External Reference Specification: KST3220 Mini Distance Sensor

Revision F - Last Updated 3rd August 2022

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Revision History

Revision	Date	Notes
A	1 June 2022 Bob Kressin	Initial Document, Preliminary Specification
B	13 June 2022 Devin Saavedra	Updated FW-06 Added FW-09, 10, and 11
C	20 June 2022 Devin Saavedra	Added FW-12
D	27 June 2022 Devin Saavedra	Updated FW-05, FW-03, and FW-08. Added HW-12 and FW-13 Business Requirements Section Added
E	7th July 2022 Devin Saavedra	Added UX-04 and UX-05
F	3rd August 2022 Devin Saavedra	Breaking out KST3220 and KST3120 to their own respective ERS docs

Requirement Key

DONE	Item is implemented in production design.
IN DESIGN	Item needs to be implemented.
UNDER REVIEW	Item requires clarification and is under review with the customer.
FUTURE	Item is a future consideration.
ON HOLD	Item requires clarification and is under internal review.

Stage Key

LP	Lab Prototype
PP	Production Prototype
PD	Production

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Product Overview

The purpose of this document is to define objective requirements for a Lab Prototype of the KST3220 LoRaWAN Distance Sensor (hereafter referred to as the "Device").

Hardware Requirements

Key	Stage	Description
HW-01	LP	The Device contains an FCC pre-certified LoRa wireless module that supports LoRa Specification v1.0.2 or higher with +20dBm default gain.
HW-02	LP	The Device requires 2x, AAA, Lithium, +1.5VDC batteries.
HW-03	LP	The Device guarantees a 6-month battery life when set to 15-minute uplink intervals. **NOTE**: The default uplink interval may not be set to 15 minutes. This setting is reset upon a fresh power-up of the device.
HW-04	LP	The Device uses a 915MHz (LoRa) internal chip antenna.
HW-05	LP	The Device has no internally or externally accessible button.
HW-06	LP	Lab prototype devices will not carry FCC Part 15B (USA) or IC (Canada) certifications.
HW-07	LP	The Device is uniquely serialized.
HW-08	LP	The Device contains support for one Distance sensor.
HW-09	LP	The Distance Satellite Sensor has a maximum range of 4000mm with a nominal resolution of 10mm. **NOTE**: High ambient light levels may degrade the maximum range.
HW-10	LP	Batteries are **NOT** included.

Firmware Requirements

Key	Stage	Descriptions
FW-01	LP	The Device's LoRaWAN Packet Structure follows the KST Key-Length-Value (KLV) encoding paradigm: `1st byte` = Data Type ID - 2 bytes `3rd byte` = Length of Payload `N bytes` = Payload of the data type
FW-02	LP	The Device supports the Distance (A) Sensor KLV Uplink Message -

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		• Key (Data Type ID): `0x0082` • Length: 2 • Value: Distance in Millimeters, Unsigned Integer As an example - `0x0082020363` = 867mm to the nearest object
FW-03	LP	The Distance (A) Sensor KLV Uplink Message is sent on a fixed interval, occurring every 15 minutes indefinitely.
FW-04	LP	The Device supports two primary States - • ACTIVE: The Device is only in this mode when its host processor is able to send and receive data. The firmware intentionally limits the time in this State to increase battery life and attempts to go back into the SLEEP State as much as possible. • SLEEP: The Device is in this State for the majority of its existence. All radios are turned off.

FW-05	LP	The Device supports Downlink Message for changing the Uplink Interval as follows:
		• Key (Data Type ID): `0x0100`
		• Length: 1
		• Value: 1-240
		  ○ Minimum of 1 minute
		  ○ Maximum of 240 minutes (4 hours)
		
		Downlink must be sent on FPort 2.
		
		As an example -
		`0x0100011E` = Uplink Interval changed to 30mins

FW-06	LP	Any sensor value read in error uses the Error KLV Uplink Message.
		• Key (Data Type ID): `0xFFFF`
		• Length: 1
		• Value: Error Code
		  ○ `0x01` = Insufficient Ambient Light Level for Reading
		  ○ `0x02` = Insufficient Reflective Light Level for Reading
		  ○ `0x03` = Unknown Error; Cannot Read Distance
		
		As an example -
		`0xFFFF0102` = Error: Insufficient Reflective Light Level for Reading

FW-07	LP	The Device supports the Battery KLV Uplink Message - • Key (Data Type ID): `0x0078` • Length: 1 • Value: `0x00 – 0xFF`

		As an example - `0x007801FF` = 100%
FW-08	LP	The Device KLV Concatenated Payload is as follows: ● Battery - `0x007801FE` ● Distance - `0x0082020363` ● Error - `0xFFFF0102` As an example - `0x007801FE0082020363FFFF0102`
FW-09	LP	The Device has the following appEUI & appKEY: ● appEUI: `8000000000000007` ● appKEY: `2B7E151628AED2A6ABF7158809CF4F3D`
FW-10	LP	Upon removal of batteries, the uplink interval will be instantiated to its default value of 15 minute.

Mechanical Requirements

Key	Stage	Description
ME-01	LP	The Device carries no IP Rating.
ME-02	LP	The operating temperature of the Device is 10^0C - 35^0C.
ME-03	LP	The Device's operating humidity is 5-95%RH.
ME-04	LP	The Device carries no drop test rating.
ME-05	LP	The Device is housed in a plastic enclosure.
ME-06	LP	The Device enclosure housing is UV resistant.
ME-07	LP	The Device housing is made of polycarbonate or ASA.
ME-08	LP	The assembled Device housing is 65mm x 40.62mm x 27.18mm.
ME-09	LP	The Device weight does not exceed 38.1 grams without batteries or mounting hardware. The mounting bracket does not exceed 10 grams.
ME-10	LP	The batteries can be accessed by means of removal of a battery lid.
ME-11	LP	The Device includes a bracket for mounting.

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Mobile App Requirements

Key	Stage	Description
MA-01	LP	The Device does not support communication directly with a Mobile App.

UX Requirements

Key	Stage	Description
UX-01	LP	The Device has user-accessible and changeable batteries.
UX-02	LP	The Device includes 2 labels. Label one includes the FCC and IC numbers for the modules that are used in the Device. Label two includes the Part Number, Serial Number, and devEUI in a human-readable format. A QR code is available that includes the devEUI. Examples of labels, FCC, SN, and devEUI may not be representative of the Device. **Contains FCC IDs: Z4T-LORA-E5** **KST3220 000100** **003E68BE003E68BE**
UX-03	LP	A CSV is sent once an order is placed that includes the Serial Number, devEUI, appEUI, and appKEY for each device.
UX-04	LP	The Downlink receive window is performed after a successful uplink. If the Downlink receive window is missed on the initial uplink, it will attempt to send the Downlink on the next scheduled uplink during its receive window. For example, if the uplink interval is set to 15 minutes, it may take up to 30 minutes for the downlink to take.
UX-05	LP	The scheduled uplink interval that is selected is not always guaranteed to be accurate due to the nature of LoRaWAN and the many limitations with structural & environmental abnormalities depending on your individual location and application. For example, if the uplink interval is set to 15 minutes, it may take upwards of 1 hour & 15 mins for data to be pushed successfully.

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Cloud Requirements

Key	Stage	Description
CL-01	LP	There are no KST Cloud requirements.
CL-02	LP	No Dashboard is provided.

Factory Requirements

Key	Stage	Description
FR-01	LP	Company Name, Part Number, Serial Number, devEUI, appKEY, and appEUI are stored in KSTs Factory Records, in the Cloud.
FR-02	LP	There is no Factory Record API to access Factory Records outside of KST.

Business Requirements

Key	Stage	Description
BZ-01	LP	The Device has a KST Manufacturer Part Number KST3220. A maximum of 50 Lab Prototypes are available for purchase prior to FCC Certification.
BZ-02	LP	The following costs apply to the KST3220 - • 1 - 50: $175/u • 50 - 1000: $125/u • 1000+: $78/u
BZ-03	LP	Integration with a LoRaWAN Network Server and an Application Server is the responsibility of the customer. KST is available for consulting, hosting a private LNS, integrating with an existing public LNS, and/or creating dashboards as required.

Signature Approvals

In witness whereof, the parties have executed this Agreement effective as of the date of the last party to sign this Agreement below.

Authorized KST Representative

Signature:

Name: **Robert W. Kressin**
Title: **President**

Date:

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