**Test Case LightDimmer**

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| **Name of the Test Case** | | Light Dimmer |
| **Narrative** | | A light dimmer is used to control the light level according to the user’s preferences. This test quantifies the variation to which the light dimmer affects the brightness of a range of bulbs in the market . |
| **Function(s) under Investigation (***FuI***)**  “the referenced specification of a function realized (operationalized) by the object under investigation” | | * A single tap of the button should toggle light between on- and off. * If the light is on, a long hold of the button should first dim, and then brighten the light. * On being turned on, the light should resume at its previous dimming level. |
| **Object under Investigation (***OuI***)**  "the component(s) (1..n) that are to be qualified by the test” | | Light dimmer box |
| **Domain under Investigation (***DuI***):**  “the relevant domains or sub-domains of test parameters and connectivity.” | | Haptic and photometric. |
| **Purpose of Investigation** *(PoI)*  The test purpose in terms of Characterization, Verification, or Validation | | * Verify the correct operation of the light switching and memory functions of the light dimmer. * Characterize the dimming properties of the light switchfor a range of bulbs acquired in the market * Validate the haptic feasibility of the switching for a range of user types |
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| **System under Test** (*SuT*):  Systems, subsystems, components included in the test case or test setup. | | The light dimmer forms an electrical connection between the grid and the bulb. The light dimmer has a physical input which allows the user to steer the light level. |
| **Functions under Test** (*FuT*)  Functions relevant to the operation of the system under test, including FuI and relevant interactions btw. OuI and SuT. | | Light dimming  Bulb light-emission |
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| **Test criteria:** Formulation of criteria for each PoI based on properties of SuT; encompasses properties of test signals and output measures. | | 1. Light-intensity for different switch states 2. Light stability for different bulbs (rate of change of light intensity) 3. Touch feedback and click-sound on performing switch action |
|  | **target metrics**  Measures required to quantify each identified test criteria | Brightness [lumen]- quantitative  Flickering - qualitative  Haptic experience - qualitative |
| **variability attributes**  controllable or uncontrollable factors and the required variability; ref. to PoI. | Grid connection with nominal power quality.  Luminosity of surroundings  Bulb types  Bulb samples for each type  Variation of user properties: pressure applied when switching, frequency of switching. |
| **quality attributes**  threshold levels for test result quality as well as pass/fail criteria. | Brightness: rated lumen of bulb  Haptic assessment: user sampled from 3sigma of population distribution.  Confidence interval of x%, p-value < .05, |
| **Detailed PoI and Factor Analysis** | | *N/A* |

**Qualification Strategy**

*i.e. how are the PoI to be met by the different tests and how will the test results be combined to yield the desired PoI outcomes (see guideline)*

Several configurations will be evaluated, where the test results of each will be used as reference to qualify the complementary setup: (qr : qualification result)

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|  | **Experiment 1** | **Experiment 2** | **Insight** |
| qr1 | LightDimmer.TS1.Incadescent | LightDimmer.TS1.LED | *Difference between using LED and Incandescent bulb* |
| qr2 | LightDimmer.TS1.Incadescent | LightDimmer.TS1.Incadescent | *experiment repeated with different users as experience samples* |
| qr3 | LightDimmer.TS1.LED | LightDimmer.TS1.LED | *experiment repeated with different users as experience samples* |

The experiments will be carried out with a common set of variation parameters, the resulting data sets form the basis of a statistical assessment of the final qualification parameters.

**Test Specification LightDimmer.TS1**

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| **Reference to Test Case** | LightDimmer |
| **Title of Test** | Test of light dimmer |
| **Test Rationale** | This generic dimmer should allow dimming any bulb on the market. A testing regiment is described below which any bulb should be able to pass. |
| **Specific Test System** (graphical) |  |
| **Target measures** | * Brightness of the bulb [lumen] * Customer satisfaction of haptic feedback (survey) |
| **Input and output parameters** | Inputs:   * User contact press   Outputs:   * Bulb brightness |
| **Source of uncertainty** | Supply voltage of LV grid (normal distribution, mean equal to nominal, standard deviation 5% of mean)  Flicker due to supply voltage variations (interval [0,1] of flicker severity)  Ambient Light (equivalent irradiance in interval [100,1000] Watt/sqrm)  Bulb samples for each type (samples with characteristics following normal distribution around nominal values)  user ability to press  user experience |
| **Test Design** | 1. Tap once to turn the light off and record the light level. 2. Dim the light to its lowest level and record this level. 3. Tap twice to turn off and on the light, and verify that the light comes back on at its lowest level. 4. Hold the button until the light returns to its highest level, and record this level. 5. Tap twice to turn off and on the light, and verify that the light comes back on at its highest level. 6. Tap once to turn off.   Repeat this test for all light bulbs needed. |
| **Initial system state** | Grid connected, bulb turned off |
| **Evolution of system state and test signals** | ./. |
| **Other parameters** | ./. |
| **Temporal resolution** | 1 second |
| **Suspension criteria / Stopping criteria** | Test complete OR bulb fails to turn on OR bulb fails to dim |

**Mapping to Research Infrastructure**

*i.e. how is it planned to distribute (map) and execute the specified test system in a given research infrastructure (free text); this section can be used to list the intended Experiment specifications.*

**Experiment Specification LightDimmer.TS1.Incandescent**

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| **Reference to Test Specification** | LightDimmer.TS1 |
| **Title of Experiment** | Verification of dimming behaviour with incandescent bulb |
| **Research Infrastructure** | B325-017 |
| **Experiment Realisation** |  |
| **Experiment Setup** (concrete lab equipment) | Grid: 240V plug  Light dimmer switch: Biard 1 Gang White Glass  Designer Touch Light Switch  Bulb: Halco A19 Clear |
| **Experimental Design and  Justification** | The same as the test design in the Test Specification, since it is realizable at the laboratory. |
| **Precision of equipment and measurement uncertainty** | Test subjects subjective opinion of light levels may be subject to bias, and only qualitative measurements can be made.  The uncertainty in brightness is high, but negligible due to the qualitative nature of the measure. |
| **Storage of experiment data** | A checklist is provided and filled in |

**Experiment Specification LightDimmer.TS1.LED**

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| **Reference to Test Specification** | LightDimmer.TS1 |
| **Title of Experiment** | Verification of dimming behaviour with LED bulb |
| **Research Infrastructure** | B325-017 |
| **Experiment Realisation** |  |
| **Experiment Setup** (concrete lab equipment) | Grid: 240V plug  Light dimmer switch: Biard 1 Gang White Glass  Designer Touch Light Switch  Bulb: Ikea LEDARE 600 Lumens E14  Light meter: Extech HD450 |
| **Experimental Design and  Justification** | The same as the test design in the Test Specification, since it is realizable at the laboratory. |
| **Precision of equipment and measurement uncertainty** | Light meter is calibrated to pm 5%.  5% due to light meter. No other significant uncertainty. |
| **Storage of experiment data** | A trace of the light meter data time series is stored in .csv format |