Low Resolution Position Sensor

Executive Summary Report

Date: 2022/11/02	**Document Id.:** EMX-LRPS-TN-0062		**Dept.:** R&D
Project: LRPS	**Authors**: Higinio Alavés	**Signatures:**	**N. Pages:** 6
Contract: 4000128512/19/NL/MG	**Checked by**: Jose A. Carrasco **Authorized by**: Francisco J. García de Quirós Nieto		**Version:** 01

Prepared By: R&D.
Embedded Instruments and Systems S.L.
Ed. Quorum IV · Parque Científico UMH
Avda. Universidad S/N
03202 Elche (Spain)

DOCUMENT CONTROL

Contract:	**4000128512/19/NL/MG**
Project:	Low Resolution Position Sensor
Acronym:	LRPS
Title:	Executive Summary Report
Document Type:	Technical Note
Internal Reference:	EMX-LRPS-TN-0062
Issue:	01
Date:	2022/11/02
Configuration Management:	Configuration Management
Internal Department:	R&D

DISTRIBUTION LIST

Other Company:	ESA – Fernando Romera
	ATN – Alina Spuma
	ATN – Enrique Cordero
EMXYS:	Higinio Alavés
	José A. Carrasco
	Francisco J. García de Quirós

CHANGE RECORD SHEET

Iss./Rev	Date	Affected pages	Reason for change
1	2022/11/02	All	Initial issue

Table of Contents

1. INTRODUCTION

The present document provides an one page executive summary of the “Low-Cost Low-Resolution Position Sensor” ESA project.

2. APPLICABLE & REFERENCE DOCUMENTS

2.1 Applicable documents

[AD1] Low Cost Low Resolution Position Sensor, ITT Detailed Proposal, EMX-LRPS-OF-0001-ISS01

2.2 Acronyms list

Acronym	Description
AD	Applicable Documents
EMXYS	Embedded Instruments and Systems S.L.
ESA	European Space Agency
LRPS	Low Resolution - Low Cost Position Sensor.
RD	Reference Document. Public information used in this document as reference.

3. EXECUTIVE REPORT

The current project with title “LOW-COST LOW-RESOLUTION POSITION SENSOR” had the motivation of finding a substitute of potentiometers for angular measurements in space applications that, offering similar features while eliminating the slide contact, may compete in price with them.

After a market survey of 25 potential space customers, two potential customers consider usable the LRPS in their applications for the specific list of requirements developed for this project. The project then followed different stages to achieve finally a possible solution with 10-bits of resolution, weight, cost and dimensions according to requirements proposed as a competitive positioning sensor replacement in space applications.

From the point of view of the technology, the sensor consists of a capacitive device with analogue output, duplicated but not fully redundant. Capacitive sensors are quite sensible to small voltage and intensity biasing in electronic components, but a careful selection of space qualified parts in combination with a smart electronic design has made possible repetitive measurements with 10-bit resolution.

The device designed meets space market requirements in term of dimensions, weight, and power consumption. The developed part has achieved a measurement accuracy of 10-bit resolution at laboratory conditions. The sensor was tested mechanically in shock and vibration, electrical EMC, ESD and TVAC was performed to analyze performance in space conditions and evaluate its potential to be upgraded to TRL6.

The final conclusions point out the the following improvements of the technology:

- Improving the mechanical interface and present the sensor as an equivalent mechanical substitution to potentiomenters, with a mechanical (cylindrical) body and a rotating axis. The inner stators and rotors are not exposed to potential customers.
- Improving the electronics to deliver one analog output similar to potentiometers and minimize the “death zone” to less than 5 degrees.
- Improve the electrical interface by hiding the connections between the stators within the mechanical enclosure and providing a wire with a connector and three electrical interfaces similar to potentiometers (one reference, +5VDC supply and output measurement between the reference and the supply).
- Improve the pattern of the stators to minimize the error and a minimum of 8-bit over all the temperature range.
- Realize a mathematical model based on the calculus of variations to achieve the previous bullet. The error of the sensor depends on minimizing the area (mathematical integral) sweet by the rotor over the stators as a function of its angle, a problem usually solved using this mathematical theory. The present model is based on a result based on sinusoidal functions calculated numerically with a Python script. The generalization of the problem to an expanded range of functions and a program in C may speed simulations and improve the stators pattern.

At the writing of this report, we think that the presented actions may be achieved with an investment in effort that may lead to TRL6 sensor with potential to become a substitution to present technologies with better reliability and competitive cost.