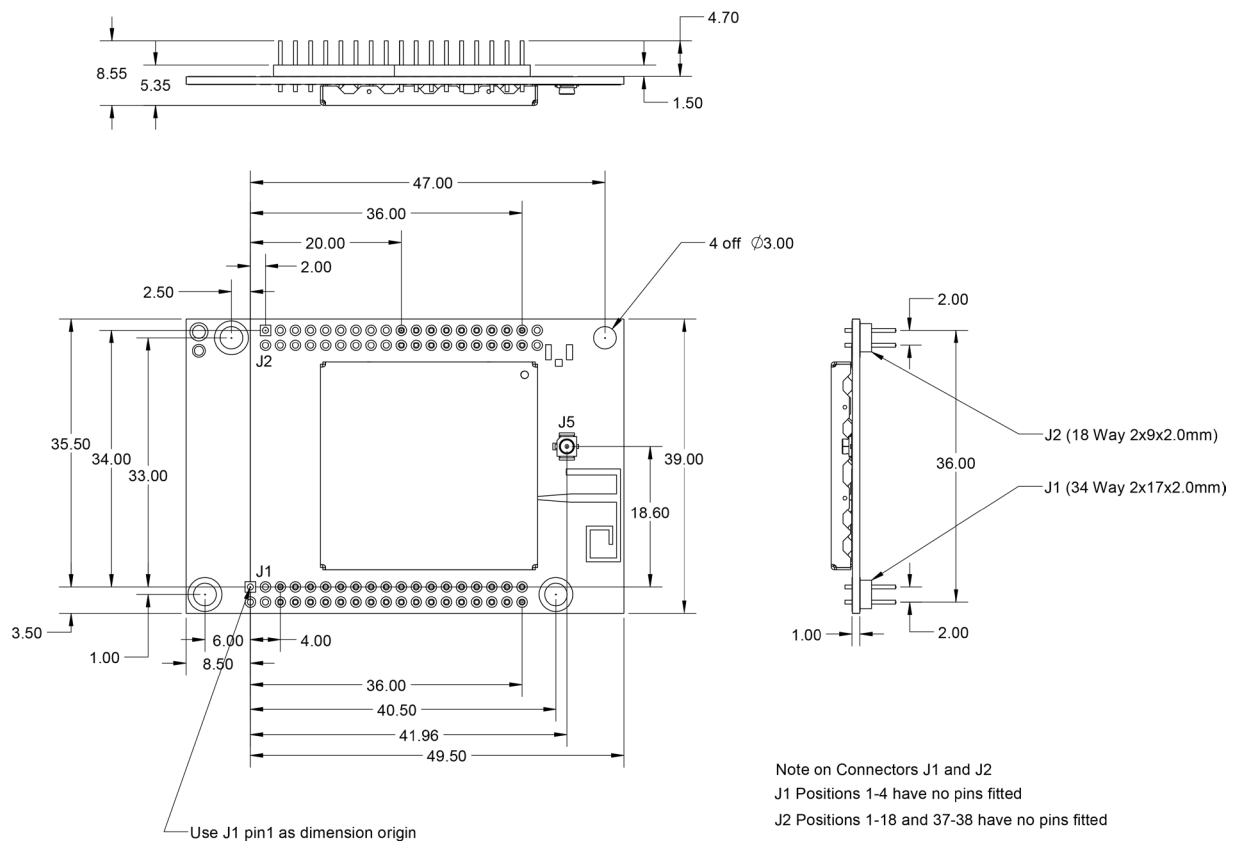


Figure 4: Board dimensions (with screening can shown)

9.3 Mounting

9.3.1 Cooling

Adequate clearance must be provided to allow air cooling of the module under heavy Wi-Fi and processing activity. Minimum 10mm with good airflow.

9.3.2 RF Clearance

The normal Wi-Fi operation relies on transmissions of RF signals at 2.4 and 5 GHz. Ensure that sensitive circuitry is no nearer than necessary to avoid electromagnetic pulse malfunction. Recommended 20-40mm clearance. This clearance is also required to avoid Wi-Fi radiation pattern degradation due to antenna effects.

9.3.3 Ground

No physical attachments to be made to the screen can lid (to avoid displacement and degradation of screening integrity).

9.4 Labels

AURIA is supplied with two labels.

- 1) Manufacturing serial number
- 2) Wi-Fi/Bluetooth MAC addresses

9.5 RF antenna connectors

RF antenna connectors for AURIA are described in RF Connector Assembly Details, RF connector specifications are uniform across Frontier Smart Technologies modules.

9.6 Wi-Fi/Bluetooth antennas

9.6.1 On-board antenna

The AURIA module provides an on-board PIFA antenna:

Manufacturer:	Frontier Smart Technologies Ltd.
Model:	FS2345
Antenna Type:	PIFA antenna
Max measured gain:	1.86 dBi at 2402-2480MHz; 3.03 dBi at 5150-5350MHz; 2.04 dBi at 5470-5725MHz; 0.22 dBi at 5725-5850MHz;

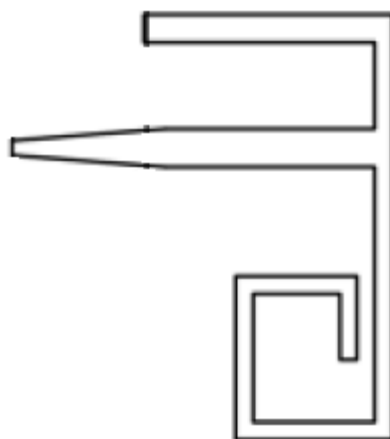


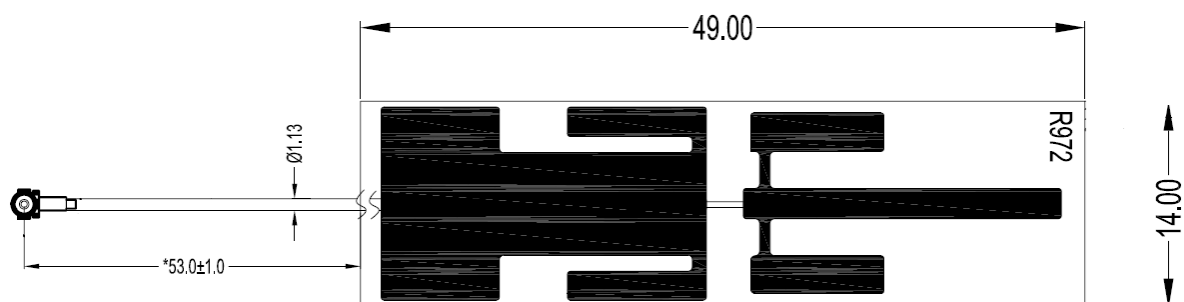
Figure 5: Physical drawing of on-board PIFA Antenna

9.6.2 External antenna

The Wi-Fi/Bluetooth external antenna has an input impedance of $50\ \Omega$, using IPEX connector.

The AURIA module is tested for FCC/IC modular approval in standalone configuration with following external antenna:

Manufacturer:	Shenzhen South Star Technology Co. Ltd
Model:	SW750M-JH
Part number:	N12-2985-R0A
Antenna Type:	PIFA antenna
Max Gain:	2.21 dBi at 2390-2500MHz
	2.11 dBi at 5150-5250MHz
	3.42 dBi at 5250-5350MHz
	4.54 dBi at 5470-5725MHz
	3.05 dBi at 5725-5850MHz



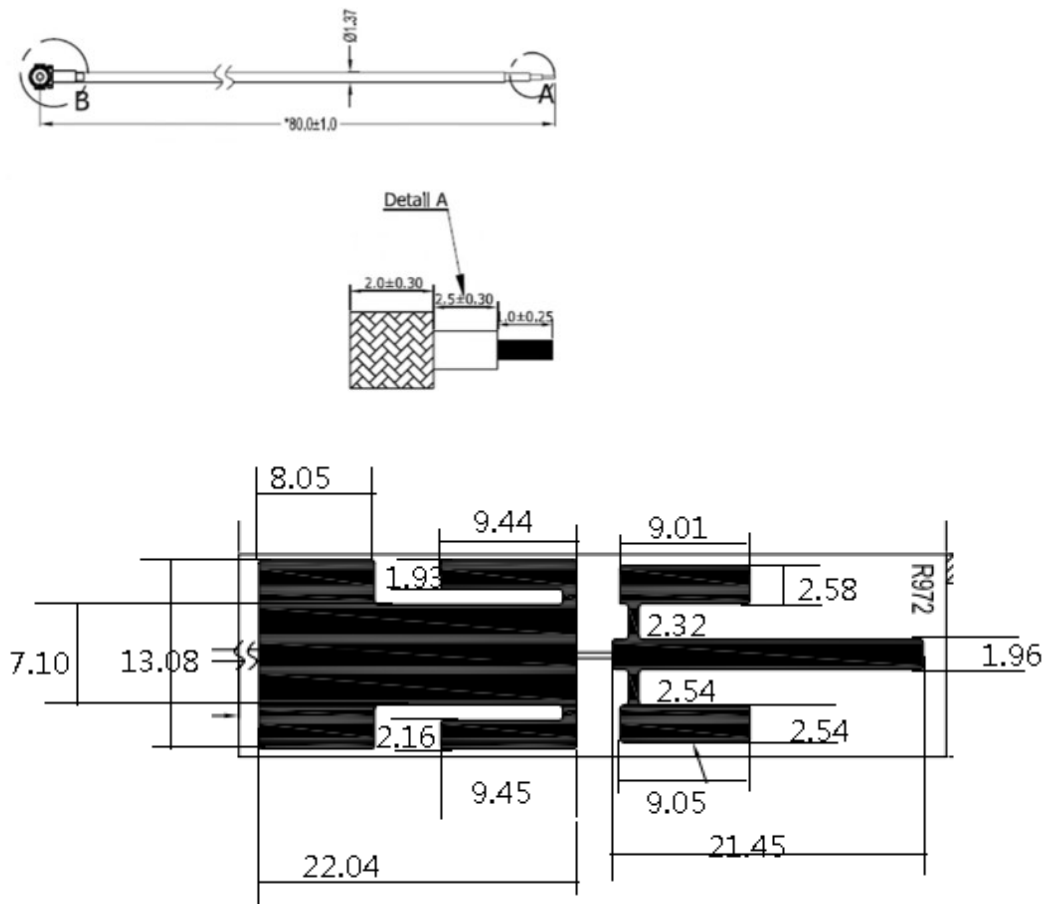


Figure 6: Physical dimensions of external Antenna

9.6.3 Antenna Type and placement in the host product

The AURIA module with FCC ID: YYX-FS2345 and IC: 11458A-FS2345 is provided with an IPEX connector for connection to external antenna stated in 9.6.1 and 9.6.2. Host Manufacturer should ensure that the host antenna connector must be unique. The antenna type states above are the only authorised antenna type for FCC ID: YYX-FS2345 and IC: 11458A-FS2345. The antenna must be placed in the host product to comply with the following conditions:

- Must be placed in internal part of the product enclosure
- Host Manufacturer Product user guide must include a warning:

Warning: Removal/replacement of the original antenna is not allowed and to do so will invalidate FCC/IC modular approval.

- If the end users can replace the antenna, the host antenna connector must be unique, using a non-unique connector on the host will invalidate the FCC/IC modular approval.
- The host product manufacturer must seek advice from a Technical Competent Body (TCB) if they want to use a similar antenna with different gain than the antenna type listed. Compliance to FCC and Industry Canada's licence-exempt RSS is the responsibility of the AURIA module integrator if any antenna other than the antenna listed above is used with the AURIA module. If any new antenna type, or antenna with higher gain is used, that would require a Class II permissive change and the requirements of Part 15C (15.203) must need to be met.

10 Compliance standards

The module is designed to comply with the applicable standards in:

- Europe (RED)
- North America (FCC/IC)

AURIA has been tested to comply with the standards listed in the following sections.

It is the responsibility of the end-product designer/manufacturer to ensure that the end-product complies with the standards applicable in the countries where the product is to be used.

The electromagnetic compatibility of a particular product is dependent upon the use and installation of the module within the product. Care should be taken to integrate the module with due regard to the effects of conducted and radiated signals.

Frontier Smart Technologies FAEs will advise on compliance issues. The radio/EMC/Wi-Fi performance will depend significantly on the end product design.

10.1 Electrostatic discharge (ESD) protection

AURIA is an ESD-sensitive device. It is tested to BS EN 6100-4-2 0. Special handling precautions should be used during manufacturing and testing. For example, use electrostatic controls compliant with ANSI/ESD S20.20 0, or JEDEC Standard JESD-625 0.

10.2 Restriction of Hazardous Substances (RoHS)

All Frontier Smart Technologies products meet the requirements of the EU RoHS directive (EU) 2015/863 (also known as RoHS 3 Directive), use RoHS-certified components and are assembled using lead-free processes. See the Frontier Smart Technologies Declaration of Materials Compliance.

Additionally, Frontier Smart Technologies adheres to best industry practice regarding the avoidance of environmentally harmful substances in products, above and beyond legal requirements such as RoHS.

- Directive for Restriction of Hazardous Substances 2015/863
- Sony Green Standard (Management Regulations for the Environment-related Substances to be Controlled which are Included in Parts and Materials) SS-00259.

10.3 ErP Standby Directive

AURIA's standby mode with clock display active meets the Energy-related Products (ErP) Standby Directive effective from 2025:

- 0.5W when not connected to any network and in standby
- 2W under network connected standby.

EU Directives

ECO-design Directive for Energy-using Products

(EU) 2023/826

10.4 Bluetooth SIG Requirements

AURIA has been tested by a third party to ensure that the Bluetooth SIG radio requirements for Class 1 Bluetooth 5.2 radio (RF PHY Category A tests) are met.

10.5 Wi-Fi

AURIA module is designed to comply with applicable standards in Europe and America.

10.5.1 Europe - RED

AURIA module will comply with the RED Directive to the following standards:

- EN 300 328: V2.2.2 (Data transmission equipment operating in the 2.4 GHz ISM band and using wideband modulation techniques; Harmonised Standard covering the essential requirements article 3.2 of Radio Equipment Directive (RED) 2014/53/EU.
- Radio Performance Testing of Wireless LAN Product to EN 301 893: V2.1.1 (5 GHz high performance RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU)
- Radio Performance Testing to EN 300 440 V2.1.1 (Short Range Devices (SRD) Radio equipment to be used in the 1GHz to 40GHz frequency range; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU) [21]
- EN 301 489-17 v3.2.0 (Electro-Magnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard covering the essential requirements article 3.1(b) of Radio Equipment Directive (RED) 2014/53/EU
- Safety testing – EN 62368-1:2014+A11:2017
- Maximum Permissible Exposure (MPE) Calculation to EN 62311: 2008 (human exposure to electromagnetic fields).

10.5.2 North America – FCC/IC

- Part 15C (15.247 / RSS-247 issue 3 August 2023)
- Part 15E (15.407 / RSS-247 issue 3 August 2023)

Auria will be available with Federal Communications Commission FCC modular certification, with an FCC ID label fixed on the module.

- Radio Performance Testing to FCC Part 15 Subpart E Clause 407 (Unlicensed National Information Infrastructure Device), covering 5150 MHz to 5350 MHz, 5470 MHz to 5725 MHz and 5725 MHz to 5875 MHz
- Radio Performance Testing of Wireless LAN Product to FCC Part 15 Sub Part C Clause 247 (Spread Spectrum radio systems)
- Auria will comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules
- Maximum Permissible Exposure (MPE) Calculation to OET Bulletin 65 Supplement C
- RF exposure Assessment to CFR47 Pt 1.1310, and RSS-102 Issue 6 December 2023

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

10.6 Electromagnetic Compatibility

AURIA has been validated for EMC purposes in the 3D platform, a configuration representative of typical consumer product

11 FCC Statement

The Auria module is conformant with FCC standards under single modular approval only. This is intended to provide customers a convenient way to achieve conformity with FCC part15C and part 15E rules applicable to the transmitter part of the module.

DECLARATION OF CONFORMITY WITH FCC RULES FOR ELECTROMAGNETIC COMPATIBILITY

Frontier Smart Technologies Limited declares under its sole responsibility that the product FCC ID: YYX-FS2345, to which this declaration relates, complies with part 15C and part 15E of the FCC rules for the transmitter operation of the Auria module.

The device complies with part 15 of the FCC rules.:

This modular is intended only for host integrators, under the following conditions:

1. The antenna must be installed such that 20cm is maintained between the antenna and users
2. The transmitter module may not be co-located with any other transmitter or antenna.

The host integrator is responsible for testing the end-product for any additional compliance requirements required with this module installed.

This module must not be installed to co-locate and operate simultaneously with other radios in the host system except by following FCC multi-transmitter product procedures.

Additional testing and device authorization may be required to operate simultaneously with other radios.

The host product manufacturer is responsible for compliance with any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

The separate approval is required for all other operating configurations including portable configurations with respect to Part 2.1093 and different antenna configuration.

The end-user manual shall include all required regulatory information/warnings as shown in this manual, including “This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body” . The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install module.

The manufacturer of the final product containing the Auria module must ensure that the product includes an exterior label with the following wording: “Contains FCC ID: YYX-FS2345”.

MODIFICATION: Any changes or modifications not expressly approved by the grantee of this device could void the user’s authority to operate the device.

12 IC Statement

The Auria complies with Industry Canada's licence-exempt RSSs. This is intended to provide customers a convenient way to achieve conformity with IC rules applicable to the transmitter part of the module.

DECLARATION OF CONFORMITY WITH FCC RULES FOR ELECTROMAGNETIC COMPATIBILITY

Frontier Smart Technologies Limited declares under its sole responsibility that the product IC: 11458A-FS2345 to which this declaration relates, complies with Industry Canada's licence-exempt RSSs for the transmitter operation of the Auria module.

It is the responsibility of the final product manufacturer to achieve conformance with Industry Canada's licence-exempt RSSs for all other operating modes, in the final application.

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

- 1: This device may not cause interference. and
- 2: This device must accept any interference received, including interference that may cause undesired operation.

The manufacturer of the final product containing the Auria module must ensure that the product includes an exterior label with the following wording: "Contains IC: 11458A-FS2345".

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

Use Restriction: Operation at 5150 to 5250 MHz is restricted to indoor use only.

12.1 Déclaration de l'IC

L'Auria est conforme aux normes RSS sans licence d'Industrie Canada. Cela a pour but d'offrir aux clients un moyen pratique d'assurer la conformité avec les règles de l'IC applicables à la partie émettrice du module.

DÉCLARATION DE CONFORMITÉ AVEC LES RÈGLES DE LA FCC POUR LA COMPATIBILITÉ ÉLECTROMAGNÉTIQUE

Frontier Smart Technologies Limited déclare sous sa seule responsabilité que le produit IC: 11458A-FS2345 auquel cette déclaration se rapporte, est conforme aux normes RSS sans licence d'Industrie Canada pour l'opération émettrice du module Auria.

Il incombe au fabricant du produit final de garantir la conformité avec les normes RSS sans licence d'Industrie Canada pour tous les autres modes de fonctionnement, dans l'application finale.

Cet appareil est conforme aux normes RSS sans licence d'Industrie Canada. Son fonctionnement est soumis aux deux conditions suivantes :

- (1) Cet appareil ne doit pas causer d'interférences nuisibles, et
- (2) Cet appareil doit accepter toute interférence reçue, y compris celle qui pourrait provoquer un fonctionnement indésirable.

Le fabricant du produit final contenant le module Auria doit s'assurer que le produit inclut un étiquette extérieure comportant la mention suivante : « Contient IC: 11458A-FS2345 »

Cet équipement est conforme aux limites d'exposition aux radiations définies par IC pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre l'émetteur et votre corps.

Restriction d'utilisation : L'utilisation dans la bande de 5150 à 5250 MHz est limitée à un usage intérieur uniquement.

12.2 FCC and IC label

The manufacturer of the final product containing the Auria module must ensure that the product includes an exterior label with the following wording: "Contains FCC ID: YYX-FS2345, Contains IC: 11458A-FS2345"

and,

The device complies with part 15 of the FCC and IC licence-exempt RSSs 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.

12.2.1 1 Étiquette FCC et IC

Le fabricant du produit final contenant le module Auria doit s'assurer que le produit inclut une étiquette extérieure comportant la mention suivante : « Contient FCC ID : YYX-FS2345, Contient IC: 11458A-FS2345 »

et,

L'appareil est conforme à la partie 15 des règles FCC et des normes RSS sans licence de l'IC. Son fonctionnement est soumis aux deux conditions suivantes :

- (1) Cet appareil ne doit pas causer d'interférences nuisibles, et
- (2) Cet appareil doit accepter toute interférence reçue, y compris celle qui pourrait provoquer un fonctionnement indésirable.

13 References

The following documents provide background, peripheral or more detailed information for AURIA. They are not all specifically referenced within the text of this datasheet.

Domain	Document	
	Title	Number
Frontier Smart Technologies	Environmental Policy	EMS00002
	Application Note	TBD
IEC	Safety	IEC 62368-1:2014
British Standards	Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge (ESD) immunity test.	BS EN 61000-4-2
	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0Hz - 300 GHz)	EN 62311: 2008 OET Bulletin 65 Supplement C RSS-102 Issue 4 March 2010
ETSI Standards	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum	EN 300 328:V2.2.2
	5 GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU	EN 301-893:V2.1.1
	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU	EN 301 489-17 V3.2.0
	Broadcast Sound Receivers; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU	EN 303 345 v1.1.7
EU Directives	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment	2015/863
	ECO-design Directive for Energy-using Products	(EU) 2023/826
FCC	Federal Communications Commission	47CFR15
	Radio Frequency radiation exposure limits	47CFR 1.1310
Sony	Management Regulations for the Environment-related Substances to be Controlled which are Included in Parts and Materials	SS-00259

Domain	Document	
	Title	Number
JEDEC	Electrostatic Discharge (ESD) Sensitivity Testing Human Body Model (HBM)	JESD22-A114
	Requirements For Handling electrostatic discharge-sensitive (ESDS) devices	JESD625
ANSI	ESD Association Standard for the Development of an Electrostatic Discharge Control Program for – Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)	ESDS20.20
ETSI Standards	Short Range Devices (SRD) Radio equipment to be used in the 1GHz to 40GHz frequency range; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU	EN 300 440 V2.1.1

14 Glossary

ADC	Analogue to Digital Converter
BDR	Base Data Rate
BLE	Bluetooth Low Energy
EDR	Enhance Data Rate
EIRP	Equivalent Isotropic Radiated Power
EMC	Electro Mechanical Compatibility
ETSI	European Telecommunications Standards Institute
FAE	Field Applications Engineer
GPIO	General Purpose Input/Output
I2C	Inter-Integrated Circuit
I2S	Intergrated Interchip Sound
LE	Low Energy (Bluetooth)
LED	Light-emitting Diode
PIFA	Printed Inverted-'F' Antenna
RED	Radio Equipment Directive
SNR	Signal to Noise Ratio
SPI	Serial Peripheral Interface
TBD	To be determined
THD	Total Harmonic Distortion
USB	Universal Serial Bus

