



WAHOO FITNESS EQUIPMENT PROFILE

Application Developers Guide

Version 0.1

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WAHOO FITNESS INTELLECTUAL PROPERTY

THIS DOCUMENT IS INTENDED FOR USE BY APPLICATION DEVELOPERS TO CREATE APPLICATIONS COMPATIBLE WITH THE WAHOO FITNESS GEM MODULE. USE OF THE TECHNICAL INFORMATION CONTAINED IN THIS DOCUMENT TO CREATE COMPETING HARDWARE TO THE WAHOO GEM MODULE IS STRICTLY PROHIBITED.

Wahoo Fitness Equipment Profile

Overview

The Wahoo Fitness Machine Profile defines the services and characteristics exposed to an application connecting over the Bluetooth Smart with a fitness equipment device that has incorporated the Wahoo Fitness GEM OEM module or Wahoo Fitness GEM retrofit module.

Wahoo Fitness Equipment Profile

In the Wahoo Fitness Equipment Profile the GEM module acts as the peripheral (or GATT server) and the mobile device will act as the central (or GATT client).

All values transmitted are in little endian format.

Wahoo Fitness Equipment Advertisement Packet

The Wahoo Fitness Equipment Advertisement Packet denotes that the Wahoo GEM is scannable, connectable, and has limited-discoverability. When the GEM module is advertising and scanned by the Bluetooth low energy central device, the Wahoo GEM will report its complete local name and the service UUID of the Wahoo Fitness Equipment Service.

Wahoo Fitness Equipment Services

Once in a connection, the Wahoo GEM will report the following services to the connected Bluetooth Central device:

Device Information Service

UUID=180A

GEM Module Firmware update Service

UUID = A026EE01-0A7D-4AB3-97FAF1500F9FEB8B

Wahoo Fitness Equipment Service

UUID = A026EE07-0A7D-4AB3-97FAF1500F9FEB8B

Device Information Service - UUID 180A

This service is a standard service of Bluetooth low energy devices and is used to expose manufacturer and/or vendor information about a device. The fitness machine console integrated with the Wahoo GEM OEM module or GEM retrofit module uses the CSAFE protocol to provide data for these characteristics. For further details on using the Wahoo CSAFE application programming interface, please refer to the Wahoo Fitness Machine CSAFE protocol users guide.

The Wahoo Fitness Machine exposes the following data using the Device Information Service characteristics:

Characteristic	Properties	Permissions	Comments
Manufacturer Name	Read	None	
Model Number	Read	None	Not currently supported
Serial Number	Read	None	Not currently supported
Hardware Revision	Read	None	Not currently supported
Firmware Revision	Read	None	
Software Revision	Read	None	Not currently supported
System ID	Read	None	Not currently supported

These values for these characteristics are read using the Characteristic Value Read Procedure.

Example for Device Information Service

UUID	Characteristic	Value	Interpretation
2A29	Manufacturer Name	0x537461722054726163	Star Trac
2A26	Firmware Version	0x312E30	1.0

Note: If the CSAFE Master is not connected to the GEM module, the Device Information Service will display the Wahoo GEM module manufacturer name, hardware revision number, and firmware revision number.

Wahoo GEM Firmware Update Service - UUID = A026EE01-0A7D-4AB3-97FAF1500F9FEB8B

The Wahoo GEM Firmware Update Service is used to update GEM module firmware over the air. Use of this service in a customer application is currently beyond the scope of this document. Future revisions to this document will include details of this service and how it can be used in a customer application.

Wahoo Fitness Equipment Service – UUID A026EE07-0A7D-4AB3-97FAF1500F9FEB8B

This service is a custom service used to expose exercise and equipment specific data for a fitness equipment device. Data for this service is written to the integrated GEM OEM module or GEM retrofit module using CSAFE protocol commands. For further details on using the Wahoo CSAFE application programming interface, please refer to the Wahoo Fitness Machine CSAFE protocol users guide.

The Wahoo Fitness Equipment service exposes the following characteristics:

- Fitness Equipment Type
- Fitness Equipment State
- Fitness Equipment State Name
- Fitness Equipment Measurement
- Fitness Equipment Workout Program Name Characteristic
- Sensor Measurement Input

Details of these characteristics are provided in the next section of this document.

Fitness Equipment Type Characteristic

The Fitness Equipment Type Characteristic exposes the Fitness equipment type such as treadmill, bike, elliptical, etc.

Characteristic UUID

UUID = A026E01F-0A7D-4AB3-97FAF1500F9FEB8B

Characteristic Properties

The Fitness Equipment Type Characteristic supports Read and Notify

Packet Format

Name	Field Requirement	Format	Additional Information	
Model Code	Mandatory	uint8	Value	Meaning
			0	Unknown
			1	Treadmill
			2	Bike
			3	Stepper
			4	Step Mill
			5	Cross Trainer
			6	Total Body Trainer
			7	Tread Climber
8	Rower			

Example for Fitness Equipment Type Characteristic

UUID	Value	Interpretation
A026E01F-0A7D-4AB3-97FAF1500F9FEB8B	02	The Fitness Equipment is a Bike

Fitness Equipment State Characteristic

The Fitness Equipment State Characteristic exposes what the current operating state of the fitness equipment device.

Characteristic UUID

A026E01E-0A7D-4AB3-97FAF1500F9FEB8B

BLE Characteristic Properties

The Fitness Equipment State Characteristic supports Read and Notify

Packet Format

Name	Field Requirement	Format	Additional Information	
Model Code	Mandatory	uint8	Value	Meaning
			0	Unknown
			1	Idle
			2	Paused
			3 - 9	RESERVED
			10	In Use
			11	In Use - Warming Up
			12	In Use - Low Intensity
			13	In Use - High Intensity
			14	In Use - Recovery
			15 - 126	RESERVED
			127	In Use - Custom State Name (see Fitness Equipment State Name Characteristic)
			128	Finished
129 - 255	RESERVED			

Example for Fitness Equipment Type Characteristic

UUID	Value	Interpretation
A026E01F-0A7D-4AB3-97FAF1500F9FEB8B	0x02	The Fitness Equipment is paused

Fitness Equipment State Name Characteristic

The Fitness Equipment State Name Characteristic exposes what the current custom operating state name of the fitness equipment device.

Characteristic UUID

A026E020-0A7D-4AB3-97FAF1500F9FEB8B

BLE Characteristic Properties

The Fitness Equipment State Name Characteristic supports Read and Notify

Name	Field Requirement	Format	Additional Information
Fitness Equipment State Name	Mandatory	UTF-8 String, variable length	<p>If the first read/notify is 20 bytes in total, then the BLE central should issue “read long” commands to attempt to read additional data that may be contained in the Fitness Equipment State Name.</p> <p>Note: A Notification packet will contain truncated UTF-8 data if the actual data is longer than can fit in the notification packet. Be aware that this truncated data may not be a valid UTF-8 string. Read long should be used in this situation to ensure that the entire UTF-8 string is read.</p>

Fitness Equipment Measurement Characteristic

The Fitness Equipment Measurement Characteristic exposes in workout data from a fitness equipment device.

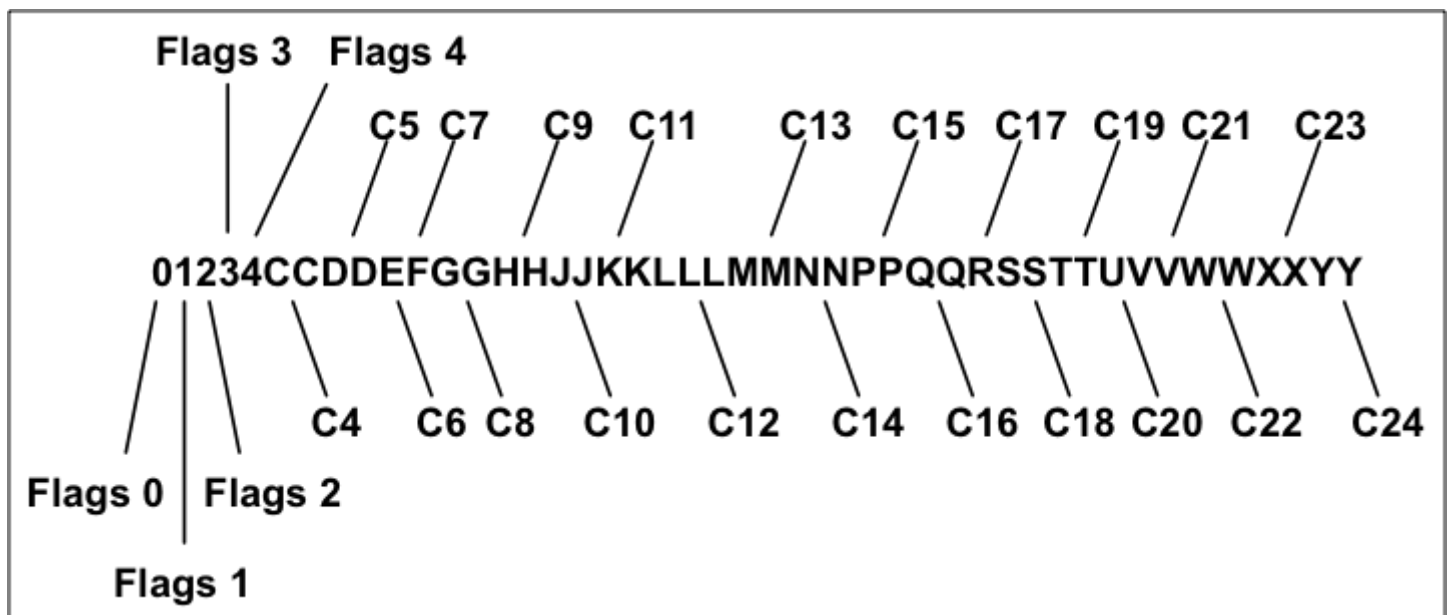
Characteristic UUID

A026E01D-0A7D-4AB3-97FAF1500F9FEB8B

BLE Characteristic Properties

This Characteristic supports Notify

Fitness Equipment Measurement Characteristic Packet is a combination of flags fields and individual workout data elements. The data in the packet is in little endian format. The complete packet structure is detailed below, however it should be noted that the actual packet structure would vary depending on the fields included in the message:



Flags 0 (FO)

Name	Field Requirement	Format	Length	Additional Information
Flags 0	Mandatory	8 bit flag	1 byte	This flag is mandatory for each fitness measure characteristic packet

Bit	Name	Requires	Detail
0	"Flags 1" field	C0	If set, the "Flags 1" field (conditional field C0) is included
1	"Flags 2" field	C1	If set, the "Flags 2" field (conditional field C1) is included
2	"Flags 3" field	C2	If set, the "Flags 3" field (conditional field C2) is included
3	"Flags 4" field	C3	If set, the "Flags 4" field (conditional field C3) is included
4	First Update Packet Indicator		This bit indicates the packet is the first notify packet when multiple packets are being sent in an update.
5	Final Update Packet Indicator		This bit indicates this packet is the final notify packet for an update
6	"Elapsed Workout Time"	C4	If set, the "Elapsed Workout Time" field (conditional field C4) is included
7	"Remaining Workout Time"	C5	If set, then the "Remaining Workout Time" field (conditional field C5) is included

Flags 1 (F1)

Name	Field Requirement	Format	Length	Additional Information
Flags 1	C0	8 bit flag	1 byte	This flag is optional

Bit	Name	Requires	Detail
0	"Heartrate" field	C6	If set, the "Heartrate" field (conditional field C6) is included
1	"Level/Intensity" field	C7	If set, then "Level/Intensity" field (conditional field C7) is included.
2	"Resistance Setting" field	C8	If set, then "Resistance Setting" field (conditional field C8) is included
3	"Speed" field	C9	If set, then "Speed" field (conditional field C9) is included
4	"Cadence" field	C10	If set, the "Cadence" field (conditional field C10) is included
5	"Cumulative Movements count" field	C11	If set, the "Cumulative Movements count" field (conditional field C11) is included
6	"Cumulative Horizontal Distance" field	C12	If set, the "Cumulative Horizontal Distance" field (conditional field C12) is included
7	"Cumulative Vertical Distance" field	C13	If set, the "Cumulative Vertical Distance" field (conditional field C13) is included

Flags 2 (F2)

Name	Field Requirement	Format	Length	Additional Information
Flags 2	C1	8 bit flag	1 byte	This flag is optional

Bit	Name	Requires	Detail
0	"Vertical Distance Negative" field	C14	If set, the "Vertical Distance Negative" field (conditional field C14) is included
1	"CumulativeEnergy" field	C15	If set, the "Cumulative Energy" field (conditional field C15) is included
2	"Energy Rate" field	C16	If set, the "Energy Rate" field (conditional field C16) is included
3	"METs" field	C17	If set, the "METs" field (conditional field C17) is included
4	"Power" field	C18	If set, then the "Power" field (conditional field C18) is included
5	"Torque" field	C19	If set, the "Torque" field (conditional field C19) is included
6	"Gear" field	C20	If set, the "Gear" field (conditional field C20) is included
7	"Grade" field	C21	If set, the "Grade" field (conditional field C21) is included

Flags 3 (F3)

Name	Field Requirement	Format	Length	Additional Information
Flags 3	C2	8bit flag	1 byte	This flag is optional

Bit	Name	Requires	Detail
0	"Angle" field	C22	If set, the "Angle" field (conditional field C22) is included
1	"Floor Rate" field	C23	If set, the "Floor Rate" field (conditional field C23) is included
2	"Cumulative Floors" field	C24	If set, the "Cumulative Floors" field (conditional field C24) is included
3	Reserved		
4	Reserved		
5	Reserved		
6	Reserved		
7	Reserved		

Flags 3 (F4)

Name	Field Requirement	Format	Length	Additional Information
Flags 4	C2	8bit flag	1 byte	Reserved. Set at 0x00

The Fitness Equipment Measurement Flags 3 and Flags 4 allow additional unique/manufacture specific measurement values to be included in the Fitness Machine Equipment Measurement Characteristic.

C4-C25

Name	Field	Format	Length	Additional Information
Elapsed Workout Time	C4	uint16	2 bytes	Number of seconds which have elapsed in the current workout
Remaining Workout Time	C5	uint16	2 bytes	The number of seconds remaining in the current workout
Current Heartrate	C6	uint8	1 byte	Units are BPM with a resolution of 1
Level/Intensity	C7	uint8	1 byte	
Resistance Setting	C8	uint16	2 bytes	Unitless with a resolution of 1/10
Current Speed	C9	uint16	2 bytes	Units are (km/h) with a resolution of 1/100
Current Cadence	C10	uint16	2 bytes	Units are "x per minute" with a resolution of 1/10 where:
Bike x = revolutions				
Stair Climber x = steps				
Stairmaster x = strides				
Cross Trainer x = strides				
Rower x = strokes				
Cumulative Movements	C11	uint16	2 bytes	Cumulative count of steps/strokes etc. Note: see Cadence for details
Cumulative Horizontal Distance	C12	uint24	3 bytes	Units are meters with a resolution of 1
Cumulative Vertical Distance	C13	uint16	2 bytes	Cumulative Vertical Distance. Units are meters with a resolution of 1/10. Note: If Cumulative Vertical Distance Negative field is included, this field should be interpreted as positive vertical distance.
Cumulative Negative Vertical Distance	C14	uint16	2 bytes	Units are meters with a resolution of 1/10
Cumulative Energy	C15	uint16	2 bytes	Units are kcal (Kilogram calories)
Current Energy Rate	C16	uint16	2 bytes	Units are kcal (Kilogram calories) per hour
Current METs	C17	uint8	1 byte	Units are METs with a resolution of 1/10
Current Power	C18	sint16	2 bytes	Units are Watts with a resolution of 1
Current Torque	C19	uint16	2 bytes	Units are nm with a resolution of 1/10
Current Gear	C20	uint8	1 byte	Current Gear
Current Grade	C21	sint16	2 bytes	Units are % with a resolution of 1/10
Current Angle	C22	sint16	2 bytes	Units are degrees with a resolution of 1/100
Current Floor Rate	C23	uint16	2 bytes	Units are (Floors per minute) with a resolution of 1/100
Cumulative Floors	C24	uint16	2 bytes	Cumulative Floors / 100

Example for Equipment Measurement Characteristic

UUID	Value
A026E01D-0A7D-4AB3-97FAF1500F9FEB8B	730B0AC30899059CE02A007D

The fitness equipment measurement characteristic in this example has a value of **730B0AC30899059CE02A007D**. In this example, the value can be unpacked as follows:

Byte 0

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
0	Flags 0	0x73	115	Note: Flags 0 is always present

0x73 hex which can be translated to binary as follows:

Bit Index	Binary Value	Description
0	1	"Flags 1" field included (C0)
1	1	"Flags 2" field included (C1)
2	0	"Flags 3" field is not included
3	0	"Flags 4" field is not included
4	1	This is the first packet of the update
5	1	This is the final packet of the update
6	1	"Elapsed Workout Time" field included (C4)
7	0	"Remaining Workout Time" field is not included

Byte 1

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
1	Flags 1	0x0B	11	Field is present because bit 0 of "Flags 0" (C0 flag) is set

0x0B hex can be translated to binary as follows:

Bit Index	Binary Value	Description
0	1	"Heartrate" field included (C6)
1	1	"Level/Intensity" field included (C7)
2	0	"Resistance Setting" field is not included
3	1	"Speed" field included (C9)
4	0	"Cadence" field is not included
5	0	"Cumulative Movements count" field is not included
6	0	"Cumulative Horizontal Distance" field is not included
7	0	"Cumulative Vertical Distance" field is not included

Byte 2

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
2	Flags 2	0x0A	10	Field is present because bit 1 of "Flags 0" (C1 flag) is set

0x0A hex can be translated to binary as follows:

Bit Index	Binary Value	Description
0	0	"Vertical Distance Negative" field is not included
1	1	"Cumulative Energy" field included (C15)
2	0	"Energy Rate" field is not included
3	1	"METs" field included (C17)
4	0	"Power" field is not included
5	0	"Torque" field is not included
6	0	"Gear" field is not included
7	0	"Grade" field is not included

Bytes 3 & 4

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
3	Elapsed Workout Time Least Significant Byte	0xC3	195	Field is present because bit 6 of "Flags 0" (C4 flag) is set. This is LSB (bits 0 to 7) of the elapsed workout time value.
4	Elapsed Workout Time	0x08	8	This is MSB (bits 8 to 15) of the elapsed workout time value. This raw value is formatted as "The number of seconds which have elapsed for the current workout" Hours is given by: $\text{floor}(2243 / 3600) = 0$ Minutes is given by: $\text{floor}(2243 / 60) \% 60 = 37$ Seconds is given by: $2243 \% 60 = 23$ (Note: % is the modulus operator. $\text{floor}(x)$ gives the mathematical floor value of x.)

Byte 5

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
5	Heartrate	0x99	153	Field is present because bit 0 of "Flags 1" (C6 flag) is set. Raw field value is 153. This raw value is formatted as "Beats Per Minute with a resolution of 1", therefore Heartrate value = 153 BPM

Byte 6

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
6	Level/ Intensity	0x05	5	Field is present because bit 1 of “Flags 1” (C7 flag) is set. Raw field value is 5. The field is unformatted/unitless, thus the Level/Intensity value is 5

Byte 7 & 8

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
7	Speed Least Significant Byte (LSB)	0x9C	156	Field is present because bit 3 of “Flags 1” (C9 flag) is set. This is LSB (bits 0 to 7) of the speed value.
8	Speed Most Significant Byte (MSB)	0xE0	224	This is MSB (bits 8 to 15) of the speed value. Raw field value is given by $LSB + (MSB * 256)$. For this example raw field value is: $156 + (224 * 256) = 57,500$ This raw value is formatted as “(km/h) with a resolution of 1/100” Therefore speed in km/h = $57500 / 100 = 57.500$ km/h

Byte 9 & 10

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
9	Cumulative Energy Least Significant Byte (LSB)	0x2A	42	Field is present because bit 1 of "Flags 2" (C15 flag) is set. This is LSB (bits 0 to 7) of the cumulative energy value.
10	Cumulative Energy Most Significant Byte (MSB)	0x00	0	This is MSB (bits 8 to 15) of the cumulative energy value. Raw field value is given by LSB + (MSB * 256) In this example the raw field value is: 42 + (0*256) = 42 This raw value is formatted as kcal, therefore cumulative energy value is 42 kcal.

Byte 9 & 10

The value is stored in little endian format and is located in the packet as follows:

730B0AC30899059CE02A007D

Byte Index	Field Name	Hexadecimal Value	Decimal Value	Byte Description
11	METs	0x7D	125	Field is present because bit 3 of "Flags 2" (C17 flag) is set. Raw field value is 125. This raw value is formatted as "METs with a resolution of 1/10" Thus METs value = 125 / 10 = 12.5 METs

This, in this example the following field values were included in the update (sent over the characteristic):

- Elapsed Workout Time = 37 minutes 23 seconds
- Speed = 57.500 km/h
- Heart rate = 153 BPM
- Cumulative Energy = 42 kcal
- Level/Intensity = 5
- METs = 12.5 METs

Fitness Equipment Workout Program Name Characteristic

The Fitness Equipment Workout Program Name Characteristic exposes the name of the current Workout Program in use by the Fitness Equipment

Characteristic UUID

UUID = A026E01B-0A7D-4AB3-97FAF1500F9FEB8B

Characteristic Properties

The Fitness Equipment Type Characteristic supports Read and Notify

Name	Field Requirement	Format	Additional Information
Workout Program Name	Mandatory	UTF-8 encoded string	<p>The entire packet is dedicated to representing the workout name string, in UTF-8 encoding. If the first read/notify is 20 bytes, then the BLE central should issue “read long” commands to attempt to read out more data.</p> <p>Note: a Notification packet will contain truncated UTF-8 data if the actual data is longer than 20 bytes. Be aware that this truncated data may not be a valid UTF-8 string. Read long should be used in this situation to read the entire UTF-8 string (if more than 20 bytes are available).</p>

Fitness Equipment Sensor Measurement Input Characteristic

This characteristic is a special type of characteristic and is used to pass data from the Connected Smartphone to the Fitness Equipment device. With this Characteristic, sensor data from devices like a heart rate monitor or cadence sensor can be displayed on the Fitness equipment device. Currently the Sensor Measurement Input Characteristic supports heart rate and/or cadence.

Characteristic UUID

UUID = A026E016-0A7D-4AB3-97FAF1500F9FEB8B

Characteristic Properties

The Fitness Equipment Sensor Measurement Input Characteristic supports Write without response

Name	Field Requirement	Format	7Additional Information			
Flags 0	Mandatory	8 bit flag	Bit	Name	Requires	Detail
			0	Flags 1	Included	C0
			1	Heart Rate	Included	C1
			2	Cadence	Included	C2
			3		C3	
			4		C4	
			5		C5	
			6		C6	
7		C7				
Flags 1	C0	8bit flags	RESERVED set as 0x00			
Heart Rate	C1	uint16	Heart Rate, BPM			
Cadence	C2	uint16	Cadence, RPM or steps per minute			



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