AIS1200DS

MEMS single-axis satellite acceleration sensor with DSI 2.02 interface

Preliminary data

Features

- 6.5 to 30 V single-supply operation
- -20 V reverse battery survivability
- 10-bit data output DSI 2.02 compliant
- Embedded voltage regulator
- Customizable daisy-chain address
- Embedded self-test
- Automotive AEC-Q100 qualified
- ECOPACK® compliant
- Extended temperature range: -40 °C to +125 °C

Applications

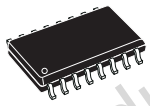
- Airbag DSI systems
- Vibration/impact monitoring

Description

The AIS1200DS is a satellite acceleration sensor with a single-axis sensing element and an IC interface capable of providing acceleration information to external applications through a 225 kbps DSI 2.02 interface.

The sensing element is manufactured using a dedicated process developed by ST to produce inertial sensors and actuators in silicon.

The IC interface is manufactured using a BCD SOI process that allows a high level of integration and specific control of parasitic currents.



SO16W

The AIS1200DS acquisition chain is composed of a C/V converter, a full-differential charge amplifier, a 1st-order LPF @ 1.6 KHz, a 3rd-order LP Bessel filter @ 360 Hz and a second charge amplifier to adapt the dynamic range to SAR A/D converter input.

The differential capacitance of the sensor is proportional to the proof mass displacement; thus, by sensing the differential capacitance, the position of the sensor is determined. Since the mass position is known and the position is related to the input acceleration, the input acceleration can be easily deduced.

The device is available in a 300 mils plastic SOIC package with reverse frame forming for EMC enhancement, and has an operating temperature range from -40 °C to +125 °C.

Table 1. Device summary

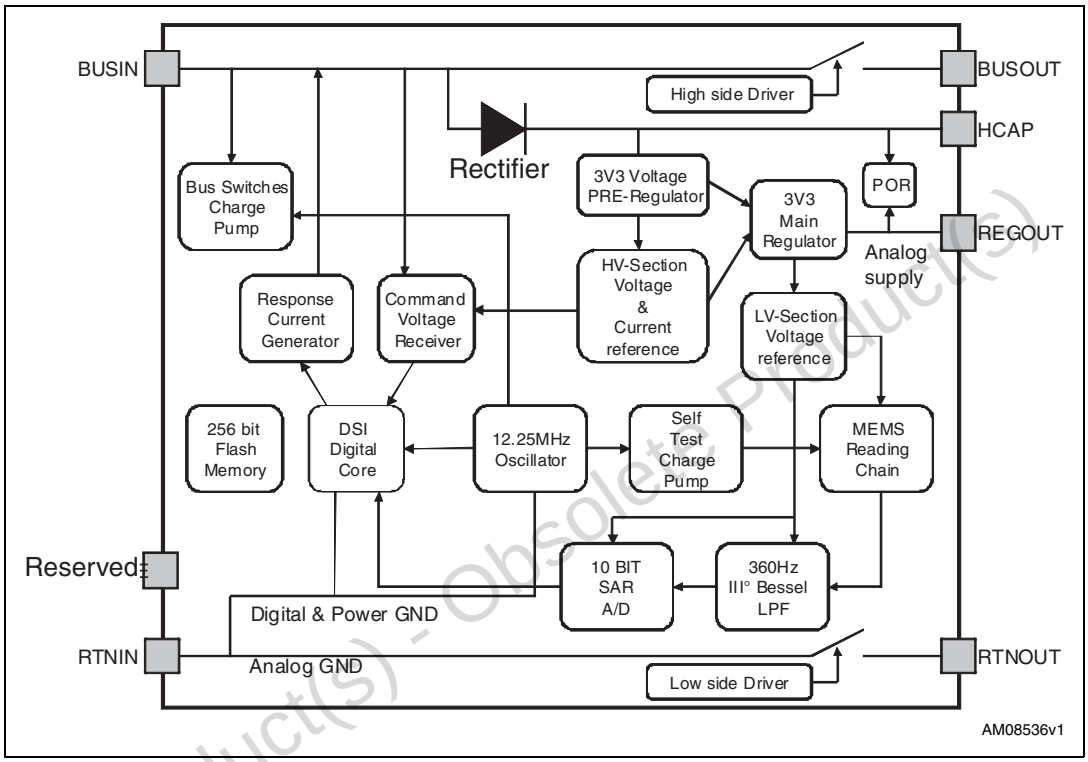
Order code	*g*-range	Operating temperature range [° C]	Package	Packing
AIS1200DS	200*g*	-40 to +125	SO16W	Tubes
AIS1200DSTR	200*g*	-40 to +125	SO16W	Tape and reel

Contents

1 Block diagram and pin description

1.1 Block diagram

Figure 1. AIS1200DS block diagram



1.2 SO16W pin information

Figure 2. Pin connection

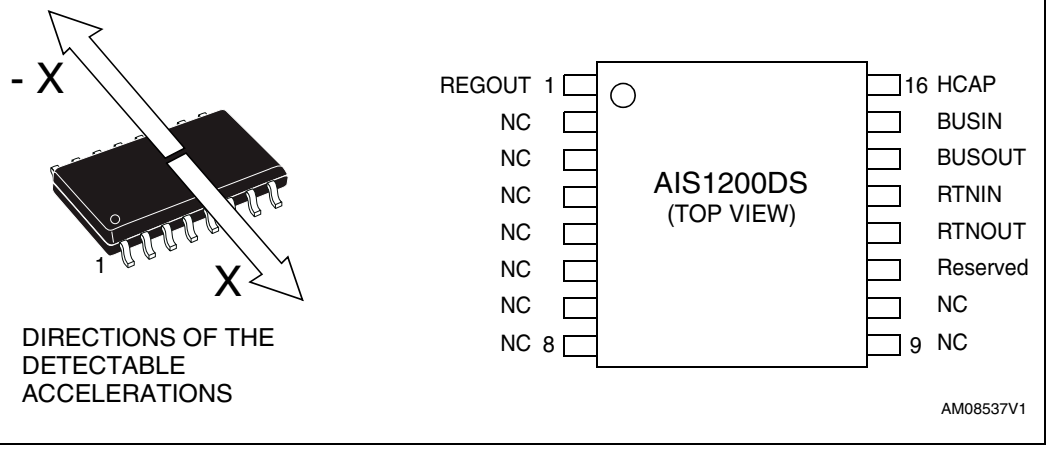


Table 2. Pin description

Pin#	Name	Function
1	REGOUT	Internal regulator output
2 to 10	NC	Leave unconnected
11	Reserved	Connect to RTNIN
12	RTNOUT	Low side bus - slave side
13	RTNIN	Low bus - master side
14	BUSOUT	Hi side bus - slaves side
15	BUSIN	Hi side bus - master side
16	HCAP	Autarchy power supply

2 Mechanical and electrical specifications

2.1 Mechanical characteristics

Table 3. Mechanical characteristics: V_{HCAP} => 6.5V to V_{HCAP} <= 30V, T_L => -40°C to T_H <= 125°C, unless otherwise noted

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
FS	Full-scale range (including errors)			±235		*g*
So	Sensitivity			0.49		*g*/LSb
TCSo	Sensitivity change vs temperature	T_A = 25°C	-5		5	%
		T_L <= T_A <= T_H	TBD		TBD	
Off	Zero-*g* level offset (1)	T_A = 25°C	488	512	536	LSb
		T_L <= T_A <= T_H	TBD	512	TBD	
NL	Non linearity(2)	Best fit straight line		±0.3		% FS
F_0	MEMS resonant frequency			19.6		KHz
$DELTA_{DEF}$	Deflection (Self-test - offset, T_A = 25°C)			30		*g*
DEF	Deflection range	T_A = 25°C	-10		10	%
		T_L <= T_A <= T_H	TBD		TBD	%
T_{OP}	Operating temperature range		-40		+125	°C

1. Zero-*g* level offset (10-bit representation).
2. Verified in characterization, not 100% tested production.

2.2 Electrical characteristics

T_A => -40°C to TH <= 125 °C, unless otherwise noted.

Table 4. Electrical characteristics (1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{HCAP}	Supply voltage		6.5		30	V
RNG	OUTPUT range 10bit	Normal	32		992	LSb
FLT_{LOW}	Error code	Low margin	0		32	LSb
FLT_{HIGH}	Error code	High margin	992		1023	LSb
V_{HLVD}	V_{HCAP} undervoltage detection		6.1		6.5	V
V_{HLVR}	V_{HCAP} recovery threshold		6.3		6.6	V
V_{HLVH}	V_{HCAP} detection hysteresis		15		200	mV
I_Q	HCAP quiescent current	V_{HCAP} = 25 V			7	mA
V_{BUS}	BUSIN, BUSOUT, RTNOUT		-20		30	V
V_{REGOUT}	REGOUT output voltage			3.3		V
V_{RLVD}	V_{REGOUT} undervoltage detection		2.9		3.1	V
V_{RLVR}	V_{REGOUT} recovery threshold		3		3.2	V
V_{RLVH}	V_{REGOUT} detection hysteresis		5		120	mV
REG_{Line}	REGOUT static line regulation	V_{HCAP} = 6.5 V to 30 V			11	mV
REG_{Load}	REGOUT static load regulation	I_{Load} = 0 to 30 mA			11	mV
$DREG_{Line}$	Dynamic line regulation	C_{REG} = 47 nF, V_{HCAP} = 5 V/µs			15	mV
$DREG_{Load}$	Dynamic load regulation	C_{REG} = 47 nF, I_{Load} = 2 mA/µs			30	mV
C_{REG}	Capacitor on REGOUT(2)		47		2600	nF
ESR	C_{REG} series resistance(2)				700	mΩ
R_{FW}	Rectifier forward resistance				2.4	Ω
R_{LEAK}	Rectifier leakage current				100	µA
R_{DROP}	Rectifier voltage drop (V_{BUSIN} - V_{HCAP})	V_{BUSIN}=7 V÷26 V; I_{BUSIN}=-15 mA			0.7	V
		V_{BUSIN}=7 V÷26 V; I_{BUSIN}=-100 mA			0.9	V
I_{BIAS}	BUSIN bias current	V_{BUSIN}=8 V; V_{HCAP}=9 V			100	µA
V_{THL}	BUSIN logic threshold low			3		V
V_{THH}	BUSIN logic threshold high			6		V
V_{HYS}	BUSIN hysteresis signal		30		90	mV
V_{HYF}	BUSIN hysteresis frame		100		300	mV
I_{RES}	BUSIN response current	V_{BUSIN}=1.0V		11		mA
SW_{RES}	BUS switches resistance				3.5	Ω

Table 4. Electrical characteristics (1) (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$DELTA_{DEF}$	Deflection (self-test - offset, T_A = 25°C)	200 g range		61		LSb
DEF	Deflection range	T_A = 25°C	-10		10	%
		T_L <= T_A <= T_H	TBD		TBD	%
T_{OP}	Operating temperature range		-40		+125	°C

1. All voltage levels are referred to RTNIN voltage.
2. Verified by characterization, not guaranteed by production testing.

2.3 Control timing

Table 5. Control timing

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{UVR}	V_{HCAP}, V_{REGOUT} undervoltage mask time		3.2		7.6	µs
t_{CON}	A/D conversion time			30		µs
t_{ITR}	BUSIN, BUSOUT current transition response	1 mA to 9 mA and v.v.		6	8	mA/µs
t_{BS}	BUS init to switch closing delay				500	µs
t_{BIT}	Signal bit transition time		4.4		200	µs
t_{TO}	Signal loss time before reset	T_{MAX} out of frame	2		8	ms
t_{RSPH}	BUSIN timing to response current @ signal Hi	I_{BUS} => 7 mA@BUSIN<=V_{THL}			2.5	µs
t_{RSPL}	BUSIN timing to response current @ signal Low	I_{BUS} <= 5 mA@BUSIN<=V_{THH}			2.5	µs
t_{FSI}	Interframe separation time following init	BS=1	4x t_{BIT}			µs
t_{FSR}	Interframe separation time following	BS=0	4x t_{BIT}			µs
t_{FSO}	Interframe separation time following other cmd		4x t_{BIT}			µs
BW_{OUT}	Low pass filter 3-pole bessel filter		324	360	396	Hz
f_{OSC}	Internal oscillator frequency			12.25		MHz
D_{CH}	Logic duty cycle	Logic “1”		67		%
D_{CL}	Logic duty cycle	Logic “0”		33		%

3 Absolute maximum ratings

Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 6. Absolute maximum ratings

Symbol	Ratings	Min	Typ	Max	Unit
V_{HCAP}	Supply voltage(1)	-0.3		50	V
V_{BUS}	BUSIN, BUSOUT, RTNOUT(1)	-50		50	V
$V_{RECTIFIER}$	HCAP-BUSIN(1)	-0.3		50	V
V_{REGOUT}	Voltage applied to REGOUT(1)			4.6	V
I_{PEAK}	BUS and HCAP current for a time <=1s			1	A
I_{MAX}	BUS and HCAP continuous current			500	mA
A_{MAX}	Acceleration before mechanical stop		4000		*g*
A_{POW}	Mechanical shock device powered		TBD		*g*
A_{UNP}	Mechanical shock device unpowered		TBD		*g*
h_{DROP}	Drop shock survivability		1.2		m
ESD	ESD protection HBM (Low voltage pins: res; TESTE		2		kV
	ESD protection HBM (Hi voltage pins: all remaining pins)		4		kV
	ESD protection HBM (system level: all pins)		2		kV
	CDM		TBD		kV
	MM		TBD		kV
T_{STG}	Storage temperature range	-40		125	°C
T_j	Junction temperature range	-40		150	°C

1. Voltage referred to RTNIN.

This is a mechanical shock sensitive device, improper handling can cause permanent damages to the part

This is an ESD sensitive device, improper handling can cause permanent damages to the part

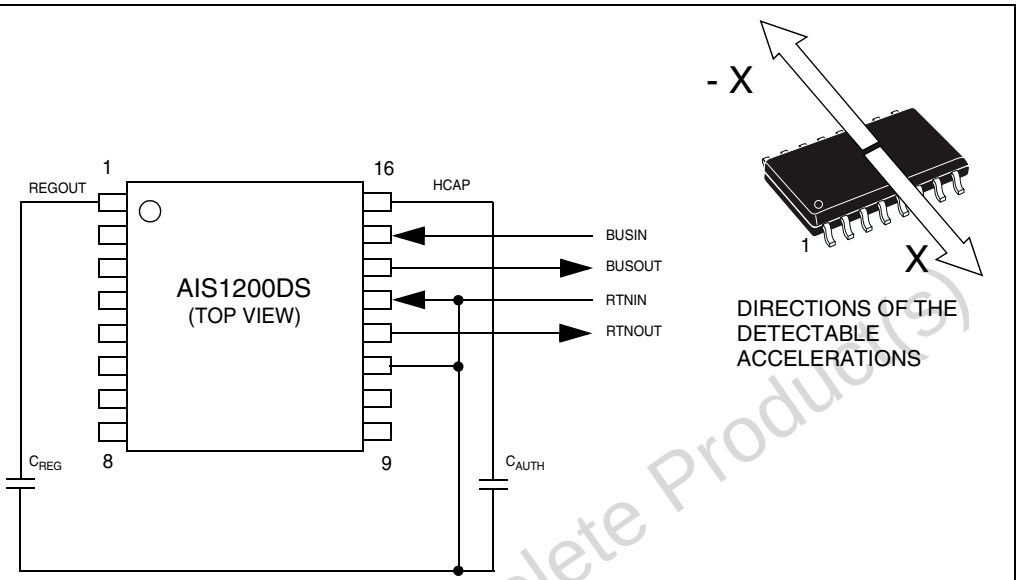
3.1 Factory calibration

The IC interface is factory-calibrated for sensitivity (So) and Zero-*g* level (Off).

The trimming values are stored inside the device in a non volatile structure. Any time the device is turned on, the trimming parameters are downloaded into the registers to be employed during the normal operation. This allows the user to employ the device without further calibration.

4 Application hints

Figure 3. AIS1xxxDS electrical connection



DSI signal through BUSIN BUSOUT and return (Lo signal) through RTNIN RTNOUT

AM08538V1

Typical configuration where BUSOUT and RTNOUT are connected to the satellite daisy-chain and BUSIN RTNIN is either connected to the previous satellite or DSI master. C_{AUTH} is actually the reservoir of energy to power the internal voltage regulator and its value depends on BUS communication levels and timing.

$$C_{AUTH} = \frac{I_{Q(MAX)} \times T_{DATA(MAXcurrent)}}{V_{BUS(MAX)} - (V_{HCAP(min)} + R_{DROP(MAXcurrent)})}$$

The value of the capacitor on the voltage regulator output C_{REG} must be within the specified range to stabilize and filter the low voltage power supply circuit.

RTNIN acts as a local ground for the system (refer to *Figure 3*).

5 Package information

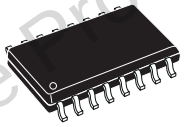
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

Figure 4. SO16W mechanical data and package dimensions

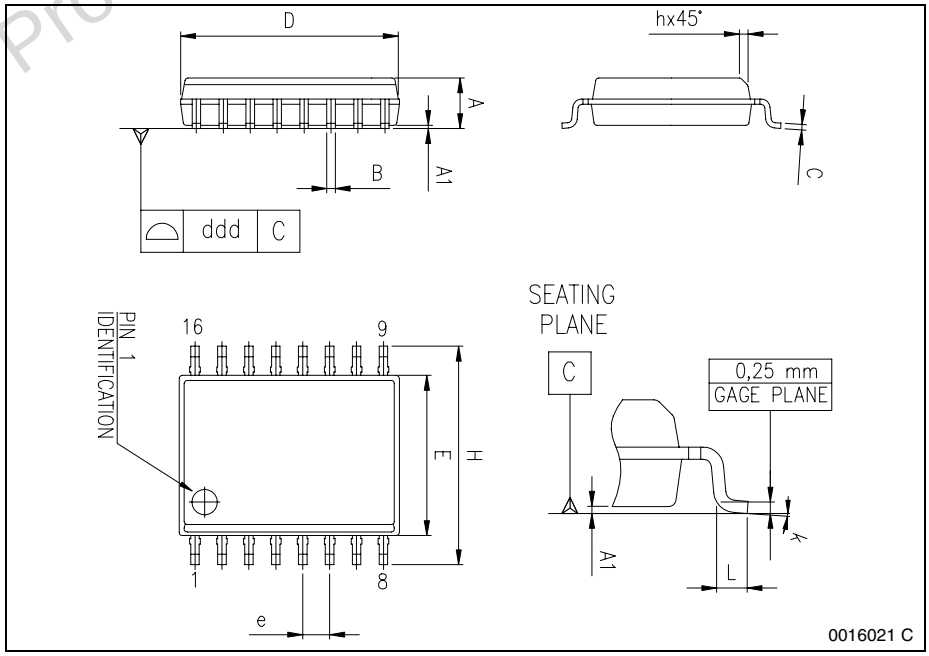
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
B	0.33		0.51	0.013		0.200
C	0.23		0.32	0.009		0.013
D (1)	10.10		10.50	0.398		0.413
E	7.40		7.60	0.291		0.299
e		1.27			0.050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.40		1.27	0.016		0.050
k	0° (min.), 8° (max.)					
ddd			0.10			0.004

(1) "D" dimension does not include mold flash, protusions or gate burrs. Mold flash, protusions or gate burrs shall not exceed 0.15mm per side.

OUTLINE AND MECHANICAL DATA



SO16 (Wide)



6 Revision history

Table 7. Document revision history

Date	Revision	Changes
21-Oct-2010	1	Initial release.

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