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| Customer: | Project: | Date: | Confidentiality |
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TSA0002 Software requirements specification

Contents

[1 INTRODUCTION 2](#_Toc198644763)

[1.1 Purpose 2](#_Toc198644764)

[1.2 Glossary 2](#_Toc198644765)

[1.3 Reference documents 3](#_Toc198644766)

[1.4 Standards 3](#_Toc198644767)

[2 LIGHTING CONTROL SYSTEM DESCRIPTION 4](#_Toc198644768)

[2.1 General 4](#_Toc198644769)

[2.2 Communication 4](#_Toc198644770)

[3 LIGHT SENSOR OPERATION 5](#_Toc198644771)

[3.1 Light value request / response 5](#_Toc198644772)

[3.2 Temperature measurement 6](#_Toc198644773)

[3.3 Voltage measurement 6](#_Toc198644774)

[4 DOCUMENT INFORMATION 7](#_Toc198644775)

1. INTRODUCTION

This document provides the Software Requirement Specification (SRS) for the digital light level sensor TSA0002. The light level sensor was developed to be used along with Teknoware’s light control units (LCU) in active light control applications.

* 1. Purpose

The purpose of this document is to give a functional description of the light level sensor unit TSA0002.

* 1. Glossary

Table 1. Definitions, acronyms and abbreviations

| Term | Definition |
| --- | --- |
| TW | Teknoware |
| SRS | Software requirements specification |
| LCU | Light Control Unit |
| TSA | Light level sensor |
| NVMEM | Non-volatile memory |
| RS485 | Serial communication interface |
| MSSP | Multi-Slave Simple Serial Protocol (TW serial communication protocol) |

* 1. Reference documents

Table 2. List of reference documents

| Reference | Document | File name and revision |
| --- | --- | --- |
| MSSP protocol | MSSP protocol description | TW\_MSSP Protocol Specification ( Rev4 or later) |

* 1. Standards

Table 3. Applicable standards

| Reference | Year | Description |
| --- | --- | --- |
| EN 50121-3-2 | 2016 | Railway applications – Electromagnetic compatibility –  Part 3-2 : Rolling stock – Apparatus |
| EN 50125 | 2014 | Railway applications – Environmental conditions for equipment –  Part 1: Rolling stock and on-board equipment |
| EN 50126-1 | 2001 | Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) –  Part 1: Basic requirements and generic process |
| EN 50153 | 2014 | Railways applications. Rolling stock. Protective provisions relating to electrical hazards |
| EN 50155 | 2007 | Railway applications – Electronic equipment used on rolling stock |
| EN 50121-3-2 | 2006 | Railway applications – Electromagnetic compatibility – Part 3-2 : Rolling stock – Apparatus |
| EN 50657 | 2017 | Railways Applications - Rolling stock applications – Software on Board Rolling Stock |

1. LIGHTING CONTROL SYSTEM DESCRIPTION
   1. General

Lighting control system consist of a LCU devices and TSA devices. The LCU devices are located typically one per car and there may be one or several TSA devices serving one LCU.

The LCU device and the TSA devices are inter-connected via RS485 network using MSSP protocol. MSSP protocol is master-slave type protocol designed for TW’s smart light control systems. The LCU is always the master unit and TSA is always slave unit.

LCU communicates with the TSA devices via RS485 to get ambient light sensor values. By the light sensor values, the LCU device can control lighting level.

* 1. Communication

When connecting TSA into RS485-network, the communication parameters of the network must be identical to all devices:

* 9600, 8, N, 1

TSA always has a default network address 125 (0x7D)

1. LIGHT SENSOR OPERATION
   1. Light value request / response

By default, TSA0002 reads light values measured by light sensor in 100ms intervals. Every sample is stored in circular buffer, which holds last 30 samples, representing values of past 3 seconds time. LCU requests light values by MSG\_GET\_LIGHT\_VALUE\_REQ MSSP-messages, which holds the number of samples to be included into the returned value. The message also contains raw-flag parameter, which in normal use is always 0.

**Table 6. Light request message**

| Paramater name | Range | Type | Description |
| --- | --- | --- | --- |
| samples | 1..30 | uint8 | Number of samples to be included in average value calculation |
| raw\_flag | 0..1 | uint8 | 0: normal operation, respond with calibrated values  1: calibration, respond with un-calibrated values |

The value TSA0002 returns is the average calculated from the number of samples requested. This value is normalized value between 0..1000. It is LCU’s task to convert the received raw value into project specific scale.

The response message TSA0002 sends contains also a ‘raw’ value from digital light sensor element. Also included in the response message is the last measured value, which is used in sensor handling for filtering.

**Table 7. Light response message values**

| Value name | Range | Type | Description |
| --- | --- | --- | --- |
| sensor\_value | 0..7000 | uint16 | Raw value of digital light sensor element, used for calibration purpose only. |
| avg\_value | 0..1000 | uint16 | Normalized average light value, used for normal light control. |
| last\_value | 0..1000 | uint16 | Normalized last measured light value, used for sensor filtering purposes. |

* 1. Temperature measurement

Temperature is measured once in 200ms. The value is stored in 30 circular samples buffer, representing values of past 6 seconds time. LCU can request the temperature with a MSG\_GET\_SINGLE\_PARAM\_REQ MSSP-message.

**Table 8. Temperature request message**

| Paramater name | Value | Description |
| --- | --- | --- |
| param\_type | 130 | Temperature type |
| param\_number | 1 |  |

Temperature is returned in MSG\_GET\_SINGLE\_PARAM\_RESP MSSP-message. Temperature value is represented in degrees Celcius and it’s always an average of latest 10 samples.

* 1. Voltage measurement

+12VDC supply voltage is measured once in 200ms. The value is stored in 30 circular samples buffer, representing values of past 6 seconds time. LCU can request the voltage with a MSG\_GET\_SINGLE\_PARAM\_REQ MSSP-message.

**Table 9. Temperature request message**

| Paramater name | Value | Description |
| --- | --- | --- |
| param\_type | 131 | Voltage type |
| param\_number | 1 |  |

Voltage is returned in MSG\_GET\_SINGLE\_PARAM\_RESP MSSP-message. Voltage value is represented in millivolts and it’s always an average of latest 10 samples.

1. DOCUMENT INFORMATION

|  |  |  |
| --- | --- | --- |
| Project: | Teknoware document reference: | |
| TSA0002 | TSA0002 SRS | |
| Customer: | Customer document reference: | Confidentiality: |
|  |  | CONFIDENTIAL |
| Prepared by: | Checked by: | Approved by: |
| TOT | JVI | JN |
| Revision: | Pages: | Date: |
| 1 | 9 | 10.6.2021 |

Revision follow-up

|  |  |  |  |
| --- | --- | --- | --- |
| Revision: | Purpose: | Date: | Author: |
| Rev 0 | First released version | 10.12.2020 | TOT |
| Rev 1 | Added address change and set-up change features | 10.6.2021 | TOT |
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