



# ANT+ Device Profile

## Bike Radar



### Notice

ANT+ Certification is limited to the technical means to enable device interoperability via ANT+ communication. Neither Garmin Canada Inc. nor its affiliates, or the administrator(s) of the ANT+ Alliance, make any other representations, warranties or certifications regarding the safety, quality, performance, or use of any products that implement this ANT+ RDR profile by certifying a product, which is limited to reviewing whether the device submitted for review communicates in a standard fashion per ANT+ Device Profile specifications.

The ANT+ Device Profile specifications outlined in this document are minimum device interoperability requirements and specifications, and as such, neither Garmin Canada Inc. nor its affiliates or the administrator(s) of the ANT+ Alliance review the submitted devices for functionality beyond what is required by these ANT+ Device Profile specifications for interoperability and therefore, make no representations, warranties, or certifications concerning the submitted devices beyond satisfaction of the requirements and specifications. These interoperability requirements and specifications do not, in any way, limit or otherwise restrict an ANT+ Adopter's ability to design its product(s) as it sees fit, including but not limited to the technical measures taken to meet the interoperability requirements and specifications specified in this document.

It is solely the responsibility of the ANT+ Adopter or other user of this document to design, test, update, and support its product(s) and provide appropriate warnings, notices, messaging, or other communications related to the design and/or functionality of its product(s) to end users. Neither Garmin Canada Inc. nor its affiliates or the administrator(s) of the ANT+ Alliance make any representations, warranties, or certifications concerning the sufficiency of any such warnings, notices, messaging, and/or communications of the devices submitted for review.

Garmin ANT+ RDR-compatible devices (the 'Garmin Radar Products') can improve situational awareness and are not a replacement for cyclist attentiveness and good judgement. It is essential that end users of the Garmin Radar Products always maintain awareness of their surroundings and operate the bicycle in a safe manner as failure to do so could result in serious injury or death.

## Important Notices

This information disclosed herein is the exclusive property of Garmin Canada Inc. ('Garmin Canada') and/or its affiliates. The recipient and user of this document must be an ANT+ Adopter pursuant to the ANT+ Adopter's Agreement (the 'Adopter's Agreement') and must use the information in this document according to the terms and conditions of the Adopter's Agreement and the following:

- a) You agree that any products or applications that you create using the ANT+ Documents and ANT+ Design Tools will comply with the minimum requirements for interoperability as defined in the ANT+ Documents and will not deviate from the standards described therein.
- b) You agree not to modify in any way the ANT+ Documents provided to you under the Adopter's Agreement.
- c) You agree not to distribute, transfer, or provide any part of the ANT+ Documents or ANT+ Design Tools to any person or entity other than employees of your organization with a need to know.
- d) You agree to not claim any intellectual property rights or other rights in or to the ANT+ Documents, ANT+ Design Tools, or any other associated documentation and source code provided to you under the Adopter's Agreement. Garmin Canada retains all right, title, and interest in and to the ANT+ Documents, ANT+ Design Tools, associated documentation, and source code and you are not granted any rights in or to any of the foregoing except as expressly set forth in the Adopter's Agreement.
- e) GARMIN CANADA AND ITS AFFILIATES MAKE NO CONDITIONS, WARRANTIES OR REPRESENTATIONS ABOUT THE SUITABILITY, RELIABILITY, USABILITY, SECURITY, QUALITY, CAPACITY, PERFORMANCE, AVAILABILITY, TIMELINESS OR ACCURACY OF THE ANT+ DOCUMENTS, ANT+ DESIGN TOOLS OR ANY OTHER PRODUCTS OR SERVICES SUPPLIED UNDER THIS DOCUMENT OR THE ADOPTER'S AGREEMENT OR THE NETWORKS OF THIRD PARTIES. GARMIN CANADA AND ITS AFFILIATES EXPRESSLY DISCLAIM ALL CONDITIONS, WARRANTIES AND REPRESENTATIONS, EXPRESS, IMPLIED OR STATUTORY INCLUDING, BUT NOT LIMITED TO, IMPLIED CONDITIONS OR WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, DURABILITY, TITLE, AND NON-INFRINGEMENT, WHETHER ARISING BY USAGE OF TRADE, COURSE OF DEALING, COURSE OF PERFORMANCE OR OTHERWISE.
- f) You agree to indemnify and hold harmless Garmin Canada and its affiliates for claims, whether arising in tort or contract, against Garmin Canada and/or its affiliates, including legal fees, expenses, settlement amounts, and costs, arising out of the application, use or sale of your designs and/or products that use ANT, ANT+, ANT+ Documents, ANT+ Design Tools, or any other products or services supplied under this document or the Adopter's Agreement.

If you are not an ANT+ Adopter, please visit our website at [www.thisisant.com](http://www.thisisant.com) to become an ANT+ Adopter. Otherwise, you must destroy this document immediately and have no right to use this document or any information included in this document.

Garmin Canada may modify this document at any time. You are bound by any such modification and should therefore visit the page on which this document is made available periodically to review this document and any changes.

Garmin Radar Products sold by Garmin Canada, or its affiliates are not designed for use in life support and/or safety equipment where malfunction of the Garmin Radar Products can reasonably be expected to result in injury or death. Your use of this document or sale of products implementing the ANT+ RDR Device Profile is at your own risk, and you agree to defend, indemnify, and hold harmless Garmin Canada and its affiliates from any and all damages, claims, suits, or expense resulting from such use. It is solely the responsibility of the ANT+ Adopter, or other user of this document, to provide appropriate warnings, notices, messaging, or other communications related to the functionality of its product to the end user.

## Revision History

Revision	Effective Date	Description
1.0	December 2016	- Creation of Document.
2.1	October 2022	<p><b>Legal Updates</b></p> <ul style="list-style-type: none"> <li>- Add Notice to bottom of cover page.</li> <li>- Rename Copyright and Usage Notices to Important Notices.</li> <li>- Add to Important Notices section.</li> <li>- Add to Using This Document section.</li> <li>- Clarify meaning of self-verify.</li> </ul> <p><b>Radar Target Updates</b></p> <ul style="list-style-type: none"> <li>- Add requirement for displays to inform user if target pages not received within prior 2 seconds.</li> <li>- Add requirement for user understanding of how the display represents targets.</li> <li>- Add a bit in status page to request clearing of targets shown to user.</li> <li>- Clarify that targets are not necessarily sorted by radar.</li> <li>- Clarify Target Speed as relative in data pages 48 and 49.</li> </ul> <p><b>Radar Error Handling Updates</b></p> <ul style="list-style-type: none"> <li>- Add more explicit required handling of error page for displays.</li> <li>- Clarify handling of values contained within error page.</li> </ul> <p><b>Radar Shutdown Updates</b></p> <ul style="list-style-type: none"> <li>- Add option for sensors to either shut down or stay powered on in response to shutdown commands.</li> <li>- Add sensor requirement for how to handle Device Command – Shutdown commands when aborting the shutdown.</li> <li>- Clarify display behaviour when handling Device Status - Shutdown Requested.</li> <li>- Clarify that Shutdown and Abort Shutdown commands are optional for display.</li> <li>- Clarify sensor behaviour when receiving Shutdown or Abort Shutdown command.</li> <li>- Clarify transmission pattern requirements for shutdown states.</li> </ul> <p><b>Radar and Light Combo Updates</b></p> <ul style="list-style-type: none"> <li>- Add Bike Radar/Bike Light combination requirements.</li> </ul> <p><b>General Updates</b></p> <ul style="list-style-type: none"> <li>- Add more general "Additional Requirements" pertaining to the entire profile.</li> <li>- Add and remove multiple scripts associated with testing certification requirements.</li> <li>- Add "Sensor States" and "Display States" sections.</li> <li>- Add recommendation for low battery shutdown battery status page transmission.</li> <li>- Fix reserved bits value in byte 1 of data page 1. Two values have been used by sensors which do not match previously published value.</li> <li>- Fix incomplete device state values.</li> </ul>

## Table of Contents

<b>1</b>	<b>Overview of ANT+ .....</b>	<b>8</b>
<b>2</b>	<b>Related Documents.....</b>	<b>9</b>
<b>3</b>	<b>Using This Document.....</b>	<b>9</b>
<b>4</b>	<b>Overview of ANT+ Bike Radar Use Case.....</b>	<b>10</b>
<b>5</b>	<b>Channel Configuration.....</b>	<b>11</b>
5.1	Slave Channel Configuration .....	11
5.1.1	Transmission Type .....	11
5.1.2	Channel Period .....	11
5.2	Master Channel Configuration .....	12
5.2.1	Channel Type .....	12
5.2.2	Transmission Type .....	12
5.2.3	Device Number .....	12
<b>6</b>	<b>Message Payload Format.....</b>	<b>13</b>
6.1	ANT+ Message Data Formats.....	13
6.2	Data Page Types .....	13
6.3	Sensor States: Transmission Patterns.....	14
6.3.1	If no other state applies.....	14
6.3.2	Error States.....	14
6.3.3	Shutdown.....	14
6.3.4	Shutdown aborted.....	15
6.3.5	Reporting ≤ 4 Targets .....	15
6.3.6	Reporting > 4 Targets .....	15
6.4	Display States.....	16
6.4.1	Not receiving target pages .....	16
6.4.2	Receiving error state .....	16
6.4.3	Receiving target pages .....	16
6.4.4	Receiving shutdown requested .....	16
6.5	Data Page 48 – Radar Targets A (0x30) .....	18
6.5.1	Threat Level .....	18
6.5.2	Threat Side.....	19
6.5.3	Target Range.....	19
6.5.4	Target Closing Speed.....	19
6.6	Data Page 49 – Radar Targets B (0x31) .....	20
6.7	Data Page 1 – Device Status (0x01).....	21
6.7.1	Device State .....	21
6.7.2	Inverted Clear Targets.....	21
6.8	Data Page 2 – Device Command (0x02) .....	22
6.8.1	Device Command .....	22

- 6.9 Data Pages 3 – 47, 50 – 63: Reserved ..... 23
- 6.10 Required Common Pages ..... 24
  - 6.10.1 Common Page 80 – Manufacturer’s Identification (0x50) ..... 24
  - 6.10.2 Common Page 81 – Product Information (0x51) ..... 24
  - 6.10.3 Common Page 82 – Battery Status (0x52)..... 24
  - 6.10.4 Common Page 87 – Error Description (0x57)..... 25
- 6.11 Optional Common Data Pages ..... 27
  - 6.11.1 Common Page 70 - Request Data Page (0x46) ..... 27
  - 6.11.2 Other Common Data Pages ..... 28
- 7 Additional Requirements..... 29**
- 7.1 Combined Bike Radar and Bike Light Devices ..... 31
- 8 ANT+ Bike Radar Device Interoperability Icon..... 32**

## List of Tables

Table 5-1. ANT Channel Configuration for ANT+ Bike Radar Display (i.e., Slave) .....	11
Table 5-2. ANT Channel Configuration for ANT+ Bike Radar (i.e., Master) .....	12
Table 6-1. ANT+ General Message Format .....	13
Table 6-2. ANT+ Bike Radar Data Pages .....	13
Table 6-3. Data Page 48 Format - Radar Targets A .....	18
Table 6-4. Radar Target Threat Level.....	18
Table 6-5. Radar Threat Side .....	19
Table 6-6. Data Page 49 Format - Radar Targets B .....	20
Table 6-7. Data Page 1 Format – Device Status .....	21
Table 6-8. Device State .....	21
Table 6-9. Data Page 2 Format – Device Command.....	22
Table 6-10. Device Command Field.....	22
Table 6-11. Common Data Page 87 – Error Description Data .....	25
Table 6-12. Bike Radar Error Level Definitions .....	25
Table 6-13. ANT+ Bike Radar Device Profile Error Codes.....	26
Table 6-14. Common Data Page 70 - Request Data Page .....	27

## List of Figures

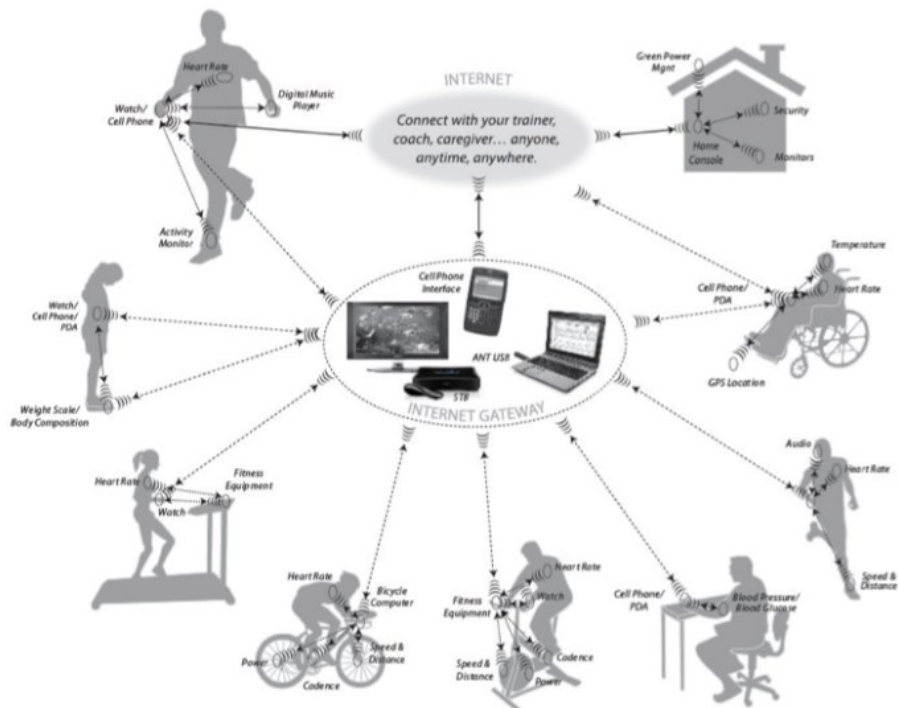
Figure 1-1. ANT+ Device Ecosystem .....	8
Figure 3-1. ANT+ Certification Requirement Marker.....	9
Figure 4-1. ANT+ Bike Radar Use Case .....	10
Figure 6-1. Transmission Pattern – Error State.....	14
Figure 6-2. Transmission Pattern – Shutdown .....	14
Figure 6-3. Transmission Pattern – Aborting a Shutdown .....	15
Figure 6-4. Broadcast Transmission Pattern ( $\leq 4$ Targets) with Common Pages.....	15
Figure 6-5. Regular Broadcast Transmission Pattern ( $>4$ Targets) with Common Pages.....	15
Figure 6-6. Aborting an ANT+ Bike Radar Shutdown .....	17
Figure 8-1. ANT+ Bike Radar Interoperability Icon .....	32

## 1 Overview of ANT+

The ANT+ Managed Network is comprised of a group of devices that use the ANT radio protocol and ANT+ Device Profiles to determine and standardize wireless communication between individual devices. This management of device communication characteristics provides interoperability between devices in the ANT+ network.

Developed specifically for ultra-low-power applications, the ANT radio protocol provides an optimal balance of RF performance, data throughput and power consumption.

ANT+ Device Profiles have been developed for devices used in personal area networks and can include, but are not limited to, devices that are used in sport, fitness, wellness, and health applications. Wirelessly transferred data that adheres to a given device profile will have the ability to interoperate with different devices from different manufacturers that also adhere to the same standard. Within each device profile, a minimum standard of compliance is defined. Each device adhering to the ANT+ Device Profiles must achieve this minimum standard to ensure interoperability with other devices.



**Figure 1-1. ANT+ Device Ecosystem**

This document details the wireless communication between devices adhering to this ANT+ Device Profile. The typical use case of the device(s), wireless channel configuration, data format(s), minimum compliance for interoperability, and implementation guidelines are also detailed.

### **IMPORTANT:**

**If you have received this document, you have agreed to the terms and conditions of the Adopter's Agreement and have downloaded the ANT+ Managed network key. By accepting the Adopter's Agreement and receiving the ANT+ device profiles, you agree to:**

**Implement and test your product to this specification in its entirety**

**To implement only ANT+ defined messages on the ANT+ managed network**



## 2 Related Documents

Refer to current versions of the listed documents. To ensure you are using the current versions, check the ANT+ website at [www.thisisant.com](http://www.thisisant.com) or contact your ANT+ representative.

1. ANT Message Protocol and Usage
2. ANT+ Bike Lights Device Profile
  - a. An ANT+ Bike Light and Bike Radar Sensor can be combined as a single device. See section 7.1 for combined light and radar requirements.
3. ANT+ Common Data Pages

## 3 Using This Document

This ANT+ RDR document defines the technical requirements for compatible ANT+ products to be certified. ANT+ Certification is limited to the technical means to enable device interoperability via ANT+ communication. Garmin Canada Inc. and its affiliates do not make any other representations, warranties, or certifications regarding the safety, quality, performance, or use of any products that implement this ANT+ RDR profile by certifying a product, which is limited to reviewing whether the device submitted for review communicates in a standard fashion per ANT+ Device Profile specifications.

The ANT+ Device Profile specifications outlined in this document are minimum device interoperability requirements and specifications, and as such, neither Garmin Canada Inc. nor its affiliates or the administrator(s) of the ANT+ Alliance review the submitted devices for functionality beyond what is required by these ANT+ Device Profile specifications for interoperability and therefore, make no representations, warranties, or certifications concerning the submitted devices beyond satisfaction of the requirements and specifications. These interoperability requirements and specifications do not, in any way, limit or otherwise restrict an ANT+ Adopter's ability to design its product(s) as it sees fit, including but not limited to the technical measures taken to meet the interoperability requirements and specifications specified in this document.

It is essential that end users of your product(s) always maintain awareness of their surroundings and operate the bicycle in a safe manner as failure to do so could result in serious injury or death and it is solely your responsibility to provide appropriate warnings, notices, messaging, or other communications related to the functionality of your product(s) to end users. Neither Garmin Canada Inc. nor its affiliates or the administrator(s) of the ANT+ Alliance make any representations, warranties, or certifications concerning the sufficiency of any such warnings, notices, messaging and/or communications of the devices submitted for review.

As a developer, use this document to identify requirements that need to be met to make your product ANT+ compliant. Use the SimulANT+ Profile Verification Suite with the certification requirement markers (Figure 3-1) in this document to test that the requirements are met before submitting your product for ANT+ certification.



**Figure 3-1. ANT+ Certification Requirement Marker**

Each requirement in the profile is marked with a test number in bold square brackets **[XX\_XXXX]**. Profile verification tests for master (sensor) devices are prefixed with 'MD\_' whereas slave (display) devices are marked as 'SD\_'. As you run the tests on SimulANT+, you can check back to the requirements in this document to understand and fix test failures. Requirements marked as **[self-verify]** do not have a related SimulANT+ Profile Verification Test and must be verified manually by the implementer. Self-verify items are not tested by the ANT+ certification process.



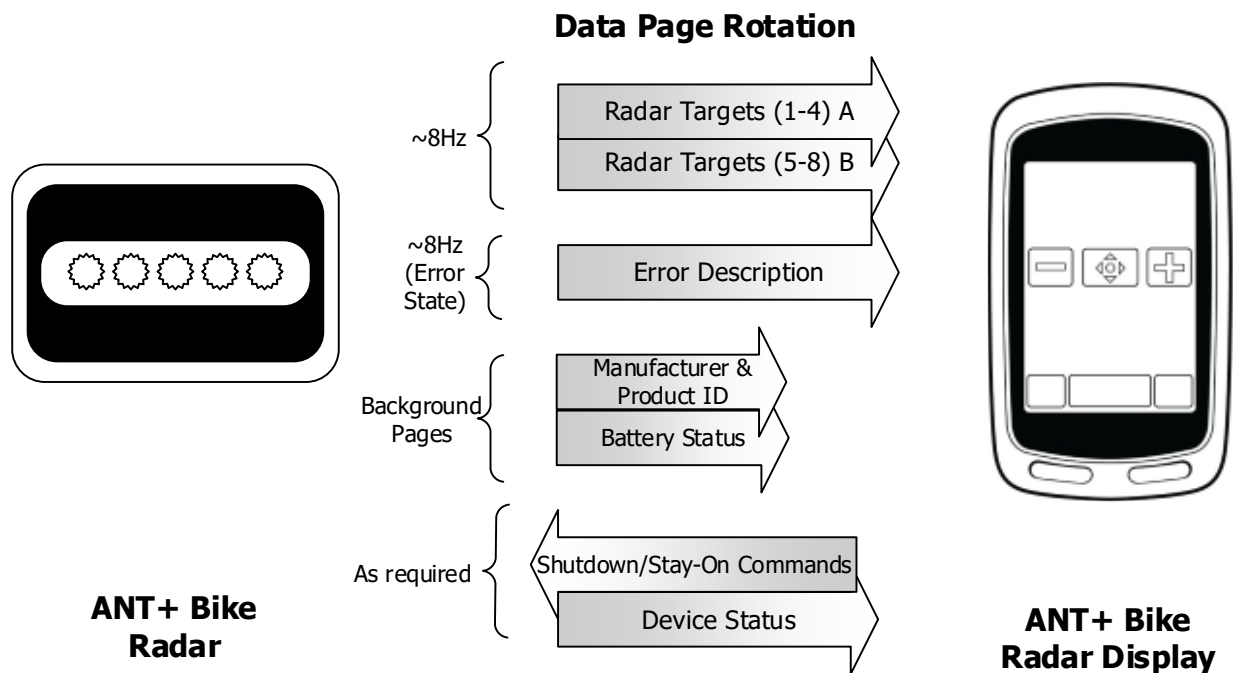
## 4 Overview of ANT+ Bike Radar Use Case

The ANT+ bike radar device profile defines wireless communication between a bike radar device and compatible radar displays. A bike radar device is a device capable of detecting traffic behind a user's bike and providing real time information on vehicle targets to a display in front of the user. The bike radar can report the following properties for each detected vehicle target:

- **Threat Level:** Relative threat level of the specific vehicle target.
- **Target Side:** Position of vehicle target relative to the user.
- **Target Range:** Distance of vehicle target from the user.
- **Target Closing Speed:** Speed of the vehicle target relative to the user.

In addition to the primary function of providing vehicle target information, the ANT+ bike radar device profile also defines:

- Reporting battery status, product, and manufacturer information of the bike radar device.
- A shutdown command scheme to allow the display device to turn off the bike radar device wirelessly to aid battery conservation and provide a simpler user experience.
- An error state messaging scheme to allow bike radar devices to indicate if an error has occurred in operation.



**Figure 4-1. ANT+ Bike Radar Use Case**

All messages transmitted from the ANT+ bike radar device are broadcast messages, allowing multiple displays to connect and receive vehicle target information from the same bike radar device.

## 5 Channel Configuration

The channel configuration parameters of the ANT+ bike radar and all other ANT-enabled devices are defined by the ANT protocol. Refer to the ANT Message Protocol and Usage document for more details.

### 5.1 Slave Channel Configuration

The device expected to receive data from an ANT+ bike radar **shall** [SD\_0001] [SD\_0002] [SD\_0003] [self-verify] configure an ANT channel with its channel parameters set as listed in Table 5-1.

**Table 5-1. ANT Channel Configuration for ANT+ Bike Radar Display (i.e., Slave)**

Parameter	Value	Comment
Channel Type	Slave (0x00)	The ANT+ bike radar is a master device; therefore, the display device must be configured as the slave. Bidirectional communication is required.
Network Key	ANT+ Managed Network Key	The ANT+ Managed Network Key is governed by the ANT+ Managed Network licensing agreement.
RF Channel Frequency	57 (0x39)	RF Channel 57 (2457MHz) is used for the ANT+ bike radar.
Transmission Type	0 for pairing	The transmission type must be set to 0 for a pairing search. Once the transmission type is learned, <b>the receiving device should remember the type for future searches.</b>  To be future compatible, any returned transmission type is valid. Future versions of this spec may allow additional bits to be set in the transmission type.
Device Type	40 (0x28)	40 (0x28) – indicates search for an ANT+ Bike Radar. Please see the ANT Message Protocol and Usage document for more details.
Device Number	1 – 65535 0 for searching	Set the Device Number parameter to zero to allow wildcard matching. Once the device number is learned, the receiving device should remember the number for future searches. Please see the ANT Message Protocol and Usage document for more details.
Channel Period	4084 counts	Data is transmitted from the ANT+ bike radar every 4084/32768 seconds (~8 Hz) and must be received at this rate.
Search Timeout	(Default = 30 seconds)	The default search timeout is set to 30 seconds in the receiver. This search timeout is implementation specific and can be set by the designer to the appropriate value for the system.

#### 5.1.1 Transmission Type

The most significant nibble of the transmission type may optionally be used to extend the device number from 16 bits to 20 bits. In this case, the most significant nibble of the transmission type becomes the most significant nibble of the extended 20-bit device number. Therefore, a wildcard pairing scheme **shall** [SD\_0002] always be used by a display that does not know the transmission type of the ANT+ bike radar that it is searching for.

#### 5.1.2 Channel Period

The channel period is set such that the display device **shall** [SD\_0003] receive data at the full message rate (~8 Hz).



## 5.2 Master Channel Configuration

The ANT+ bike radar **shall [MD\_0001] [MD\_0002] [MD\_0003] [MD\_0004]** establish its ANT channel as shown in Table 5-2.

**Table 5-2. ANT Channel Configuration for ANT+ Bike Radar (i.e., Master)**

Parameter	Value	Comment
Channel Type	Master (0x10)	Within the ANT protocol the master channel (0x10) allows for bi-directional communication channels and utilizes the interference avoidance techniques and other features inherent to the ANT protocol.
Network Key	ANT+ Managed Network Key	The ANT+ Managed Network Key is governed by the ANT+ Managed Network licensing agreement.
RF Channel Frequency	57 (0x39)	RF Channel 57 (2457MHz) is used for the ANT+ bike radar.
Transmission Type	Set MSN to 0 (0x0) or MSN of extended device number. Set LSN to 5 (0x5)	ANT+ devices follow the transmission type definition as outlined in the ANT protocol. This transmission type cannot use a shared channel address and must be compliant with the global data messages defined in the ANT protocol
Device Type	40 (0x28)	An ANT+ bike radar device <b>shall [MD_0001]</b> transmit its device type as 40 (0x28). Please see the ANT Message Protocol and Usage document for more details.
Device Number	1-65535	This is a 2-byte field that allows for unique identification of a given ANT+ bike radar. It is imperative that the implementation allow for a unique device number to be assigned to a given device. NOTE: The device number for the transmitting sensor <b>shall [self-verify]</b> not be 0x0000.
Channel Period	4084 counts	Data is transmitted every 4084/32768 seconds (~8 Hz).

### 5.2.1 Channel Type

As communication in two directions is required, the channel type **shall [MD\_0004]** be set to bidirectional master (0x10). The bidirectional master channel is also used to enable the interference avoidance features inherent to the ANT protocol.

### 5.2.2 Transmission Type

The most significant nibble of the transmission type may optionally be used to extend the device number from 16 bits to 20 bits. In this case, the most significant nibble of the transmission type becomes the most significant nibble of the 20-bit device number.

### 5.2.3 Device Number

The device number needs to be as unique as possible across production units. An example of achieving this specification is to use the lowest two bytes of the serial number of the device for the device number of the ANT channel ID; ensure that the device has a set serial number.

The device number of the ANT+ bike radar **shall [self-verify]** not be 0x0000. Care should be taken if the device number is derived from the lower 16-bits of a larger serial number. In this case, ensure that serial numbers that are multiples of 0x10000 (65536) are handled correctly such that the device number is not set to 0.



## 6 Message Payload Format

### 6.1 ANT+ Message Data Formats

All ANT messages have an 8-byte payload. For ANT+ messages, the first byte contains the data page number, and the remaining 7 bytes are used for sensor-specific data.

**Table 6-1. ANT+ General Message Format**

Parameter	Value	Comment
0	Data Page Number	1 Bytes
1-7	Sensor Specific Data	7 Bytes

### 6.2 Data Page Types

Messages in the ANT+ Bike Radar device profile include main pages, command pages, and background pages (see Table 6-2).

- Main data pages contain the primary data broadcast in the transmission pattern of the bike radar. The transmission pattern of the bike radar may change depending on the current state of the device (section 6.3).
- Command pages are data pages transmitted as acknowledged messages from the display device to the bike radar when required.
- Background data pages contain slow changing data and are interleaved in the regular transmission pattern at a slow rate (once every 260 pages). All background pages defined in this document are common pages. Background data pages required in this profile are pages 80, 81 and 82. Refer to the ANT+ Common Pages Document for details. Supported background pages (including 80, 81 and 82) **shall [MD\_0013]** also be transmitted by the ANT+ bike radar on request by the display.

**Table 6-2. ANT+ Bike Radar Data Pages**

Data Page Types	Data Page	Description	Direction
Main Data Pages	Radar Targets A	Radar target information for vehicle targets 1 – 4	Bike Radar → Display
	Radar Targets B	Radar target information for vehicle targets 5 – 8	
	Device Status	Current Status of the Bike Radar	
	Error Description	Error Status of the Bike Radar	
Command Pages	Device Command	Commands to control the Bike Radar	Display → Bike Radar
Background Pages	Manufacturer’s Information	Manufacturer ID, Model Number and Hardware Revision of the Bike Radar	Bike Radar → Display
	Product Information	Software Version and Serial Number	
	Battery Status	Battery Status Information	

Main data pages **shall [MD\_0006] [MD\_0008] [MD\_RDR\_002] [MD\_RDR\_004] [MD\_RDR\_006] [self-verify]** be transmitted by a bike radar device under the circumstances described in this device profile. Background pages Manufacturer’s Information, Product Information, and Battery Status **shall [MD\_0006]** also be supported by ANT+ bike radar devices.



### 6.3 Sensor States: Transmission Patterns

The ANT+ bike radar broadcasts at a rate of ~8 data pages every second. The transmission pattern requirements change depending on the current state of the ANT+ bike radar as detailed in the following sections.

#### 6.3.1 If no other state applies

In such cases that none of the following states apply, the bike radar **shall [self-verify]** transmit only the Device Status (0x01) page as the main page and request that target information is cleared on the display (see section 6.7.2). It is optional to include the background data pages. Refer to section 6.4.1 for details on expected display behaviour for this state. Implementing behaviour in section 6.4.1 should be carefully considered as legacy displays do not implement the target timeout. Behaviour described in section 6.3.3 and 6.3.4 also applies while in this state.

#### 6.3.2 Error States

An error state represents a state in which target data generated by the bike radar may be unreliable/incomplete.

If the bike radar is in an error state, it **shall [MD\_RDR\_002] [self-verify]** transmit the Error Description data page (Common Page 87) as the main data page, and be transmitted at least 7/8 data pages. An error code may apply that the display may show to the user (see sections 6.10.4.3 and 6.10.4.4 regarding error codes). It is optional to include the background data pages in the error state. Behaviours described in sections 6.3.3 and 6.3.4 also applies while in this state.



Figure 6-1. Transmission Pattern – Error State

#### 6.3.3 Shutdown

If the bike radar intends to power off because of a Device Command – Shutdown it **shall [MD\_RDR\_006] [self-verify]** interleave the Device Status data page in the transmission pattern (required at least 1/8 messages, maximum 4/8 messages) for at least 2.5 seconds before powering off. The bike radar may choose to also use this transmission pattern before powering off otherwise. The device state reported will be either Shutdown Requested or Shutdown Forced depending on how the radar will treat abort shutdown commands while in the state. A particular radar may use Shutdown Requested in some cases that trigger a shutdown and may use Shutdown Forced in others.

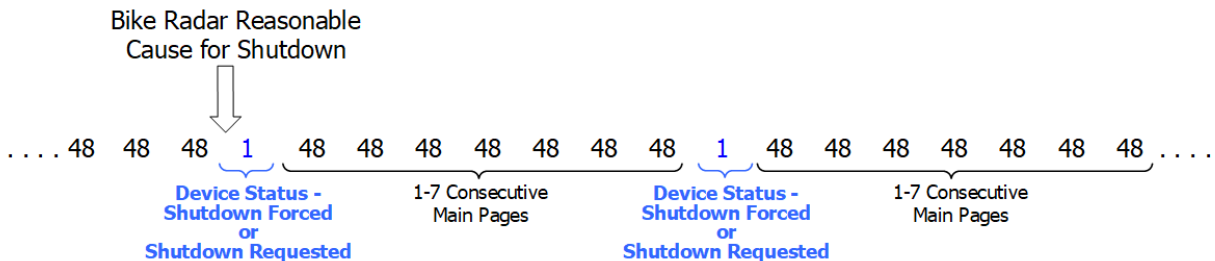


Figure 6-2. Transmission Pattern – Shutdown

If the bike radar will not power down in response to a shutdown command received from a display device, as described in the prior paragraph, then it **shall [MD\_RDR\_006] [self-verify]** indicate the shutdown request has been aborted by following section 6.3.4.

### 6.3.4 Shutdown aborted

If a Device Command – Abort Shutdown command is received from a display device while reporting Shutdown Requested, or the bike radar will not power down in response to a shutdown command, the bike radar **shall [MD\_RDR\_006] [self-verify]** interleave the Device Status – Shutdown Aborted page in the transmission pattern (required at least 1/8 messages, maximum 4/8 messages) for at least 10 seconds before returning to normal operation.

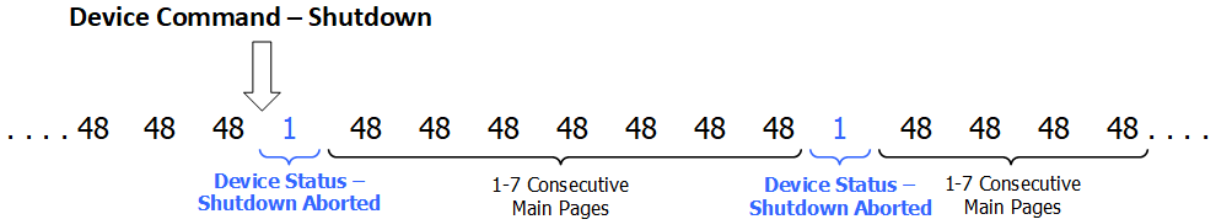


Figure 6-3. Transmission Pattern – Aborting a Shutdown

### 6.3.5 Reporting ≤ 4 Targets

When target detection is functioning normally and the bike radar is reporting target information for ≤ 4 targets, the Radar Targets A data page is transmitted as the main data page and **shall [MD\_0008] [self-verify]** be transmitted at least 6/8 data pages, except for when reporting a shutdown (section 6.3.3) or aborted shutdown (section 6.3.4) when it **shall [MD\_RDR\_006] [self-verify]** be transmitted at least 4/8 data pages.

It is recommended that a background page is interleaved once every 65 data pages. Figure 6-4 shows the transmission pattern for an ANT+ bike radar implementing three different background pages (data pages 80, 81, and 82). Required background data pages **shall [MD\_0008]** be transmitted at least once every 260 data pages when the bike radar is reporting ≤ 4 targets.

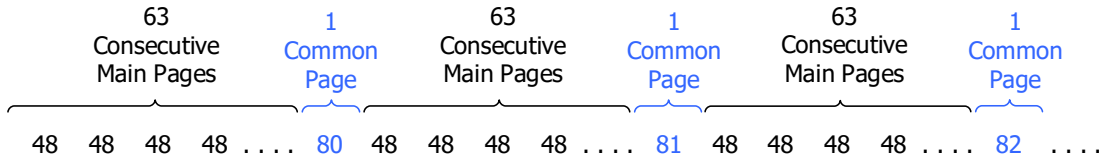


Figure 6-4. Broadcast Transmission Pattern (≤4 Targets) with Common Pages

### 6.3.6 Reporting > 4 Targets

When target detection is functioning normally and the bike radar is reporting target information for more than 4 targets, it **shall [MD\_RDR\_004]** alternate between Radar Targets A (data page 48) and Radar Targets B (data page 49) as the main data pages. Therefore, when reporting a shutdown or aborted shutdown, Radar Targets A is transmitted at least 2/8 data pages and Radar Targets B is transmitted at least 2/8 data pages. Background pages are not recommended to be interleaved into the transmission pattern when reporting more than four targets.

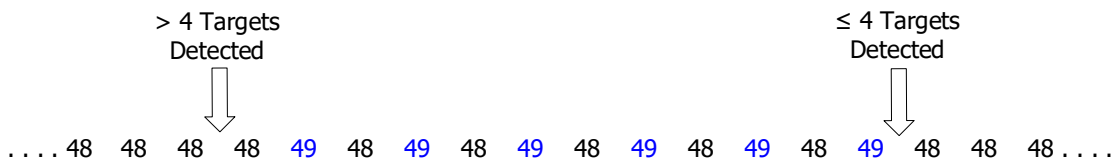


Figure 6-5. Regular Broadcast Transmission Pattern (>4 Targets) with Common Pages

Figure 6-5 above describes the transmission pattern for an ANT+ bike radar transitioning from reporting ≤ 4 targets to reporting > 4 targets, and then transitioning back to reporting ≤ 4 targets.

## 6.4 Display States

The following states are expected to be relevant to display implementations based on sensor transmissions. They are neither exhaustive nor are they fully described.

### 6.4.1 *Not receiving target pages*

If, in the last 2 seconds, none of the received pages are a Radar Targets A page or a Radar Targets B page, then the display **shall** [SD\_RDR\_004] [SD\_RDR\_011] [self-verify] clear any target information shown to users and indicate that target information is unavailable. The display **shall** [SD\_RDR\_008] [self-verify] also indicate target information is unavailable to users from the time of connection until the first target page is received.

This target timeout **shall** [self-verify] be based on time alone. It should be independent of ANT channel and radio state and independent of receiving information from the radio. It is recommended that it be based on a timer that functions independently from the ANT radio.

### 6.4.2 *Receiving error state*

Upon receiving an Error Description page from a bike radar, displays **shall** [SD\_RDR\_001] [SD\_RDR\_003] [SD\_RDR\_014] [self-verify] indicate to the user when the radar device is in an error state. Displays **shall** [SD\_RDR\_001] [SD\_RDR\_003] [SD\_RDR\_014] [self-verify] clear any target information shown to users and indicate that target information is unavailable when this page is received. These actions **shall** [self-verify] occur regardless of page content beyond the page number.

### 6.4.3 *Receiving target pages*

The user interface, including operational information, graphics, and other details presented on the display device, **must**<sup>1</sup> communicate to users the presence of targets, if any, in a clear and unambiguous manner.

### 6.4.4 *Receiving shutdown requested*

If a display receives a Device Status – Shutdown Requested page from a bike radar (indicating that the bike radar is going to shutdown), the display may abort the requested shutdown by sending the Device Command data page (see section 6.8) with the Abort Shutdown command (see Table 6-10). The delivery of the command can be verified by the application on the display device as the message is transmitted as an acknowledged message.

Figure 6-6 shows how the Device Command - Abort Shutdown may be sent to a bike radar sensor that is reporting Device Status - Shutdown Requested.

---

<sup>1</sup> It is essential that end users of your product(s) always maintain awareness of their surroundings and operate the bicycle in a safe manner as failure to do so could result in serious injury or death and it is solely your responsibility to provide appropriate warnings, notices, messaging, or other communications related to the functionality of your product(s) to end users. The adequacy or effectiveness of the communications related to any targets presented on the user interface are not reviewed or evaluated by Garmin in any manner under the certification process, as Garmin Canada Inc. and its affiliates do not make any representations, warranties, or certifications regarding the safety, quality, performance, or use of any products that implement this ANT+ RDR profile.







## 6.5 Data Page 48 – Radar Targets A (0x30)

Data page 48 is required for all ANT+ bike radar devices, and reports data for vehicle targets 1 – 4. It is broadcast according to section 6.3.5 and 6.3.6.

All bike radar capable displays **shall [SD\_0006]** support this data page.

All fields in this message **shall [MD\_0006]** be set as described in Table 6-3. Targets in data pages 48 and 49 should be enumerated in order of relative range from the radar device with 'Target 1' being the closest.

The targets in the page appear in no specific order and **shall [SD\_RDR\_005] [self-verify]** be parsed by displays accordingly.

**Table 6-3. Data Page 48 Format - Radar Targets A**

Byte	Field Description	Length	Value	Units	Range
0	Data Page Number	1 Byte	Data Page Number = 48 (0x30)	N/A	N/A
1	Threat Level Target 1	2 Bits (0:1)	Refer to Table 6-4.	N/A	N/A
	Threat Level Target 2	2 Bits (2:3)			
	Threat Level Target 3	2 Bits (4:5)			
	Threat Level Target 4	2 Bits (6:7)			
2	Threat Side Target 1	2 Bits (0:1)	Refer to Table 6-5.	N/A	N/A
	Threat Side Target 2	2 Bits (2:3)			
	Threat Side Target 3	2 Bits (4:5)			
	Threat Side Target 4	2 Bits (6:7)			
3-5	Range Target 1	6 Bits (0:5)	Range of respective targets.	3.125m	0-196.875m
	Range Target 2	6 Bits (6:11)			
	Range Target 3	6 Bits (12:17)			
	Range Target 4	6 Bits (18:23)			
6	Closing Speed Target 1	4 Bits (0:3)	Speed of respective targets relative to the rider.	3.04m/s	0-45.6m/s
	Closing Speed Target 2	4 Bits (4:7)			
7	Closing Speed Target 3	4 Bits (0:3)			
	Closing Speed Target 4	4 Bits (4:7)			

### 6.5.1 Threat Level

The threat level fields indicate the interpreted threat of the respective vehicle targets as defined in Table 6-4.

**Table 6-4. Radar Target Threat Level**

Value	Threat Level
0	No Threat
1	Vehicle Approach
2	Vehicle Fast Approach
3	Reserved

If a threat is not detected for a specific target in this data page, then this field **shall [self-verify]** be set to 0, 'No Threat'. Displays **shall [self-verify]** not further decode the threat side, range, and speed fields for a target with threat level set to 0.



### 6.5.2 Threat Side

The threat side fields indicate the position of the respective targets relative to the user facing forward on the bike as defined in Table 6-5.

**Table 6-5. Radar Threat Side**

Value	Threat Side
0	No Side/Directly Behind User
1	Right
2	Left
3	Reserved

If a threat is not detected for a specific target, then this field **shall [self-verify]** be set to 0, 'No Side'.

### 6.5.3 Target Range

The target range field indicates the distance of the respective targets from the rider in units of meters. If a threat is not detected for a specific target, then this field **shall [self-verify]** be set to 0 m.

### 6.5.4 Target Closing Speed

The target closing speed field contains the calculated speed of the respective targets relative to the user in units of meters per second. If a threat is not detected for a specific target, then this field **shall [self-verify]** be set to 0 m/s.



## 6.6 Data Page 49 – Radar Targets B (0x31)

Data page 49 is required for ANT+ bike radar devices that support detection of more than four vehicle targets, and reports data for targets 5 – 8. It is broadcast according to section 6.3.6.

All bike radar capable displays **shall [SD\_0006]** support this data page.

All fields in this message **shall [MD\_RDR\_004]** be set as described in Table 6-6. Targets in data pages 48 and 49 should be enumerated in order of relative range from the radar device with 'Target 1' being the closest.

The targets in the page appear in no specific order and **shall [SD\_RDR\_006] [self-verify]** be parsed by displays accordingly.

**Table 6-6. Data Page 49 Format - Radar Targets B**

Byte	Field Description	Length	Value	Units	Range
0	Data Page Number	1 Byte	Data Page Number = 49 (0x31)	N/A	N/A
1	Threat Level Target 5	2 Bits (0:1)	Refer to Table 6-4.	N/A	N/A
	Threat Level Target 6	2 Bits (2:3)			
	Threat Level Target 7	2 Bits (4:5)			
	Threat Level Target 8	2 Bits (6:7)			
2	Threat Side Target 5	2 Bits (0:1)	Refer to Table 6-5.	N/A	N/A
	Threat Side Target 6	2 Bits (2:3)			
	Threat Side Target 7	2 Bits (4:5)			
	Threat Side Target 8	2 Bits (6:7)			
3-5	Range Target 5	6 Bits (0:5)	Range of respective targets.	3.125m	0-196.875m
	Range Target 6	6 Bits (6:11)			
	Range Target 7	6 Bits (12:17)			
	Range Target 8	6 Bits (18:23)			
6	Closing Speed Target 5	4 Bits (0:3)	Speed of respective targets relative to the rider.	3.04m/s	0-45.6m/s
	Closing Speed Target 6	4 Bits (4:7)			
7	Closing Speed Target 7	4 Bits (0:3)			
	Closing Speed Target 8	4 Bits (4:7)			

This data page uses the same fields as data page 48 for radar targets 5 – 8. Refer to sections 6.5.1 to 6.5.4 for details on the fields used in this data page.



## 6.7 Data Page 1 – Device Status (0x01)

Data page 1 is required for all ANT+ bike radar devices. It is broadcast as described in sections 6.3.1, 6.3.3, and 6.3.4.

All bike radar capable displays **shall [self-verify]** support this data page. Data page 1 is handled as described in this section and in sections 6.4.1 and 6.4.4.

All fields in this message **shall [MD\_RDR\_006] [self-verify]** be set as described in Table 6-7.

**Table 6-7. Data Page 1 Format – Device Status**

Byte	Field Description	Length	Value	Units	Range or Rollover
0	Data Page Number	1 Byte	Data Page Number = 1 (0x01)	N/A	N/A
1	Device State	2 Bits (0-1)	Refer to Table 6-8.	N/A	N/A
	Reserved	6 Bits (2-7)	Reserved, set to 0x3F Note: Was set to 0x00 by legacy sensors.		
2	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
3	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
4	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
5	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
6	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
7	Inverted Clear Targets	1 Bit (0)	0 – Request for display to clear target information shown to users 1 – No action for display	N/A	N/A
	Reserved	7 Bits (1-7)	Reserved, Set to 0x7F	N/A	N/A

### 6.7.1 Device State

**Table 6-8. Device State**

Value	Device State
0	Broadcasting – Unit is operating normally
1	Shutdown Requested – Indication that the unit will shutdown
2	Shutdown Aborted – Indication that shutdown has been aborted
3	Shutdown Forced – Indication of shutdown typically used in cases such as low battery that cannot be aborted

When a state of 1 or 3 is received displays **shall [self-verify]** clear any target information shown to users and indicate that target information is unavailable.

### 6.7.2 Inverted Clear Targets

Displays **shall [self-verify]** clear any target information shown to users and indicate that target information is unavailable when a value of 0 is received. Note that this cannot be critically relied upon by sensors because legacy displays do not support this page and feature. An error page or closing the channel is the recommended path to ensure as many displays as possible indicate that targets are not detected.



## 6.8 Data Page 2 – Device Command (0x02)

Data page 2 is a command data page transmitted as an acknowledged message from an ANT+ bike radar display.

See section 6.4.4 for optionally supported use by displays.

See sections 6.3.3 and 6.3.4 for required use by sensors.

All fields in this message **shall [self-verify]** be set as described in Table 6-9.

**Table 6-9. Data Page 2 Format – Device Command**

Byte	Field Description	Length	Value	Units	Range or Rollover
0	Data Page Number	1 Byte	Data Page Number = 2 (0x02)	N/A	N/A
1	Device Command	2 Bits (0-1)	Refer to Table 6-10	N/A	N/A
	Reserved	6 Bits (2-7)	Reserved, Set to 0x1F		
2	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
3	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
4	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
5	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
6	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A
7	Reserved	1 Byte	Reserved, Set to 0xFF	N/A	N/A

### 6.8.1 Device Command

**Table 6-10. Device Command Field**

Value	Device Command
0	Abort Shutdown
1	Shutdown
2	Reserved
3	Reserved

## 6.9 Data Pages 3 – 47, 50 – 63: Reserved

Data pages 3 to 47, and 50 to 63 are reserved for future main data page definitions. These pages **shall [MD\_0007]** not be transmitted.



## 6.10 Required Common Pages

Common pages are pages that can be sent/received from any ANT+ device that has its channel configured to send/receive them. This is indicated via the transmission type channel parameter. See the ANT+ Common Pages document for details of all common data pages.

### 6.10.1 Common Page 80 – Manufacturer’s Identification (0x50)

Common data page 80 **shall [MD\_0009] [self-verify]** transmit the manufacturer’s ID, model number, and hardware revision.

Refer to the ANT+ Common Pages document for details of this page.

### 6.10.2 Common Page 81 – Product Information (0x51)

Common data page 81 transmits the device’s software revision and its 32-bit serial number.

Refer to the ANT+ Common Pages document for details of this page.

### 6.10.3 Common Page 82 – Battery Status (0x52)

Common data page 82 transmits the device’s battery voltage and status.

It is recommended that bike radar devices that desire to shut off due to low battery interleave the battery status page before turning off.

Refer to the ANT+ Common Pages document for details of this page.





### 6.10.4 Common Page 87 – Error Description (0x57)

The error common page allows the ANT+ bike radar to indicate it is in an error state.

This data page **shall** [MD\_RDR\_002] [self-verify] be transmitted according to section 6.3.2.

Displays **shall** [SD\_RDR\_001] [SD\_RDR\_003] [SD\_RDR\_014] [self-verify] support this data page and follow section 6.4.2.

All fields in this message **shall** [MD\_RDR\_002] [self-verify] be set as described in Table 6-11.

**Table 6-11. Common Data Page 87 – Error Description Data**

Byte	Field Description	Length	Value	Units
0	Data Page Number	1 Byte	Set to 87 (0x57).	N/A
1	Reserved	1 Byte	Set to 0xFF.	N/A
2	System Component Index	4 Bits (0:3)	System Component Identifier (defined by manufacturer). 0xF: Invalid, System Error	N/A
	Reserved	2 Bits (4:5)	Set to 0b00.	N/A
	Error Level	2 Bits (6:7)	Refer to Table 6-12	N/A
3	ANT+ Bike Radar Device Profile Error Codes	1 Byte	0-254: Refer to Table 6-13. 0xFF: Invalid	N/A
4-7	Manufacturer Specific Error Codes	4 Bytes	Defined by the manufacturer. 0xFFFFFFFF: Invalid	N/A

#### 6.10.4.1 System Component Index

The system component index field allows the device to indicate which component is responsible for causing the error associated with this data page. The values for this field are defined by the manufacturer.

The system component index field **shall** [self-verify] be set to 0xF if the error is not restricted to a specific component.

#### 6.10.4.2 Error Level

Error Level Definitions for the ANT+ Bike Radar device profile:

**Table 6-12. Bike Radar Error Level Definitions**

Value	Definition	Description
0	Reserved	Reserved
1	Warning	Bike Radar device will recover automatically from the error state.
2	Critical	The Bike Radar device will not automatically recover from the error state. User action may be required.
3	Reserved	Reserved





#### 6.10.4.3 ANT+ Bike Radar Device Profile Error Code

It is recommended that this error code is recorded and displayed to the user by the display device. Such error codes may assist the user with troubleshooting and product support. Values in the reserved range **shall [self-verify]** be handled numerically if this field is parsed by a display.

**Table 6-13. ANT+ Bike Radar Device Profile Error Codes**

Value	Definition	Description
0	Radar Saturated	Bike Radar device will recover automatically from the error state.
1	Unit Skew	The unit is mounted incorrectly and thus may not function correctly.
2-254	Reserved	Reserved

#### 6.10.4.4 Manufacturer Specific Error Codes

It is recommended that this error code is recorded and displayed (e.g., numerically) to the user by the display device. Such error codes may assist the user with troubleshooting and product support.

## 6.11 Optional Common Data Pages

### 6.11.1 Common Page 70 - Request Data Page (0x46)

Common Data Page 70 allows the display to request a specific data page from the ANT+ bike radar device. The request data page **shall [self-verify]** be sent using an acknowledged message by the display and **shall [self-verify]** be formatted as shown in Table 6-14. Bike radar devices are required to respond to requests for data pages 80, 81 and 82.

**Table 6-14. Common Data Page 70 - Request Data Page**

Byte	Field Description	Length	Value	Units
0	Command ID	1 Byte	70 (0x46) – Data Page Request	N/A
1	Reserved	1 Byte	Value = 0xFF	N/A
2	Reserved	1 Byte	Value = 0xFF	N/A
3	Descriptor Byte 1	1 Byte	Allows subpages to be requested within the requested data page. Valid Values: 0 – 254 Invalid: 255 (0xFF)	N/A
4	Descriptor Byte 2	1 Byte	Allows subpages to be requested within the requested data page. Valid Values: 0 – 254 Invalid: 255 (0xFF)	N/A
5	Requested Transmission Response	1 Byte	Describes transmission characteristics of the data requested. Bit 0-6: Number of times to transmit requested page. Bit 7: Setting the MSB means the device replies using acknowledged messages if possible. Special Values: 0x80 - Transmit until a successful acknowledge is received. 0x00 – Invalid	N/A
6	Requested Page Number	1 Byte	Page number to transmit.	N/A
7	Command Type	1 Byte	Value = 1 (0x01) for Request Data Page	N/A

#### 6.11.1.1 Descriptor Bytes 1 & 2

The descriptor byte fields are used to describe requested subpages. As no subpages are used within this device profile, these bytes should be set to invalid.

#### 6.11.1.2 Requested Transmission Response

The bike radar should be able to support all requested transmission response types; however, the ANT+ Bike Radar Device Profile further stipulates that the display **shall [self-verify]** only request broadcast messages from a bike radar.

Note that some bike radars do not support sending acknowledged messages and will instead respond with broadcast messages regardless of the response type requested.

Refer to the ANT+ Common Pages document for more details on the request data page and possible requested transmission response types.



### ***6.11.2 Other Common Data Pages***

Other common data pages that are listed in the ANT+ Common Pages document can be sent from the ANT+ bike radar device. Other common data pages are implemented at the discretion of the developer.

## 7 Additional Requirements

In addition to the requirements outlined in prior sections, the following general requirements apply:

1. A sensor **shall [MD\_0006] [self-verify]** only send broadcast messages to a display. A sensor **shall [MD\_0006] [self-verify]** not send acknowledged messages and **shall [self-verify]** not send burst messages.
2. A display **shall [SD\_0010] [self-verify]** treat data sent as acknowledged messages from a sensor no differently than data sent as broadcast messages from a sensor.
3. A display **shall [SD\_0009] [self-verify]** not decode any unexpected burst messages that are sent from a sensor and **shall [SD\_0009] [self-verify]** handle this situation gracefully\*.
  - \*A display receiving burst messages from a sensor safely ignores those messages without them affecting its visible UI state.
4. A display **shall [self-verify]** not decode reserved fields in received data pages. These are fields that may be given a new field definition in the future.
5. A sensor **shall [self-verify]** not decode reserved fields in received data pages. These are fields that may be given a new field definition in the future.
6. A display **shall [SD\_0005] [self-verify]** handle gracefully\* the receipt of undefined data pages.
  - \*A display receiving undefined data pages from a sensor safely ignores those messages without them affecting its visible UI state.
7. A sensor **shall [self-verify]** handle gracefully\* the receipt of undefined data pages.
  - \*A sensor receiving undefined data pages from a display safely ignores those messages without them affecting its visible UI state.
8. If a display requests a data page from the sensor, the display **shall [self-verify]** only request broadcast messages.
9. A sensor **shall [self-verify]** respond to requests for acknowledged messages.
10. A display **shall [self-verify]** handle receiving invalid field values gracefully.
11. A sensor **shall [self-verify]** handle receiving invalid field values gracefully.
12. A display **shall [self-verify]** handle receiving reserved field values gracefully. These are values that may be given a meaning in the future.
13. A sensor **shall [self-verify]** handle receiving reserved field values gracefully. These are values that may be given a meaning in the future.



14. A sensor **shall [MD\_0014] [self-verify]** not open any other master channel on the ANT+ Network Key except when the channel conforms to an ANT+ Device Profile.



## 7.1 Combined Bike Radar and Bike Light Devices

If an ANT+ bike radar sensor also includes ANT+ Bike Light functionality (see section 2) then the following additional requirements apply:

1. The sensor **shall [MD\_RDR\_LGT\_001]** pass the certification test.
2. The sensor **shall [MD\_RDR\_LGT\_003]** pass the certification test.



## 8 ANT+ Bike Radar Device Interoperability Icon

The ANT+ interoperability icons inform the end user of the product's capabilities. This icon indicates to the user that this specific device will transmit/receive bike radar information, and that it is interoperable with other devices that carry the same icon.

An ANT+ bike radar or display that meets the minimum compliance specifications and has been certified may use the icon shown in Figure 8-1 on packaging, documentation, and marketing material.



**Figure 8-1. ANT+ Bike Radar Interoperability Icon**