



# GPS1502L

SiGe:C low-noise amplifier MMIC for GPS, GLONASS, Galileo and COMPASS

Rev. 5 — 22 March 2019

Product data sheet

## 1 General description

The GPS1502L is a Low-Noise Amplifier (LNA) for GNSS receiver applications and is available in a small plastic 6-pin extremely thin leadless package. The GPS1502L requires only one external matching inductor.

The GPS1502L adapts itself to the changing environment resulting from co-habitation of different radio systems in modern cellular handsets. It has been designed for low power consumption and optimal performance when jamming signals from co-existing cellular transmitters are present. At low jamming power levels, it delivers 17 dB gain at a noise figure of 0.6 dB and a supply current of 4.2 mA. During high jamming power levels, resulting, for example, from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity.

The GPS1502L is optimized for 1164 MHz to 1299 MHz.

## 2 Features and benefits

- Covers full GNSS lower L-band, from 1164 MHz to 1299 MHz
- Noise figure = 0.6 dB
- Gain 17 dB
- High-input 1 dB compression point of -13 dBm
- High in-band IP<sub>3i</sub> of -1 dBm
- Supply voltage 1.5 V to 3.1 V
- Optimized performance at a low supply current of 4.2 mA
- Integrated RF supply decoupling capacitor
- Power-down mode current consumption < 1 μA
- Integrated temperature stabilized bias for easy design
- Requires only one input matching inductor
- Integrated DC blocking at both RF input and output
- Integrated matching for the output
- ESD protection on all pins
- Self-shielding package concept
- Low Bill of Materials
- 6-pin leadless package: 1.1 mm × 0.7 mm × 0.37 mm; 0.4 mm pitch
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level 1



### 3 Applications

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- Smart phones
- Feature phones
- Tablets
- Digital still cameras
- Digital video cameras
- RF front-end modules
- Complete GNSS modules
- Personal health applications

## 4 Quick reference data

**Table 1. Quick reference data**

$f = 1176 \text{ MHz}$ ;  $V_{CC} = 1.8 \text{ V}$ ;  $V_{I(ENABLE)} \geq 0.8 \text{ V}$ ;  $P_i = -45 \text{ dBm}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ ; input matched to  $50 \text{ } \Omega$  (see [Figure 3](#) and [Table 10](#)). Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC}$	supply current		2.3	4.2	6.1	mA
$G_p$	power gain		15.6	17	18	dB
NF	noise figure		[1] -	0.6	0.8	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		-15	-13	-	dBm
$IP3_i$	input third-order intercept point	$\Delta f = 1 \text{ MHz}$	-6	-1	-	dBm

[1] PCB losses are subtracted.

## 5 Ordering information

**Table 2. Ordering information**

Type number	Orderable part number	Package		Version
		Name	Description	
GPS1502L	GPS1502LX	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 mm × 0.7 mm × 0.37 mm	SOT1232

## 6 Marking

**Table 3. Marking code**

Type number	Marking code
GPS1502L	L

## 7 Block diagram

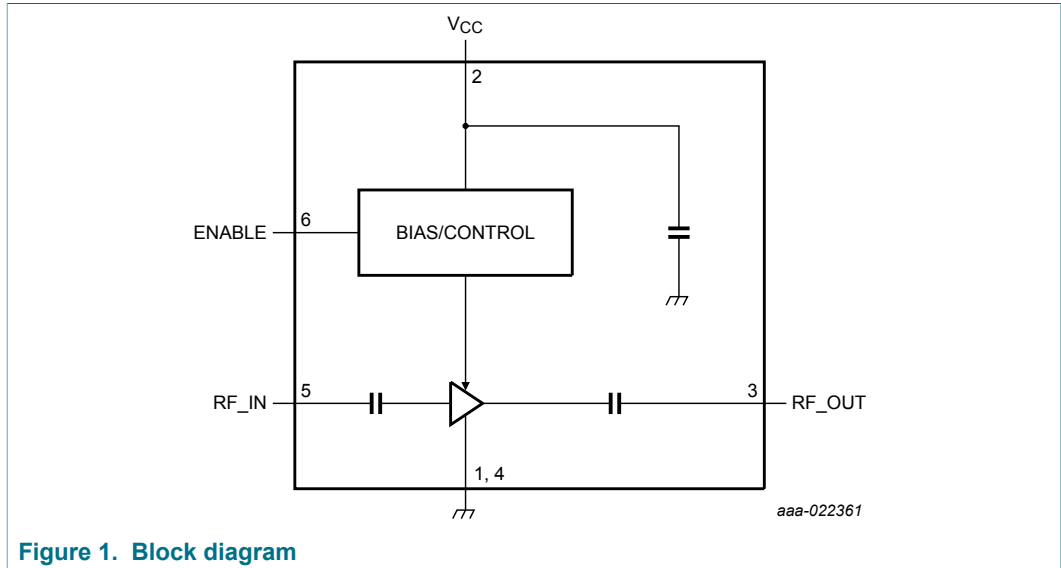


Figure 1. Block diagram

## 8 Pinning information

### 8.1 Pinning

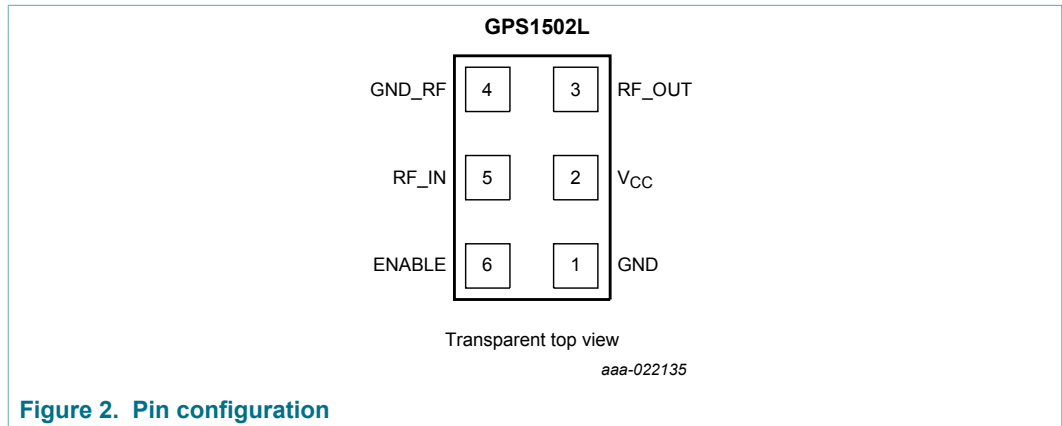


Figure 2. Pin configuration

### 8.2 Pin description

Table 4. Pin description

Symbol	Pin	Description
GND	1	ground
V <sub>CC</sub>	2	supply voltage
RF_OUT	3	RF output
GND_RF	4	ground RF
RF_IN	5	RF input
ENABLE	6	enable

## 9 Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		-0.5	+6.0	V
V <sub>I(ENABLE)</sub>	input voltage on pin ENABLE	V <sub>I(ENABLE)</sub> < V <sub>CC</sub> + 0.5 V	-0.5	+5.0	V
V <sub>I(RF_IN)</sub>	input voltage on pin RF_IN	DC [1]	-0.5	+0.5	V
V <sub>I(RF_OUT)</sub>	input voltage on pin RF_OUT	DC; V <sub>I(RF_OUT)</sub> < V <sub>CC</sub> + 0.5 V [1]	-0.5	+5.0	V
P <sub>i</sub>	input power	RF; ON state, OFF state	-	15	dBm
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>j</sub>	junction temperature		-	150	°C
V <sub>ESD</sub>	electrostatic discharge voltage	Human Body Model (HBM); according to JEDEC standard JS-001	-	±2	kV
		Charged Device Model (CDM); according to JEDEC standard JS-002	-	±1	kV

[1] The RF input and RF output are AC coupled through internal DC blocking capacitors.

## 10 Operating conditions

**Table 6. Operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.5	-	3.1	V
T <sub>amb</sub>	ambient temperature		-40	+25	+85	°C
V <sub>I(ENABLE)</sub>	input voltage on pin ENABLE	OFF state	0.0	-	0.3	V
		ON state	0.8	-	V <sub>CC</sub>	V

## 11 Thermal characteristics

**Table 7. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
R <sub>th(j-sp)</sub>	thermal resistance from junction to solder point		225	K/W

## 12 Characteristics

**Table 8. Characteristics at  $V_{CC} = 1.8\text{ V}$**

$f = 1176\text{ MHz}$ ;  $V_{CC} = 1.8\text{ V}$ ;  $V_{I(ENABLE)} \geq 0.8\text{ V}$ ;  $P_i < -40\text{ dBm}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ . Input matched to  $50\text{ }\Omega$  (see [Figure 3](#) and [Table 10](#)). Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC}$	supply current	$V_{I(ENABLE)} \geq 0.8\text{ V}$				
		$P_i < -40\text{ dBm}$	2.3	4.2	6.1	mA
		$P_i = -20\text{ dBm}$	-	4.9	-	mA
		$V_{I(ENABLE)} \leq 0.3\text{ V}$	-	-	1	$\mu\text{A}$
$G_p$	power gain	no jammer	15.6	17	18	dB
		$P_{jam} = -21\text{ dBm}$ ; $f_{jam} = 915\text{ MHz}$	-	17	-	dB
		$P_{jam} = -21\text{ dBm}$ ; $f_{jam} = 1427\text{ MHz}$	-	17	-	dB
$RL_{in}$	input return loss		8	11	-	dB
$RL_{out}$	output return loss		7	10	-	dB
ISL	isolation		25	27	-	dB
K	Rollett stability factor		1	-	-	
NF	noise figure	no jammer <sup>[1]</sup>	-	0.60	0.80	dB
		$P_{jam} = -22\text{ dBm}$ ; $f_{jam} = 915\text{ MHz}$ <sup>[1]</sup>	-	0.80	-	dB
		$P_{jam} = -22\text{ dBm}$ ; $f_{jam} = 1427\text{ MHz}$ <sup>[1]</sup>	-	0.90	-	dB
$P_{I(1dB)}$	input power at 1 dB gain compression		-15	-13	-	dBm
$IP3_i$	input third-order intercept point	$\Delta f = 1\text{ MHz}$	-6	-1	-	dBm
$t_{on}$	turn-on time	time from $V_{I(ENABLE)}$ ON to 90 % of the gain	-	-	2	$\mu\text{s}$
$t_{off}$	turn-off time	time from $V_{I(ENABLE)}$ OFF to 10 % of the gain	-	-	1	$\mu\text{s}$

[1] PCB losses are subtracted.

**Table 9. Characteristics at V<sub>CC</sub> = 2.8 V**

*f* = 1176 MHz; V<sub>CC</sub> = 2.8 V; V<sub>I(ENABLE)</sub> ≥ 0.8 V; P<sub>i</sub> < -40 dBm; T<sub>amb</sub> = 25 °C. Input matched to 50 Ω (see [Figure 3](#) and [Table 10](#). Unless otherwise specified.

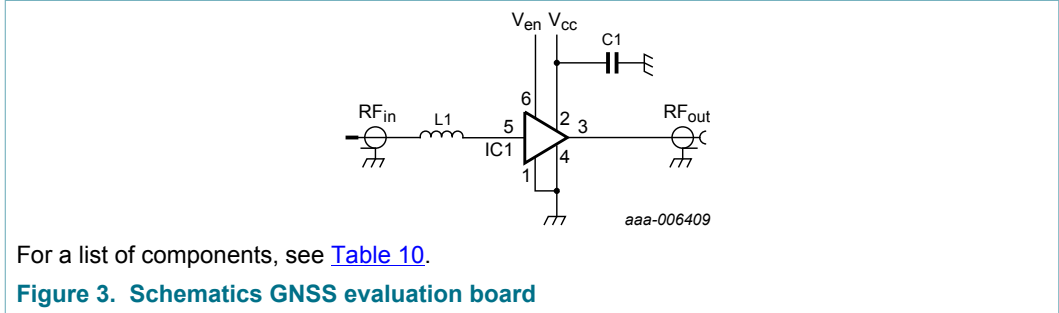
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>CC</sub>	supply current	V <sub>I(ENABLE)</sub> ≥ 0.8 V				
		P <sub>i</sub> < -40 dBm	2.4	4.4	6.4	mA
		P <sub>i</sub> = -20 dBm	-	5.1	-	mA
		V <sub>I(ENABLE)</sub> ≤ 0.3 V	-	-	1	μA
G <sub>p</sub>	power gain	no jammer	15.6	17	18	dB
		P <sub>jam</sub> = -21 dBm; f <sub>jam</sub> = 915 MHz	-	17	-	dB
		P <sub>jam</sub> = -21 dBm; f <sub>jam</sub> = 1427 MHz	-	17	-	dB
RL <sub>in</sub>	input return loss		9	12	-	dB
RL <sub>out</sub>	output return loss		7	10	-	dB
ISL	isolation		25	27	-	dB
K	Rollett stability factor		1	-	-	
NF	noise figure	no jammer <sup>[1]</sup>	-	0.65	0.85	dB
		P <sub>jam</sub> = -22 dBm; f <sub>jam</sub> = 915 MHz <sup>[1]</sup>	-	0.85	-	dB
		P <sub>jam</sub> = -22 dBm; f <sub>jam</sub> = 1427 MHz <sup>[1]</sup>	-	0.95	-	dB
P <sub>I(1dB)</sub>	input power at 1 dB gain compression		-11	-9	-	dBm
IP3 <sub>i</sub>	input third-order intercept point	Δf = 1 MHz	-6	0	-	dBm
t <sub>on</sub>	turn-on time	time from V <sub>I(ENABLE)</sub> ON to 90 % of the gain	-	-	2	μs
t <sub>off</sub>	turn-off time	time from V <sub>I(ENABLE)</sub> OFF to 10 % of the gain	-	-	1	μs

[1] PCB losses are subtracted.



### 13 Application information

#### 13.1 GNSS application



**Table 10. List of components**

For schematics, see [Figure 3](#).

Component	Description	Value	Remarks
C1	decoupling capacitor	1 $\mu$ F	The total capacitance on the $V_{CC}$ node must be at least 1 $\mu$ F. It must be positioned at a short distance from the $V_{CC}$ pin (preferably within 15 mm). Typically, such capacitance is already present at the output of the $V_{CC}$ voltage regulator.
IC1	GPS1502L	-	NXP Semiconductors
L1	high-quality matching inductor	11 nH	Murata LQW15A

14 Package outline

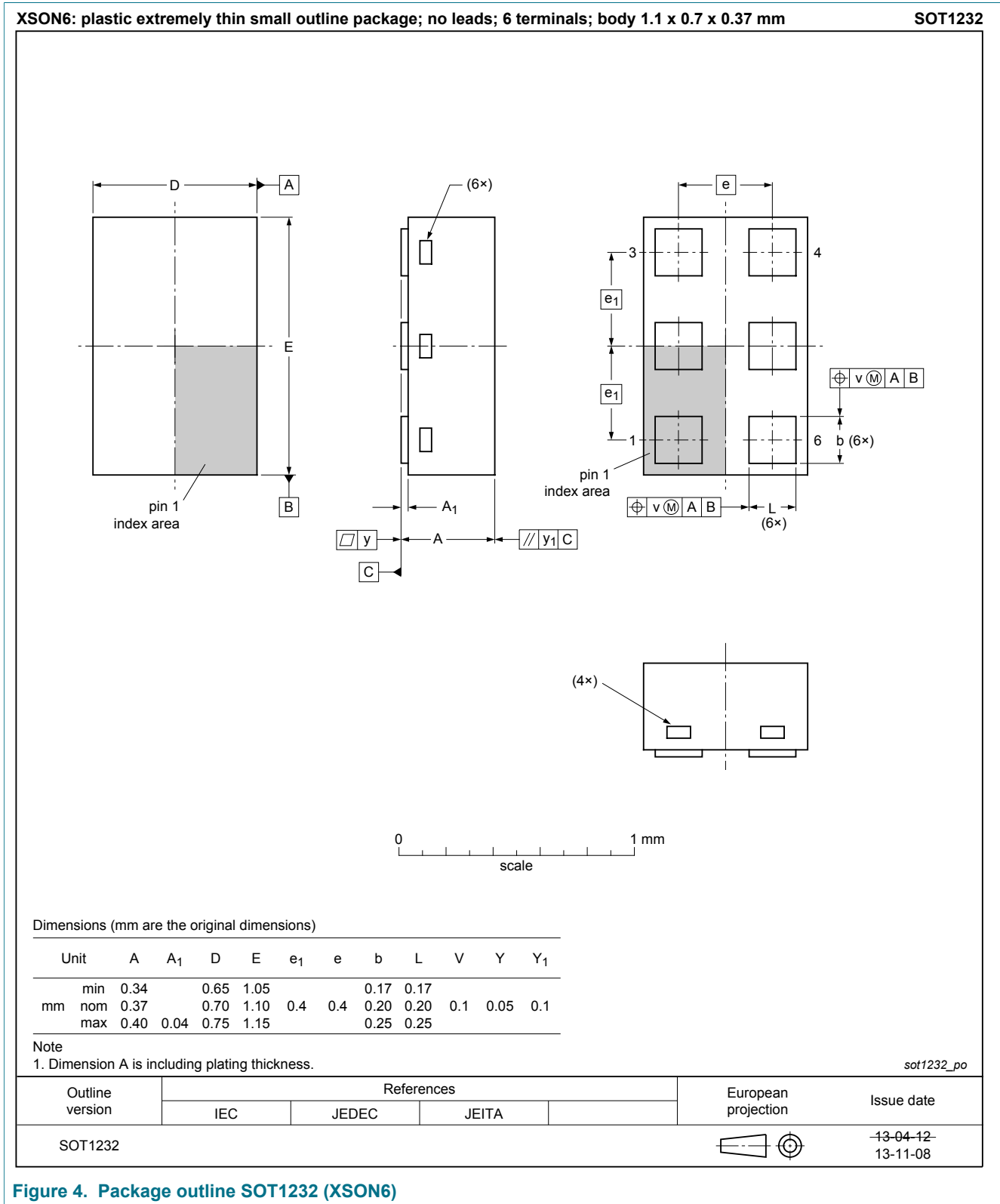


Figure 4. Package outline SOT1232 (XSON6)

## 15 Handling information

### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices. Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

## 16 Abbreviations

Table 11. Abbreviations

Acronym	Description
ESD	electrostatic discharge
GLONASS	global navigation satellite system
GNSS	global navigation satellite system
GPS	global positioning system
HBM	human body model
LNA	low-noise amplifier
MMIC	monolithic microwave-integrated circuit
PCB	printed-circuit board
SiGe:C	silicon germanium carbon

## 17 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
GPS1502L v.5	20190322	Product data sheet	-	GPS1502L v.4.2
Modification	<ul style="list-style-type: none"> <li>Changed the status of the data sheet from company confidential to public</li> </ul>			
GPS1502L v.4.2	20181207	Product data sheet	-	GPS1502L v.4.1
Modification	<ul style="list-style-type: none"> <li>adapted the Ordering information table</li> </ul>			
GPS1502L v.4.1	20181130	Product data sheet	-	GPS1502L v.4
Modification	<ul style="list-style-type: none"> <li>adapted the orderable partnumber to GPS1502LX</li> </ul>			
GPS1502L v.4	20181026	Product data sheet	-	GPS1502L v.3
Modification	<ul style="list-style-type: none"> <li>Status cahanged to Product data sheet</li> </ul>			
GPS1502L v.3	20180831	Preliminary data sheet	-	GPS1502L v.2.1
Modification	<ul style="list-style-type: none"> <li>updated min max values for various conditions</li> </ul>			
GPS1502L v.2.1	20180730	Preliminary data sheet	-	GPS1502L v.2
Modification	<ul style="list-style-type: none"> <li>data sheet changed to Preliminary</li> <li>Characteristics value on 1.8 V changed for input and output return loss</li> </ul>			
GPS1502L v.2	04192018	Objective data sheet	-	GPS1502L v.1.1
Modification	<ul style="list-style-type: none"> <li>Changed max values for VCC and P<sub>i</sub> on limiting values</li> </ul>			
GPS1502L v.1.1	03302018	Objective data sheet	-	-
Modification	<ul style="list-style-type: none"> <li>revision update</li> <li>revision update</li> </ul>			
GPS1502L v.1	03292018	Objective data sheet	-	-

## 18 Legal information

### 18.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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