

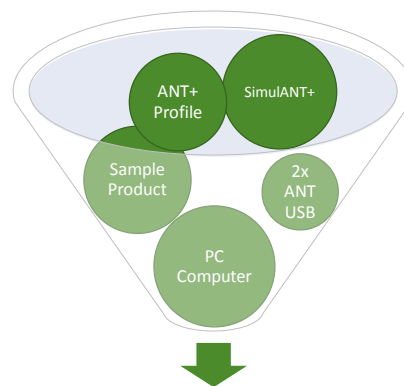


Getting Your Product Ready for ANT+ Certification

Developing with Certification in Mind

What you need to build an ANT+ product

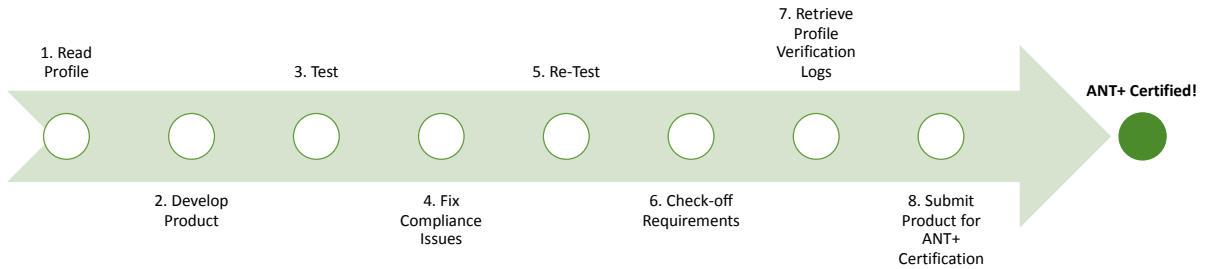
- ANT+ Device Profile
- SimulANT+ Profile Verification Suite
- Development platform for product
- 2x ANT USB Sticks
- Windows Computer



Certification Ready Product



Developing with ANT+ Certification in Mind



1. Read Profile

Defines requirements, recommendations, best practices, and allowances for certified ANT+ products.

- Certification Requirement Icon in right hand margin marks requirement
- Shalls are **bolded**, marking requirements
- Test relating to a requirement follows in [square brackets]
- Master side tests are marked **MD**, and slave side tests are marked **SD**
- A list of the profile verification tests that must be run to be certification ready are at the end of the document

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7 R-R Interval Measurements

7.1 Handling Rollovers

The Heart Beat Event Time and Heart Beat Count values that are transmitted in all data pages (Table 6-3) are subject to rollover. This means that a transmitter **shall** [MD_0011] continue to increase the value of the field until the maximum is hit, at which point the value is rolled-over. Note that a rollover makes it possible for the Heart Beat Event Time or Heart Beat Count to be less than it was in the previous message.

To properly span rollovers, calculations on the receiver side **shall** [SD_0008] first reconstruct the value from the received values, as shown in Figure 7-1. It is important to note that the Heart Beat Event Time is a bit string of size 16 and the Heart Beat Count is a bit string of size 8 as the reconstruction will vary based on the bit string size.

If $Value_{N+1} > Value_N$	255 > 1 ✓ Rollover Occurred
$\begin{array}{r} Value_N \\ + \quad \quad \quad 1 \\ \hline Value_N \text{ Rollover Correction} \end{array}$	$\begin{array}{r} 1 \\ + \quad 2^8 \\ \hline 257 \end{array}$
$\begin{array}{r} Value_N \text{ Rollover Correction} \\ - \quad \quad \quad Value_{N+1} \\ \hline Value \text{ Difference} \end{array}$	$\begin{array}{r} 257 \\ - 255 \\ \hline 2 \end{array}$

Figure 7-1. Sample Calculation of Rollover Correction for Heart Beat Count (bit string size 8)

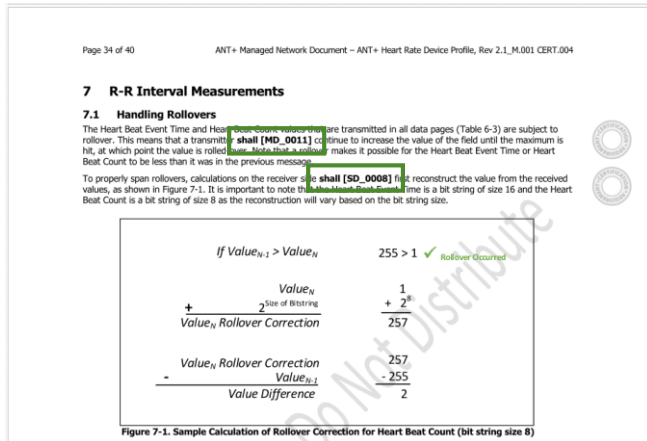




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10 Profile Verification Tests

Table 10-1. Profile Verification Tests for the Heart Rate Sensor

☑	Certification Test	Relevant Document Sections
	MD_0001 ANT Channel Parameter Test	5.2 Master Channel Configuration
	MD_0002 Transmission Type	5.2 Master Channel Configuration 6.8 Common Data Pages
	MD_0003 Channel Period	5.2 Master Channel Configuration
	MD_0004 Channel Type	5.2.1 Channel Type
	MD_0005 Toggle Bit	6.4.1 Page Change Toggle Bit 6.6 Main and Background Data Pages
	MD_0006 Tx Required Data Page	6.2 Data Page Types 8 Minimum Requirements 8.2 Additional Requirements
	MD_0007 Tx Invalid Data Page	6.9.1 Page 6-31, 33-61, & 94-111 – Reserved Range
	MD_0008 Transmission Pattern	6.2.2 Background Data Pages 6.5 Transmission Patterns 8 Minimum Requirements
	MD_0009 Manufacturer ID	6.6.3 Data Page 2 – Manufacturer Information (0x02)
	MD_0010 Page Format	6.6 Main and Background Data Pages
	MD_0011 Rollover	7.1 Handling Rollovers
	MD_0012 Request Data Page	6.6.7 Data Page 6 – Capabilities (0x06)
	MD_HRM_001 Gym Mode	6.6.7 Data Page 6 – Capabilities (0x06) 6.7.1 Data Page 32 – Gym Mode Command Page

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In this guide, we will test a Heart Rate Sensor.





2. Develop Product

Following profile definition, implement the network layer of your product.

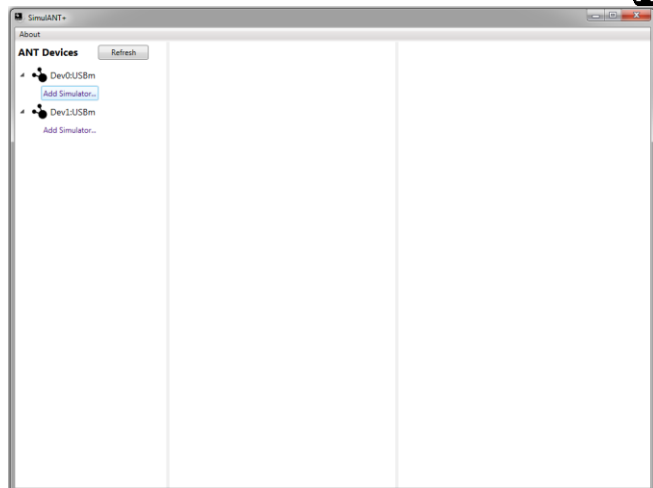
- Embedded reference designs available for some profiles in the Nordic SDK as well as thisisant.com

[illegible]

3. Test

Use the SimulANT+ Profile Verification Suite to test if your product is profile compliant.

- Simulate a complimentary device (ie. Simulate a display if your product is a sensor, vice versa)
- In the script pane, select the test you would like to run
- Watch the “Certification” tab for logs
- Read and follow instructions in prompts

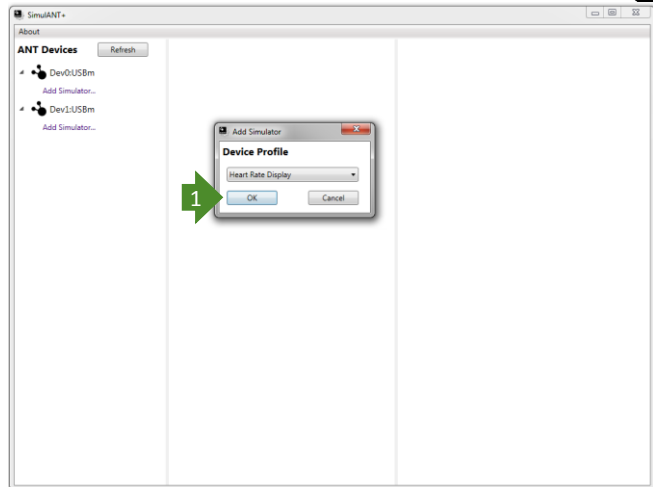




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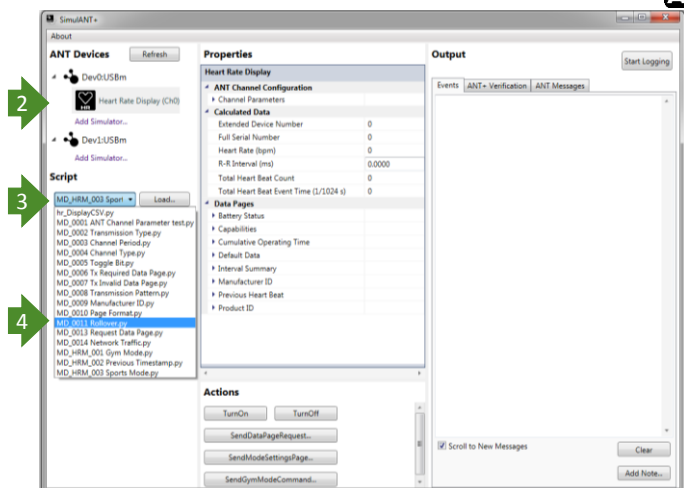
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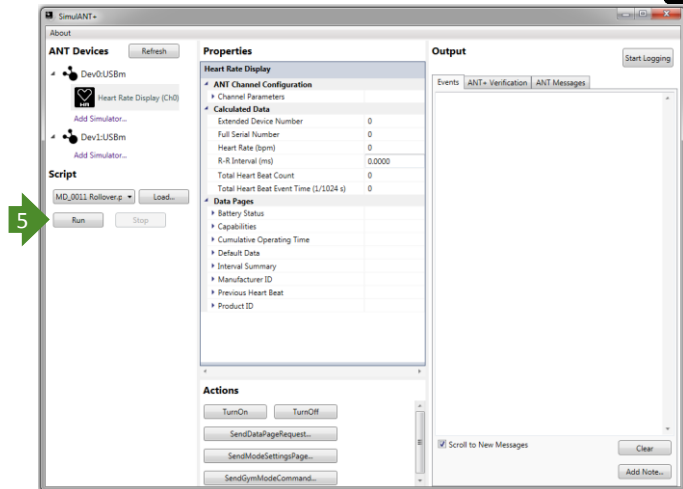




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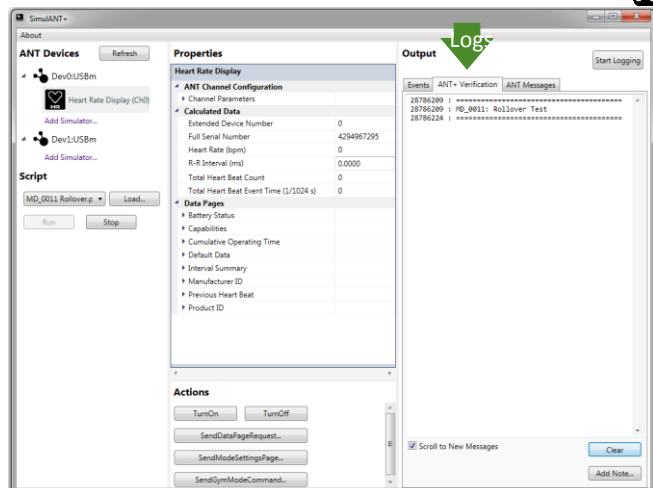
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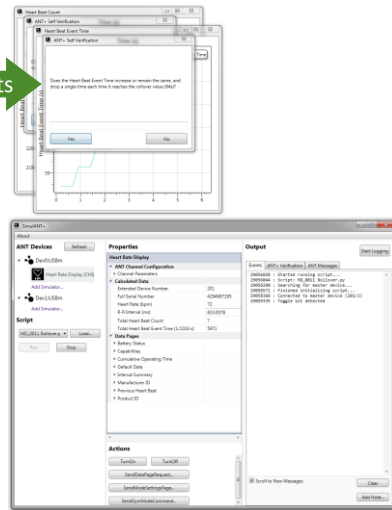


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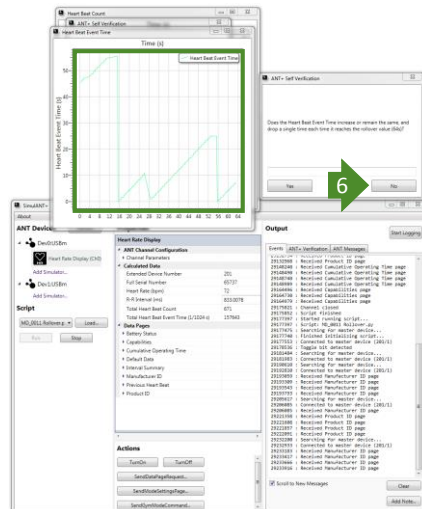
Prompts



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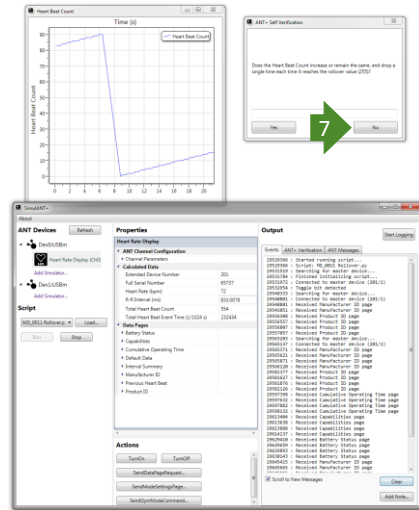




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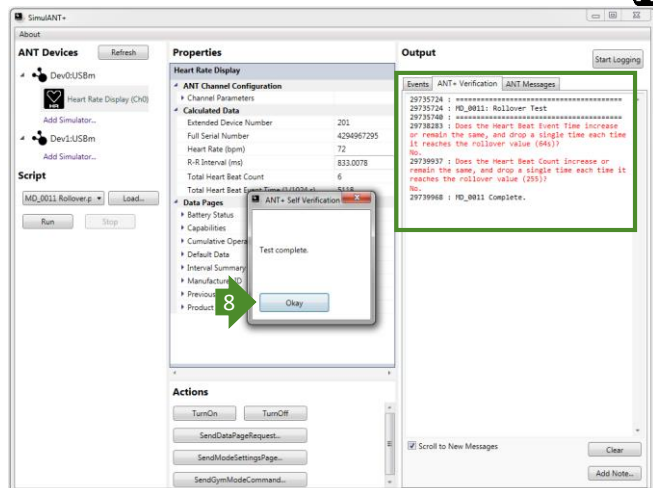
19/09/2016

15

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In this case, the test has **failed**.





4. Fix Compliance Issues

- Read the logs to identify the source of the failure
- Refer back to the profile to determine the expected profile compliant behaviour
- Optionally, review the test script to better understand the test procedure
- Modify the firmware of your product as necessary

Output

Start Logging

```

Events  ANT+ Verification  ANT Messages
29735724 : =====
29735724 : MD_0011: Rollover Test
29735740 : =====
29738283 : Does the Heart Beat Event Time increase
or remain the same, and drop a single time each time
it reaches the rollover value (64s)?
No.
29739937 : Does the Heart Beat Count increase or
remain the same, and drop a single time each time it
reaches the rollover value (255)?
No.
29739968 : MD_0011 Complete.
  
```

10 Profile Verification Tests

Table 10-1. Profile Verification Tests for the Heart Rate Sensor

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MD_0005	Toggle Bit	6.4.1 Page Change Toggle Bit 6.4 Master and Background Data Pages
MD_0006	1s Required Data Page	6.2 Data Page Types 8 Filtered Requirements 8.2 Additional Requirements
MD_0007	1s Invalid Data Page	6.4.1 Page 0-31, 32-41, & 94-101 - Reserved Range
MD_0008	Transmission Pattern	6.2.2 Background Data Pages 6.5 Transmission Patterns 8 Filtered Requirements
MD_0009	Manufacturer ID	6.4.3 Data Page 2 - Manufacturer Information (002)
MD_0011	Rollover	7.1 Handling Rollovers
MD_HRM_001	HR Mode	6.4. Data Page 6 - Capabilities (006) 6.7 Data Page 12 - Gen Mode Control

Script

MD_HRM_001: Gym Mode.py
MD_HRM_002: Sports Mode.py
MD_HRM_003: Sports Mode.py
MD_HRM_004: Sports Mode.py
MD_HRM_005: Sports Mode.py
MD_HRM_006: Sports Mode.py
MD_HRM_007: Sports Mode.py
MD_HRM_008: Sports Mode.py
MD_HRM_009: Sports Mode.py
MD_HRM_010: Sports Mode.py
MD_HRM_011: Sports Mode.py
MD_HRM_012: Sports Mode.py
MD_HRM_013: Sports Mode.py
MD_HRM_014: Sports Mode.py
MD_HRM_015: Sports Mode.py
MD_HRM_016: Sports Mode.py
MD_HRM_017: Sports Mode.py
MD_HRM_018: Sports Mode.py
MD_HRM_019: Sports Mode.py
MD_HRM_020: Sports Mode.py
MD_HRM_021: Sports Mode.py
MD_HRM_022: Sports Mode.py
MD_HRM_023: Sports Mode.py
MD_HRM_024: Sports Mode.py
MD_HRM_025: Sports Mode.py
MD_HRM_026: Sports Mode.py
MD_HRM_027: Sports Mode.py
MD_HRM_028: Sports Mode.py
MD_HRM_029: Sports Mode.py
MD_HRM_030: Sports Mode.py
MD_HRM_031: Sports Mode.py
MD_HRM_032: Sports Mode.py
MD_HRM_033: Sports Mode.py
MD_HRM_034: Sports Mode.py
MD_HRM_035: Sports Mode.py
MD_HRM_036: Sports Mode.py
MD_HRM_037: Sports Mode.py
MD_HRM_038: Sports Mode.py
MD_HRM_039: Sports Mode.py
MD_HRM_040: Sports Mode.py
MD_HRM_041: Sports Mode.py
MD_HRM_042: Sports Mode.py
MD_HRM_043: Sports Mode.py
MD_HRM_044: Sports Mode.py
MD_HRM_045: Sports Mode.py
MD_HRM_046: Sports Mode.py
MD_HRM_047: Sports Mode.py
MD_HRM_048: Sports Mode.py
MD_HRM_049: Sports Mode.py
MD_HRM_050: Sports Mode.py
MD_HRM_051: Sports Mode.py
MD_HRM_052: Sports Mode.py
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MD_HRM_069: Sports Mode.py
MD_HRM_070: Sports Mode.py
MD_HRM_071: Sports Mode.py
MD_HRM_072: Sports Mode.py
MD_HRM_073: Sports Mode.py
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MD_HRM_076: Sports Mode.py
MD_HRM_077: Sports Mode.py
MD_HRM_078: Sports Mode.py
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MD_HRM_080: Sports Mode.py
MD_HRM_081: Sports Mode.py
MD_HRM_082: Sports Mode.py
MD_HRM_083: Sports Mode.py
MD_HRM_084: Sports Mode.py
MD_HRM_085: Sports Mode.py
MD_HRM_086: Sports Mode.py
MD_HRM_087: Sports Mode.py
MD_HRM_088: Sports Mode.py
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MD_HRM_096: Sports Mode.py
MD_HRM_097: Sports Mode.py
MD_HRM_098: Sports Mode.py
MD_HRM_099: Sports Mode.py
MD_HRM_100: Sports Mode.py

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7 R-R Interval Measurements

7.1 Handling Rollovers

The Heart Beat Event Time and Heart Beat Count values that are transmitted in all data pages (table 6-3) are subject to rollover. This means that a transmitter shall MD_0011 continue to increase the value of the field until the maximum is hit, at which point the value is rolled-over. Note that a rollover makes it possible for the Heart Beat Event Time or Heart Beat Count to be less than it was in the previous message.

To properly open rollovers, calculations on the receiver side shall MD_0006 first reconstruct the value from the received values, as shown in Figure 7-1. It is important to note that the Heart Beat Event Time is a bit string of size 16 and the Heart Beat Count is a bit string of size 8 and the reconstruction will vary based on the bit string size.

$$\begin{array}{rcl}
 \text{If } \text{Value}_{n+1} > \text{Value}_n & 255 > 1 & \text{Rollover detected} \\
 \text{Value}_n & + \frac{1}{2^{\text{Size of Bitstring}}} & \\
 \text{Value}_n \text{ Rollover Correction} & + \frac{1}{257} & \\
 \text{Value}_n \text{ Rollover Correction} & - \frac{257}{2} & \\
 \text{Value Difference} & &
 \end{array}$$

Figure 7-1. Sample Calculation of Rollover Correction for Heart Beat Count (bit string size 8)

4. Fix Compliance Issues

- Read the logs to identify the source of the failure
- Refer back to the profile to determine the expected profile compliant behaviour
- Optionally, review the test script to better understand the test procedure
- Modify the firmware of your product as necessary



- Read the logs to identify the source of the failure
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The screenshot shows a Jupyter Notebook interface with a file explorer at the top listing files like 'File Edit Search View Insert Layout Help Main Run Plugins Windows'. The notebook contains Python code for testing a simulator. A green box highlights a test procedure section.

```
from Microsoft.Research.DynamicDataDisplay.DataSources import ObservableDataSource
from Microsoft.Research.DynamicDataDisplay.Charts import HorizontalLine
from Microsoft.Research.DynamicDataDisplay import *
```

Collapsing MD_001 Unit Tests (HeartBeatTest)

```
***Rollover Test.

This test verifies that rollover is implemented correctly.

Procedure:
1. Connect the simulated display to the UUT.
2. Graph the Heart Beat Count and Heart Beat Event Time.
3. Verify that the rollover fields only increase or remain the same,
   and decrease a single time each time it reaches the rollover value.

See
```

```
def __init__(self, simulator, slaveChannel, endScript):
    """Test class constructor.

    Args:
        simulator: The simulated device exposed by SIMULANT+.
        slaveChannel: The SIMULANT+ exposed ANT slave channel.
        endScript (function pointer): The SIMULANT+ exposed method
            that triggers the "Stop" button in SIMULANT+."""

    self.num_prompts_closed = 0
    self.slave_channel = slaveChannel

# Graph for Heart Beat Count field
self_graph.heart_beat_count = Graph("Heart Beat Count", "Heart Beat"
                                     + " Count")

# Graph for heart_beat_event_time field
self_graph.heart_beat_event_time = Graph("Heart Beat Event Time",
```

Python file length: 5680 lines: 147 Ln:52 Col:43 Sel:0 Doc/Windows UTF-8-BOM B6



- Read the logs to identify the source of the failure
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```

        return new FeatureFlag(request) {
            @Override public boolean request() {
                logRequest(request);
                var requestStatus = request.getStatus();
                if (requestStatus == null) {
                    logRequest(requestStatus, request, context, request.getRequestId(), request.isAsk() ? request.getRequestId() : 0, true);
                }
                // Response is not ready, return without error, pending request.
            }
        };
    }

    private void handleFlag(PollingStatusFlag receivedFlag) {
        logEvent(String.format("Received new settings page (%d) in sport mode (%d)", receivedFlag.getStatus(), receivedFlag.getMode()));
        handleSetting = receivedFlag;
        handlePollingStatusFlag(receivedFlag);
    }

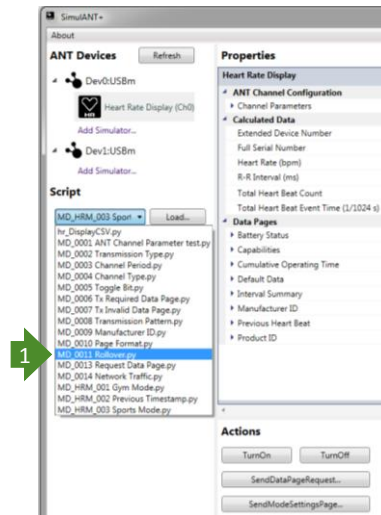
    private void handlePollingStatusFlag(PollingStatusFlag receivedFlag) {
        if (receivedFlag.getMode() == Common.Common.SportRunning) {
            if (CapabilitiesRunningSupported == true) {
                logEvent("Received Feature Running Enabled.");
                CapabilitiesRunningEnabled = true;
                CapabilitiesCyclingEnabled = false;
                CapabilitiesSwimmingEnabled = false;
                TransIntervalSummary = false;
            }
            else {
                logEvent("Display attempting to switch to sport mode 'Running'...Heart rate monitor does not support this feature. Ignoring request.");
            }
        }
        else if (receivedFlag.getMode() == Common.Common.SportCycling) {
            if (CapabilitiesCyclingSupported == true) {
                logEvent("Received Feature Cycling Enabled.");
                CapabilitiesRunningEnabled = false;
                CapabilitiesCyclingEnabled = true;
                CapabilitiesSwimmingEnabled = false;
                TransIntervalSummary = false;
            }
            else {
                logEvent("Display attempting to switch to sport mode 'Cycling'...Heart rate monitor does not support this feature. Ignoring request.");
            }
        }
        else if (receivedFlag.getMode() == Common.Common.SportSwimming) {
            if (CapabilitiesSwimmingSupported == true) {
                logEvent("Received Feature Swimming Enabled.");
            }
            else {
                logEvent("Display attempting to switch to sport mode 'Swimming'...Heart rate monitor does not support this feature. Ignoring request.");
            }
        }
    }
}

```



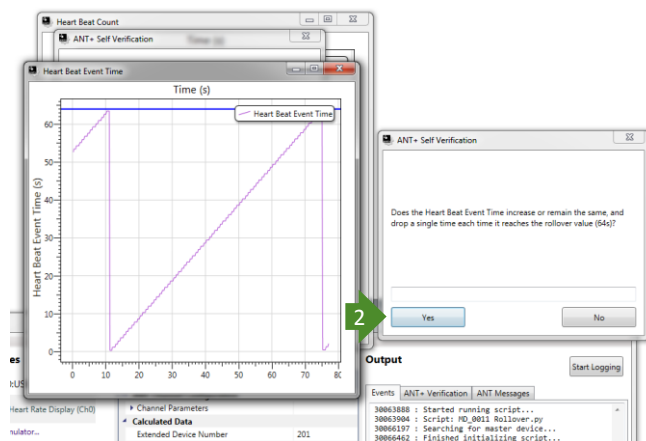
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Once the failure has been identified and corrected, re-run the failing test to ensure compliance.



5. Re-Test

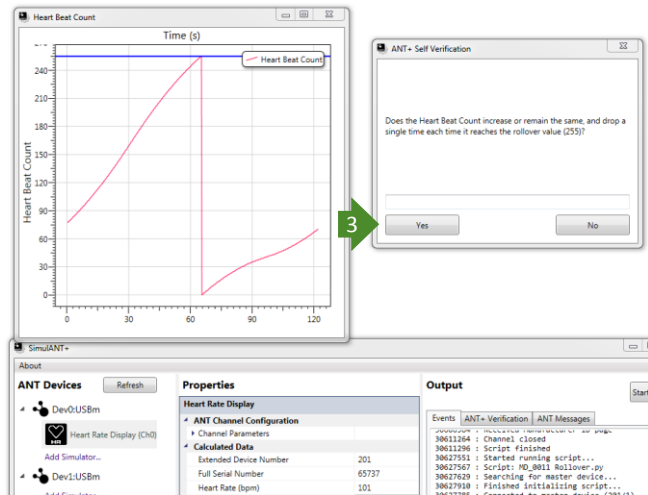
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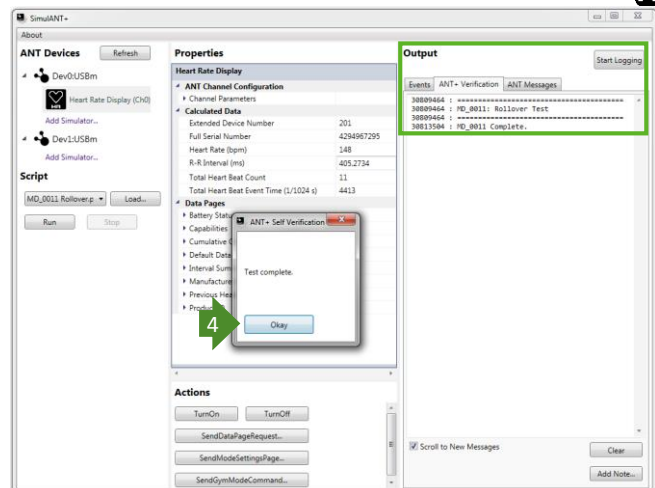
Once the failure has been identified and corrected, re-run the failing test to ensure compliance.



5. Re-Test

Once the failure has been identified and corrected, re-run the failing test to ensure compliance.

In this case, the test has **passed**.





6. Check-off

Use the provided checkboxes to mark of requirements that have been met or are not applicable.

Some requirements do not have SimulANT+ Profile Verification Tests. For those requirements, manually verify that the requirement has been met by the product. Your product may not support all the features tested by the Verification Tool.

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7 R-R Interval Measurements

7.1 Handling Rollovers

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$$\begin{array}{rcl}
 \text{If } Value_{N+1} > Value_N & 255 > 1 & \text{✓ Rollover Occurred} \\
 \frac{Value_N}{2^{\text{Size of Bitstring}}} & + \frac{1}{2^8} & \\
 \hline
 Value_N \text{ Rollover Correction} & 257 & \\
 \frac{Value_N \text{ Rollover Correction}}{2} & - \frac{255}{2} & \\
 \hline
 Value \text{ Difference} & 2 &
 \end{array}$$

Figure 7-1. Sample Calculation of Rollover Correction for Heart Beat Count (bit string size 8)



10 Profile Verification Tests

Table 10-1. Profile Verification Tests for the Heart Rate Sensor

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MD_0008	Transmission Pattern	6.2.2 Background Data Pages 6.5 Transmission Patterns 6.4 Minimum Requirements
MD_0009	Manufacturer ID	6.6.3 Data Page 2 – Manufacturer Information (MID)
MD_0010	Page Format	6.5 Main and Background Data Pages
MD_0011	Rollover	7.1 Handling Rollovers
MD_0013	Request Data Page	6.6.7 Data Page 6 – Capabilities (M06)
MD_HRM_001	Gym Mode	6.6.7 Data Page 6 – Capabilities (M06) 6.7 Data Page 32 – Gym Mode Command Page
MD_HRM_002	Previous Timestamp	6.6.5 Data Page 4 – Previous Heart Beat (M04)
MD_HRM_003	Sports Mode	6.2.1 Main Data Pages 6.4.4 Data Page 3 – Status Interval Summary (M05) 6.6.7.2.1 Extended Summing Features Enabled 6.6.2 Common Page 36 (M42) – Mode Settings Page 6.5.1 Minimum Transmission Timing Requirements
Self-verify		5.2 Master Channel Configuration 5.2.3 Device Number 6.6 Main and Background Data Pages 6.6.4 Data Page 3 – Product Information (M03) 6.6.2.1 Features Supported 6.6.3 Invalid Battery Voltage 6.9.2 Page 112-127 – Manufacturer Specific Range

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Certification Test	Relevant Document Sections	
MD_0001 ANT Channel Parameter Test	5.2 Master Channel Configuration	
MD_0002 Transmission Type	5.2 Master Channel Configuration 6.8 Common Data Pages	
MD_0003 Channel Period	5.2 Master Channel Configuration	
MD_0004 Channel Type	5.2.1 Channel Type	
MD_0005 Toggle Bit	6.4.1 Page Change Toggle Bit 6.6 Main and Background Data Pages	
MD_0006 Tx Required Data Page	6.2 Data Page Types 8 Minimum Requirements 8.2 Additional Requirements	
MD_0007 Tx Invalid Data Page	6.5.1 Page 9-31, 33-61, & 94-111 – Reserved Range	
MD_0008 Transmission Pattern	6.2.2 Background Data Pages 6.5 Transmission Patterns 8 Minimum Requirements	
MD_0009 Manufacturer ID	6.5.3 Data Page 3 – Manufacturer Information (Manufacturer ID)	
MD_0010 Page Format	6.6 Main and Background Data Pages	
MD_0011 Rollover	7.1 Handling Rollovers	
MD_0013 Request Data Page	6.6.7 Data Page 6 – Capabilities (Data)	
MD_HRM_001 Gym Mode	6.4.7 Data Page 6 – Capabilities (Data) 6.7 Data Page 12 – Gym Mode Command Page	
MD_HRM_003 Protocol Timestamp	6.5.3 Data Page 4 – Previous Heart Beat (Data)	
MD_HRM_003 Sports Mode	6.2.2 Main Data Pages 6.6.6 Data Page 5 – Swim Interval Summary (Data) 6.6.7.2.1 Extended Swimming Features Enabled 6.6.2 Common Page 74 (Data) – Mode Settings Page 6.5.3 Minimum Transmission Timing Requirements	
Self-verify	5.2 Master Channel Configuration 5.2.2 Device Number 6.6 Main and Background Data Pages 6.6.4 Data Page 3 – Product Information (Data) 6.6.5.1 Features Supported 6.6.6.3 Invalid Battery Voltage 6.5.3 Page 113-127 – Manufacturer Specific Range	

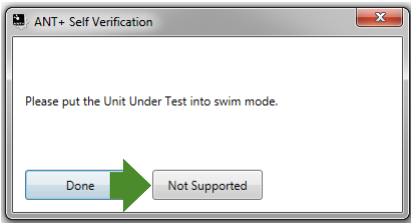


6. Check-off

Use the provided checkboxes to mark of requirements that have been met or are not applicable.

Some requirements do not have SimulANT+ Profile Verification Tests. For those requirements, manually verify that the requirement is has been met by the product.

Your product may not support all the features tested by the Verification Tool.





6. Check-off

Use the provided checkboxes to mark of requirements that have been met or are not applicable.

Some requirements do not have SimulANT+ Profile Verification Tests. For those requirements, manually verify that the requirement is has been met by the product.

Your product may not support all the features tested by the Verification Tool.

In this case, all of the requirements have been met, and all of the tests **pass**.

10 Profile Verification Tests

Table 10-1. Profile Verification Tests for the Heart Rate Sensor		
✓	Certification Test	Relevant Document Sections
✓	MD_0001 ANT Channel Parameter Test	5.2 Master Channel Configuration
✓	MD_0002 Transmission Type	5.3 Master Channel Configuration 6.8 Common Data Pages
✓	MD_0003 Channel Period	5.3 Master Channel Configuration
✓	MD_0004 Channel Type	5.3.1 Channel Type
✓	MD_0005 Toggle Bit	6.4.1 Page Change Toggle Bit 6.6 Main and Background Data Pages
✓	MD_0006 Tx Required Data Page	6.2 Data Page Types 8 Minimum Requirements 8.2 Additional Requirements
✓	MD_0007 Tx Invalid Data Page	6.9.1 Page 9-31, 33-63, & 94-111 – Reserved Range
✓	MD_0008 Transmission Pattern	6.2.2 Background Data Pages 6.5 Transmission Patterns 8 Minimum Requirements
✓	MD_0009 Manufacturer ID	6.6.3 Data Page 3 – Manufacturer Information (Manufacturer ID)
✓	MD_0010 Page Format	6.6 Main and Background Data Pages
✓	MD_0011 Rollover	7.1 Handling Rollovers
✓	MD_0013 Request Data Page	6.6.7 Data Page 6 – Capabilities (Data)
✓	MD_HRM_001 Gym Mode	6.6.7 Data Page 6 – Capabilities (Data) 6.7 Data Page 12 – Gym Mode Command Page
✓	MD_HRM_003 Protocol Timestamp	6.6.3 Data Page 3 – Previous Heart Beat (Data)
✓	MD_HRM_005 Sports Mode	6.2.2 Main Data Pages 6.6.6 Data Page 5 – Sports Interval Summary (Data) 6.6.7.2.1 Extended Summing Features Enabled 6.6.2 Common Page 76 (Data) – Page Settings Page 8.1.1 Minimum Transmission Timing Requirements
✓	Self-verify	5.3 Master Channel Configuration 5.2.2 Device Number 6.6 Main and Background Data Pages 6.6.4 Data Page 3 – Product Information (Data) 6.6.2.1 Features Supported 6.6.8.3 Invalid Battery Voltage 6.9.2 Page 112-117 – Manufacturer Specific Range

7. Generate Profile Verification Logs

As part of the ANT+ Certification process, logs are required to be submitted to prove that the development team has run through the SimulANT+ Profile Verification Suite, and that the product is certification ready.

- Before running the tests, start logging
 - Enter Product Information
- Run through all certification scripts
- Stop logging
- Retrieve log files

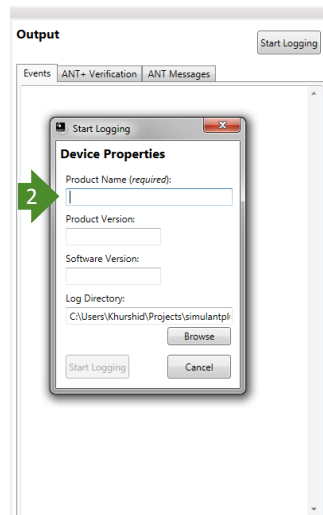




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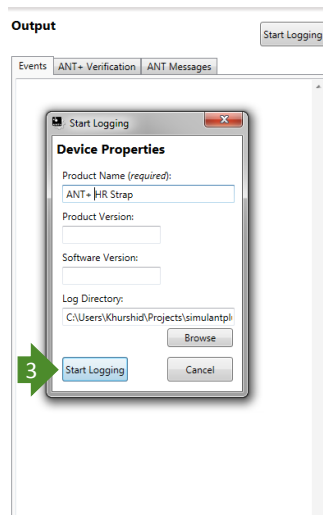
- Before running the tests, start logging
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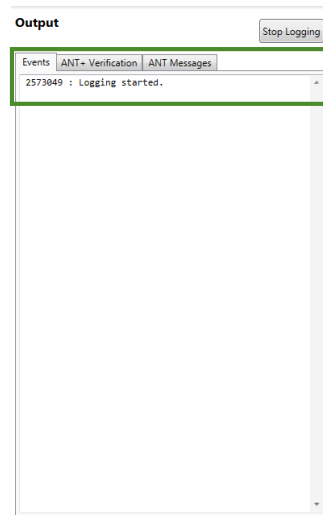




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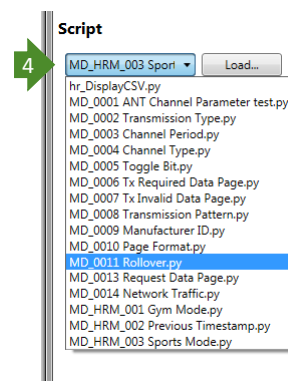
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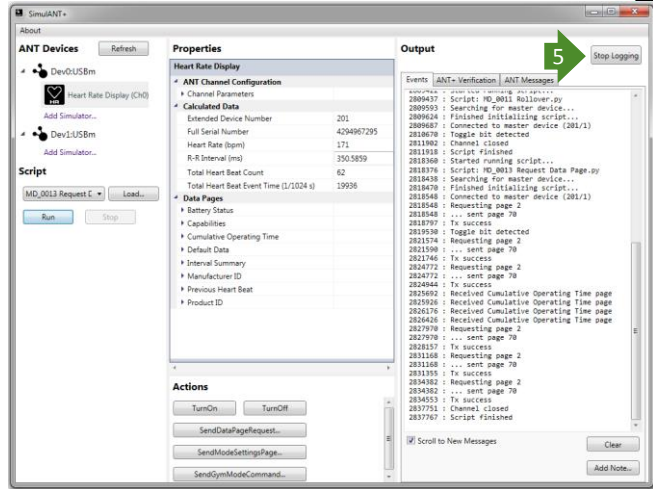




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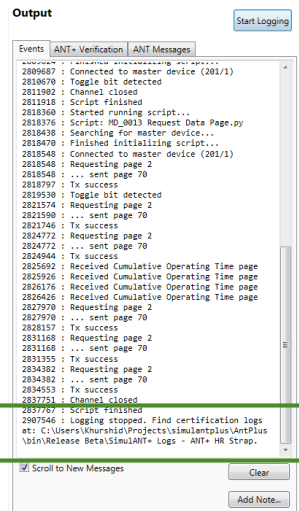
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- Stop logging
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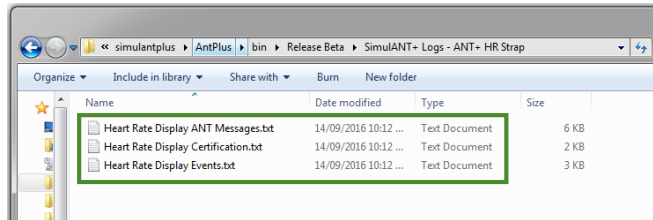




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- Run through all certification scripts
- Stop logging
- Retrieve log files



8. Submit Product for ANT+ Certification

1. Complete the [ANT+ Product Certification Application Request](https://www.thisisant.com/developer/ant-plus/certification)
2. Prepare and submit application materials
 1. Technical Materials
 2. Brand Materials
3. Pay the certification fee
4. Ship your test sample
5. Review results and update product as needed
6. Once reviews pass, your product is listed as **ANT+ Certified**

<https://www.thisisant.com/developer/ant-plus/certification>

