

# DIN EN 16603-60-20:2020-12 (E)

Space engineering - Star sensor terminology and performance specification; English version EN 16603-60-20:2020

---

## Table of contents

---

<b>European Foreword.....</b>	<b>5</b>
<b>Introduction.....</b>	<b>7</b>
<b>1 Scope.....</b>	<b>8</b>
<b>2 Normative references .....</b>	<b>9</b>
<b>3 Terms, definitions and abbreviated terms.....</b>	<b>10</b>
3.1 Terms from other standards.....	10
3.2 Terms specific to the present standard .....	10
3.3 Abbreviated terms.....	29
3.4 Nomenclature .....	30
<b>4 Functional requirements.....</b>	<b>31</b>
4.1 Star sensor capabilities.....	31
4.1.1 Overview.....	31
4.1.2 Cartography .....	32
4.1.3 Star tracking.....	33
4.1.4 Autonomous star tracking.....	33
4.1.5 Autonomous attitude determination.....	34
4.1.6 Autonomous attitude tracking .....	35
4.1.7 Angular rate measurement.....	35
4.1.8 (Partial) image download.....	36
4.1.9 Sun survivability .....	37
4.2 Types of star sensors .....	37
4.2.1 Overview.....	37
4.2.2 Star camera .....	37
4.2.3 Star tracker .....	37
4.2.4 Autonomous star tracker .....	38
4.3 Reference frames .....	38
4.3.1 Overview.....	38
4.3.2 Provisions .....	38
4.4 On-board star catalogue .....	38

<b>5 Performance requirements .....</b>	<b>40</b>
5.1 Use of the statistical ensemble .....	40
5.1.1 Overview.....	40
5.1.2 Provisions .....	41
5.2 Verification methods .....	42
5.2.1 Overview.....	42
5.2.2 Provisions for single star performances.....	42
5.2.3 Provisions for attitude performances .....	42
5.2.4 Provision for tests .....	42
5.3 <>deleted>> .....	43
5.4 General performance requirements .....	43
5.5 General performance metrics .....	45
5.5.1 Overview.....	45
5.5.2 Bias.....	45
5.5.3 Thermo elastic error .....	46
5.5.4 FOV spatial error.....	46
5.5.5 Pixel spatial error .....	47
5.5.6 Temporal noise .....	48
5.5.7 Aberration of light.....	49
5.5.8 Measurement date error.....	50
5.5.9 Measured output bandwidth.....	50
5.6 Cartography.....	50
5.7 Star tracking .....	51
5.7.1 Additional performance conditions .....	51
5.7.2 Single star tracking maintenance probability .....	51
5.8 Autonomous star tracking .....	51
5.8.1 Additional performance conditions .....	51
5.8.2 Multiple star tracking maintenance level.....	52
5.9 Autonomous attitude determination .....	52
5.9.1 General.....	52
5.9.2 Additional performance conditions .....	52
5.9.3 Verification methods.....	53
5.9.4 Attitude determination probability .....	53
5.10 Autonomous attitude tracking .....	54
5.10.1 Additional performance conditions .....	54
5.10.2 Maintenance level of attitude tracking .....	55
5.10.3 Sensor settling time.....	56

5.11	Angular rate measurement .....	56
5.11.1	Additional performance conditions .....	56
5.11.2	Verification methods.....	56
5.12	Mathematical model.....	57
5.13	Robustness to solar events.....	57
5.13.1	Additional robustness conditions .....	57
5.13.2	Continuity of tracking during a solar event.....	58
5.13.3	Ability to solve the lost in space problem during a solar event.....	59
5.13.4	Flux levels .....	59
	<b>Bibliography.....</b>	<b>88</b>

## Figures

Figure 3-1:	Star sensor elements – schematic.....	13
Figure 3-2:	Example alignment reference frame .....	15
Figure 3-3:	Boresight reference frame .....	16
Figure 3-4:	Example of Inertial reference frame.....	16
Figure 3-5:	Mechanical reference frame .....	17
Figure 3-6:	Stellar reference frame.....	18
Figure 3-7:	Schematic illustration of reference frames .....	18
Figure 3-8:	Schematic timing diagram .....	20
Figure 3-9:	Field of View.....	22
Figure 3-10:	Aspect angle to planetary body or sun.....	23
Figure 4-1:	Schematic generalized Star Sensor model .....	32
Figure B-1 :	Rotational and directional Error Geometry .....	65
Figure F-1 :	Angle rotation sequence.....	76
Figure H-1 :	Example of detailed data sheet.....	82

## Tables

Table C-1 :	Minimum and optional capabilities for star sensors .....	69
Table G-1 :	Contributing error sources .....	78
Table I-1 :	Command table .....	84
Table I-2 :	Telemetry table.....	86