### Prüfbericht-Nr.: 18060504 001  
**Test Report No.:**  
**Order No.:** 89213672  
**Page 1 of 8**

### Kunden Referenz-Nr.: 11695250  
**Client Reference No.:**

### Auftragsdatum: 31-05-2018  
**Order date:**

### Auftraggeber:  
**Client:** TÜV Rheinland of North America Inc.  
1279 Quarry Lane, Suite A  
94566  Pleasanton, CA  
United States of America

### Prüfwesen  
**Tel.:** +31 594 50 50 05  
**MAIL:** EPS@NL.TUV.COM  
**WEB:** WWW.TUV.COM

### Prüfgegenstand:  
**Test item:** Advanced Lighting Control

### Bezeichnung / Typ-Nr.:  
**Identification / Type No.:** ALC-BASE-200-COM-LORA-200-SEM1272N

### Auftrags-Inhalt:  
**Order content:** Testing according to LoRa End Device Certification US902-928 Version 1.3

### Prüfgrundlage:  
**Test specification:** LoRa End Device Certification US902-928 Version 1.3

### Wareneingangsdatum: 25-06-2018  
**Date of receipt:**

### Prüfmuster-Nr.: UE50aC01 (OTAA)  
**Test sample No.:** UE50bCO1 (ABP)

### Prüfzeitraum: 25-06-2018 - 28-06-2018  
**Testing period:**

### Ort der Prüfung: Leek, Netherlands  
**Place of testing:**

### Prüflaboratorium: TÜV Rheinland NL B.V.  
**Testing laboratory:**

### Prüfergebnis: PASS  
**Test results:**

### Geprüft von  
**Tested by:** Lourens Koopmans  
Senior Test Engineer

### Kontrolliert von  
**Reviewed by:** Kutbuddin Vora  
Senior Project Engineer

### Datum  
**Date:**

### Unterschrift  
**Signature:**

### Sondiges / Other: -

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Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.  
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.
### Revisions

<table>
<thead>
<tr>
<th>Revision</th>
<th>Datum</th>
<th>Anmerkung</th>
<th>Verfasser</th>
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Note: Latest revision report will replace all previous reports
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# 1 PRODUCT INFORMATION

The device under test (DUT) is a wireless UBICQUIA LLC Advanced Lighting Control for LoRaWAN 1.0.2 Certification testing

## General information

<table>
<thead>
<tr>
<th>Product name:</th>
<th>ALC-BASE-200-COM-LORA-200-SEM1272N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model:</td>
<td>Ubicell</td>
</tr>
<tr>
<td>Description:</td>
<td>LoRa Alliance LoRaWAN compliance testing</td>
</tr>
<tr>
<td>Manufacturer SKU</td>
<td>-</td>
</tr>
<tr>
<td>Hardware version:</td>
<td>32-00-030-4</td>
</tr>
<tr>
<td>Software version:</td>
<td>10</td>
</tr>
<tr>
<td>Contact person:</td>
<td>Hoyt M. Layson, Jr.</td>
</tr>
<tr>
<td>Phone number:</td>
<td>+1 727-424-6180</td>
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## LoRaWAN information

<table>
<thead>
<tr>
<th>Type of DUT</th>
<th>End Device</th>
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<tbody>
<tr>
<td>LoRa Device Class</td>
<td>A</td>
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<tr>
<td>Geographical area of operation</td>
<td>USA 902-928 common region</td>
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<tr>
<td>Operating frequency</td>
<td>915 MHz</td>
</tr>
<tr>
<td>Adaptive Data Rate (ADR) supported?</td>
<td>Yes</td>
</tr>
<tr>
<td>Activation possibilities</td>
<td>both Over the air and by personalization</td>
</tr>
<tr>
<td>Test According LoRaWAN™ Spec</td>
<td>V1.0.2</td>
</tr>
<tr>
<td>Output Power</td>
<td>up to 30 dBm ERP</td>
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<tr>
<td>Number / Type of Antenna(s)</td>
<td>1</td>
</tr>
<tr>
<td>Antenna Gain</td>
<td>1.2 dBi</td>
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<tr>
<td>Test sample information</td>
<td>production unit</td>
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</table>
For OTA activation:

<table>
<thead>
<tr>
<th>Serial No of Device with OTAA</th>
<th>ASM 32-00-030-4 PCB 32-99-030-4 3593 0198 UE50aC01 (OTAA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-device identifier (DevEUI)</td>
<td>3CCA00E69C84449A</td>
</tr>
<tr>
<td>Application identifier (AppEUI)</td>
<td>ADA4DAE3AC12676B</td>
</tr>
<tr>
<td>Application key (AppKey)</td>
<td>11B0282A189B75B0B4D2D8C7FA38548B</td>
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</table>

For activation by personalization:

<table>
<thead>
<tr>
<th>Serial No of Device with ABP</th>
<th>ASM 32-00-030-4 PCB 32-99-030-4 3630 0244 UE50bC01 (ABP)</th>
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</thead>
<tbody>
<tr>
<td>End-device identifier (DevAddr)</td>
<td>0000000A</td>
</tr>
<tr>
<td>Application identifier (AppSKey)</td>
<td>2B7E151628AED2A6ABF7158809CF4F3C</td>
</tr>
<tr>
<td>Application key (NwkSKey)</td>
<td>2B7E151628AED2A6ABF7158809CF4F3C</td>
</tr>
</tbody>
</table>

| Default RX2 Window Frequency  | 923.3 MHz                                                        |
| Default RX2 Window Data Rate  | DR8 (SF12, 500 kHz)                                             |
| RECEIVE_DELAY1               | 1 s                                                              |
| RECEIVE_DELAY2               | 2 s (must be RECEIVE_DELAY1 + 1s)                               |
| JOIN_ACCEPT_DELAY1           | 5 s                                                              |
| JOIN_ACCEPT_DELAY2           | 6 s                                                              |
| MAX_FCNT_GAP                 | 16384                                                            |
| ADR_ACK_LIMIT                | 64                                                               |
| ADR_ACK_DELAY                | 32                                                               |
| ACK_TIMEOUT                  | 2 +/- 1 s (random delay between 1 and 3 seconds)                 |

Submitted Documents:
LoRa Certification Customer Questionnaire document.
LoRa Test Environment log files.

Remarks:
All test cases are tested with Over the Air (OTA). and for Activation by Personalization (ABP) all test cases except 2.3.6 and 2.3.7 as per LoRa Alliance Certification committee recommended guidelines.
## 2 TEST EQUIPMENT

<table>
<thead>
<tr>
<th>Prüfmittel</th>
<th>Marke</th>
<th>Version</th>
</tr>
</thead>
</table>
| Comprehensive Testing Environment (CTE) | TÜV Rheinland Group | CTE - TMF V45.1  
                                  |                        | CTE - SIG - LoRa V3.3  |
| Senet 915MHz Gateway 0005863 (SX1301 Array library version) | Senet | >=1.0.rc10  |
| Senet 915MHz Gateway 0005863(Semtech Packet Forwarder) | Senet | >=1.0.rc3  |
| ALC-BASE-200-COM-LORA-200-SEM1272N | UBICQUIA LLC | 32-00-030-4 / 10 |
### 3 SUMMARY

<table>
<thead>
<tr>
<th>Verdicts of functional requirements:</th>
<th>Verdict</th>
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<tbody>
<tr>
<td>Cert-Application Activation</td>
<td>PASS</td>
</tr>
<tr>
<td>Over the Air Activation</td>
<td>PASS</td>
</tr>
<tr>
<td>Channel Plan and Usage</td>
<td>PASS</td>
</tr>
<tr>
<td>Cryptography</td>
<td>PASS</td>
</tr>
<tr>
<td>Downlink Error Rate</td>
<td>PASS</td>
</tr>
<tr>
<td>Receive Window Timing</td>
<td>PASS</td>
</tr>
<tr>
<td>Frame Sequence Number</td>
<td>PASS</td>
</tr>
<tr>
<td>Confirmed Frames</td>
<td>PASS</td>
</tr>
<tr>
<td>Dev Status Request MAC command</td>
<td>PASS</td>
</tr>
<tr>
<td>New Channel Request MAC command</td>
<td>PASS</td>
</tr>
<tr>
<td>RX Parameter Setup Request</td>
<td>PASS</td>
</tr>
<tr>
<td>RX Timing Setup Request</td>
<td>PASS</td>
</tr>
<tr>
<td>Link ADR Request MAC command</td>
<td>PASS</td>
</tr>
<tr>
<td>RX1 Receive Window Test</td>
<td>PASS</td>
</tr>
<tr>
<td>RX2 Receive Window Test</td>
<td>PASS</td>
</tr>
<tr>
<td>RX Oversized Payload</td>
<td>PASS</td>
</tr>
<tr>
<td>Maximum Allowed Payload</td>
<td>PASS</td>
</tr>
<tr>
<td>MAC Command(s) in App-Payload (FRMPayload)</td>
<td>PASS</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Supported optional features:</th>
<th>YES / No</th>
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<tbody>
<tr>
<td>Adaptive Data Rate (ADR)</td>
<td>YES</td>
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**Overall Test Result:** PASS
## 4 TEST CASE VERDICTS AS PER TEST SPECIFICATIONS

<table>
<thead>
<tr>
<th>Test item</th>
<th>Description</th>
<th>Implementation</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>US902-928 2.1.1</td>
<td>Cert-Application Activation</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.1.2</td>
<td>Over The Air Activation</td>
<td>Mandatory</td>
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<td>US902-928 2.2.1.a</td>
<td>Channel Plan and Usage</td>
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<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.b.i</td>
<td>AES Encryption</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.b.ii</td>
<td>Message Integrity Code</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.c</td>
<td>Downlink Error Rate</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.d</td>
<td>Downlink Window Timing</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.e.i</td>
<td>Uplink Sequence Number</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.e.ii</td>
<td>Downlink Sequence Number &amp; Downlink</td>
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</tr>
<tr>
<td>US902-928 2.2.2.a</td>
<td>Confirmed Uplinks</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.2.b</td>
<td>Confirmed Uplink Retransmission</td>
<td>Mandatory</td>
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<tr>
<td>US902-928 2.2.2.c</td>
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<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.2.d</td>
<td>Confirmed Downlink Retransmission</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.1</td>
<td>DevStatusReq MAC Command</td>
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</tr>
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<td>US902-928 2.3.2.a &amp; 2.3.2.b</td>
<td>Addition of A Channel &amp; Removal of A Channel</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
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<td>US902-928 2.3.3</td>
<td>RXParamSetupReq MAC command</td>
<td>Mandatory</td>
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</tr>
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<td>US902-928 2.3.4</td>
<td>RXTimingSetupReq MAC command</td>
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<td>US902-928 2.3.5.a</td>
<td>ADR Bit</td>
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<td>TX Power</td>
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<td>125KHz Uplink Channel Management</td>
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<td>US902-928 2.3.5.f</td>
<td>500KHz Uplink Channel Management</td>
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<td>US902-928 2.3.5.g</td>
<td>Channel Block Channel Management</td>
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<td>RX2 Receive Window Test</td>
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<td>Test item</td>
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<td>Implementation</td>
<td>Result</td>
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<td>------------------------------------------</td>
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<tr>
<td>US902-928 2.1.1</td>
<td>Cert-Application Activation</td>
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<td>US902-928 2.1.2</td>
<td>Over The Air Activation</td>
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<td>US902-928 2.2.1.a</td>
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<td>Mandatory</td>
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<td>US902-928 2.2.1.c</td>
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<td>PASS</td>
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<tr>
<td>US902-928 2.2.1.d</td>
<td>Downlink Window Timing</td>
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<td>US902-928 2.2.1.e.i</td>
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</tr>
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<td>US902-928 2.2.1.e.ii &amp; 2.2.1.e.iii</td>
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<tr>
<td>US902-928 2.2.2.a</td>
<td>Confirmed Uplinks</td>
<td>Mandatory</td>
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<tr>
<td>US902-928 2.2.2.b</td>
<td>Confirmed Uplink Retransmission</td>
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<td>US902-928 2.2.2.d</td>
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</tr>
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<td>Addition of A Channel &amp; Removal of A Channel</td>
<td>Mandatory</td>
<td>PASS</td>
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<td>Addition &amp; Removal of Multiple Channels</td>
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<tr>
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<td>RXParamSetupReq MAC command</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.4</td>
<td>RXTimingSetupReq MAC command</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.5.a</td>
<td>ADR Bit</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.5.b</td>
<td>TX Power</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.5.c</td>
<td>Redundancy</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.5.d</td>
<td>Data Rate Decay</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.5.e</td>
<td>125KHz Uplink Channel Management</td>
<td>Mandatory</td>
<td>PASS</td>
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<tr>
<td>US902-928 2.3.5.f</td>
<td>500KHz Uplink Channel Management</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.5.g</td>
<td>Channel Block Channel Management</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.6</td>
<td>RX1 Receive Window Test</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.7</td>
<td>RX2 Receive Window Test</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.8</td>
<td>RX Oversized Payload</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.9</td>
<td>Maximum Allowed Payload (UL)</td>
<td>Mandatory</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.3.10</td>
<td>MAC Command in App-Payload and FOpts</td>
<td>Mandatory</td>
<td>PASS</td>
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</tbody>
</table>
## 5 TEST RESULTS

### Detailed test results (OTAA):

<table>
<thead>
<tr>
<th>Test item</th>
<th>Test Case Name</th>
<th>DataRate/ Timing</th>
<th>Limit</th>
<th>Results</th>
<th>Verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td>US902-928 2.2.1.c</td>
<td>Downlink Error Rate RX1</td>
<td>SF10BW500</td>
<td>5%</td>
<td>0.00%</td>
<td>PASS</td>
</tr>
<tr>
<td>US902-928 2.2.1.c</td>
<td>Downlink Error Rate RX2</td>
<td>SF12BW500</td>
<td>5%</td>
<td>0.00%</td>
<td>PASS</td>
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<td>US902-928 2.2.1.d</td>
<td>Downlink Window Timing</td>
<td>-20ms</td>
<td></td>
<td></td>
<td>PASS</td>
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<td></td>
<td></td>
<td>+20ms</td>
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<td></td>
<td>PASS</td>
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<td>US902-928 2.3.6</td>
<td>RX1 Receive Window Test</td>
<td>SF12BW500</td>
<td>5%</td>
<td>1.67%</td>
<td>PASS</td>
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<tr>
<td></td>
<td></td>
<td>SF11BW500</td>
<td>5%</td>
<td>0.00%</td>
<td>PASS</td>
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<td></td>
<td></td>
<td>SF10BW500</td>
<td>5%</td>
<td>0.00%</td>
<td>PASS</td>
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<td></td>
<td></td>
<td>SF9BW500</td>
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6 PHOTO DOCUMENTATION

Photo 1: EUT top view in auxiliary equipment

Photo 2: EUT PCB top view

Photo 3: EUT PCB side view No. 1

Photo 4: EUT PCB side view No. 2
Photo 5: EUT PCB side view No. 3

Photo 6: EUT + auxiliary equipment side view

Photo 7: EUT + auxiliary equipment top view

Photo 8: Auxiliary equipment top view