

SNP739X DATASHEET

Version 1.5

Description

The SNP739X is a sensor for air pressure measurements designed for TPMS (Tire Pressure Monitoring System) applications.

Features

- Calibrated pressure sensor for absolute pressure measurement
- 3 in 1 integration for ease usage: accelerometer, temperature and supply voltage sensor
- 8051 based micro-controllers
- Standby current 0.25uA
- RF Transmitter 433MHz/315MHz integrated
- Support LF programming
- Absolute Pressure range: 900kPa/1500kPa
- Accelerometer mechanical shock: 6000g
- Package: LGA 24pins. 6.0mm x 5.0mm x 1.9mm



RF			Comment
Frequency		315 / 433.92	MHz – programmable about centre freq
PA		On chip	3.5 ~10 dBm output power
Modulation		ASK / FSK	
FSK deviation		90	kHz – programmable
Format		Manchester	Mark/space also supported
LF (Wakeup, Programming)			
Format		Manchester	Carrier wakeup also supported
Format speed		3.9/6.5	Kbps
Pressure			
Sensor resistance		20 to 3.3	kOhm
Main measure		ADC	12 bit
Temperature			
Main measure		ADC	12 bit
On chip oscillator			
frequency		4/39/2000	KHz
Micro			
LF decoder		Fuzzy	Improves noise and distortion performance.
Flash		16	Kbytes
RAM		384	Bytes
GPIO		6	2 GPIO support low power wakeup.
Other			

Package		LGA 24Pin	SIP (System In Package)
Battery Supply		2.1~3.6	Volts
Pressure Sensor accuracy		± 5 Kpa	0~900KPa Range
Accelerometer accuracy		± 3 g	$ a_{in} < 20g, -40^{\circ}C \leq T < 90^{\circ}C$
Mechanical shock		5000g	5 shocks in 0.3 ms half sine pulses

Applications

- Tire Pressure Monitoring System
- MEMs sensor

Functional Description

SNP739X consists of 16k Flash memory, interrupt bus, configuration registers and control bus which operate the analogue circuitry all of which are controlled via a 8-bit integrated microcontroller. The micro is clocked by a tunable oscillator with a selectable center frequency. The motion detection is achieved via external accelerometer.

Measurements of accelerometer, pressure, temperature, accelerometer and battery voltage are performed under software control, and the data can be formatted and prepared for RF transmission by the microcontroller. A software defined wakeup mechanism is developed for minimizing power consumption. An Interval timer controls the timing of measurements and transmissions.

For smart manage SNP739X work load, accelerometer motion and phase location detection integrated in SNP739X. And both detect tire roll status and tire auto location are supported, with no addition accelerometer need.

Embedded LF receiver can help SNP739X wake up at regular intervals or it can be woken up by the integrated LF Receiver independently with no CPU aids at any time of user definition timeout period, thus helps power save greatly, LF also support Manchester decode, which furthermore enables the sensor to receive data.

The LF receiver supports wireless Flash programming to the chip with no need of I2C communication which demonstrates high efficiency in customer firmware development phase.

The integrated microcontroller is instruction set compatible to the standard 8051 processor. It is equipped with hardware Manchester, bi-phase encoder/decoder and CRC generator and checker, which enable easy implementations of customer specific applications.

The low-power RF Transmitter for 315 and 434 MHz contains a fully integrated PLL synthesizer, an ASK/FSK modulator and an efficient power amplifier.

On-chip Flash memory is integrated to store the customer specific application program code, the unique ID-number of the sensor and the calibration data for the sensor. Additionally flash embedded library functions developed by SENASIC cover standard tasks used by the application.

Block Diagram

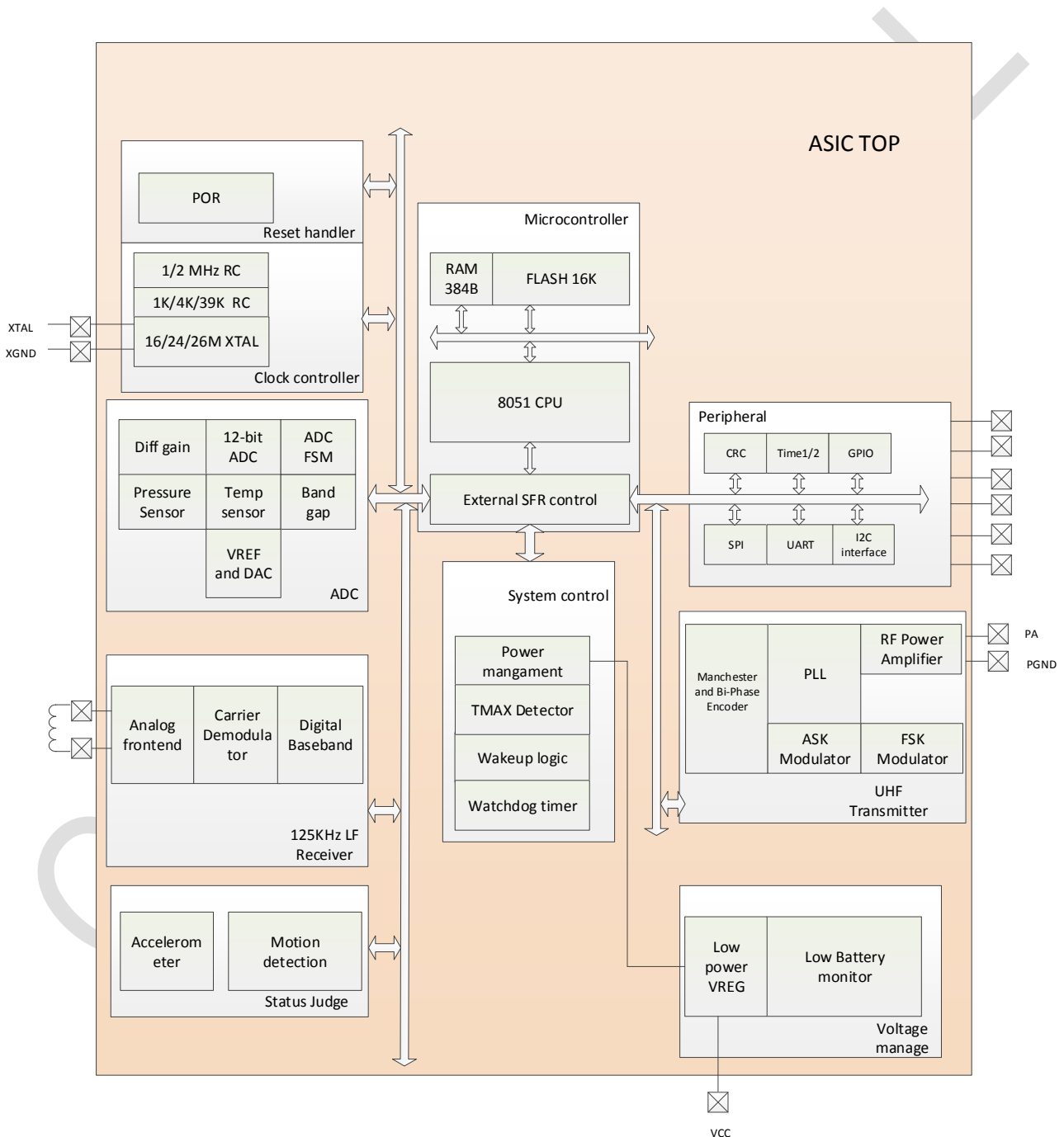


Figure 1 SNP739X Function Diagram for ASIC

SNP739X ORDERING INFORMATION	
Part number	Absolute Pressure range
SNP739-3	900kPa
SNP739-5	1500kPa

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Electrical Characteristics

Table 1 Absolute Maximum Ratings

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Supply Voltage	V_{bat}	-0.3	—	+3.8	V		1.1
Operating Temperature	T_j	-40	—	+125	°C	Normal mode	1.2
		-40	—	+150	°C	Idle mode	1.3
Storage Temperature	$T_{storage}$	-40	—	+150	°C	Device not powered	1.5
ESD HBM	$V_{ESD,HBM}$	-2000	—	+2000	V	All pins according to JS-001-2014	1.6
		-4000	—	+4000	V	RF pin according to JS-001-2014	1.7
ESD CDM	$V_{ESD,CDM}$	-500	—	+500	V	All pins according to JS-002-2014	1.8
Latch up	I_{LU}	-100	—	+100	mA	All pins according to JEDEC 78D	1.9
Input Voltage	V_{in}	-0.3	—	$V_{bat}+0.3$	V	GPIO0~GPIO5	1.10
		-0.3	—	$V_{bat}+0.3$	V	XTAL	1.11
		-0.3	—	$V_{bat}+0.3$	V	LFA, LFB	1.12
Input and Output Current (digital IO pins)	$I_{io,dig}$	-10	—	+10	mA	GPIO0~GPIO5	1.13
		I_{in}	-10	—	+10	mA	LFA, LFB, XTAL

Table 2 Operating Range

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Supply Voltage	V_{bat1}	2.1	3.0	3.6	V	Measurement of pressure, acceleration, temperature and battery	2.1
	V_{bat2}	2.1	3.0	3.6	V	Operation of LF receiver	2.2
	V_{bat3}	2.1	3.0	3.6	V	RF transmission	2.3
	V_{bat4}	2.1	3.0	3.6	V	MCU, FLASH reading/programming/erasing	2.4
Ambient Temperature	$T_{operating}$	-40	—	125	°C	Normal operation	2.6
	T_{Flash}	-20	—	90	°C	Flash programming/erasing	2.7

Table 3 Pressure Sensor

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Measurement Error	P _{Error}	-7	—	+7	Kpa	T = 0...70°C, V _{bat} =2.1...3.6V	3.2
		-15	—	+15	Kpa	T = -40...125°C, V _{bat} =2.1...3.6V	3.5
RAW LSB resolution	P _{LSB, RAW}	—	—	2.1	Kpa	T = -40°C, V _{bat} =2.1...3.6V	3.6
		—	—	2.3	Kpa	T = 25°C, V _{bat} =2.1...3.6V	3.7
		—	—	2.5	Kpa	T = 125°C, V _{bat} =2.1...3.6V	3.8
Pressure Measurement Stability Range	P _{sta}	-2.75	—	2.75	Kpa	Minimum 95% of the measurement	3.9

1) Above pressure error result was tested based on SNP739-3, SNP739-5 has a larger pressure error due to large pressure range ;about more information of SNP739-5 ,please contact with SENASIC FAE

2) SNP739-3 (900Kpa)detail pressure error is as below :

Temperature condition	0°C~70°C		-40~0°C; 70~125°C	
Absolute Pressure(kPa)	100~500	500~900	100~500	500~900
Measurement Error(kPa)	±5	±7	±10	±15

3) SNP739N-5(1500Kpa)detail pressure error is as below :

Temperature condition	0°C~70°C			-40~0°C; 70~125°C		
Absolute Pressure(kPa)	100~500	500~900	900~1500	100~500	500~900	900~1500
Measurement Error(kPa)	±7	±12	±20	±15	±25	±40

Table 4 Accelerometer Sensor

Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Input acceleration Range	a _{in}	-250		250	g		12.1
Total Acceleration Error	a _{err_tot}	-3		+3	g	a _{in} <20g, -40°C ≤ T < 90°C	12.2
		-5		+5	g	a _{in} <<20g, 90°C ≤ T < 125°C	12.3
		-7		+7	g	20g ≤ a _{in} < 100g, -40°C ≤ T < 90°C	12.4
		-9		+9	g	20g ≤ a _{in} < 100g, 90°C ≤ T < 125°C	12.5
		-11		+11	g	100g ≤ a _{in} < 200g, -40°C ≤ T < 90°C	12.6
		-13		+13	g	100g ≤ a _{in} < 200g, 90°C ≤ T < 125°C	12.7
		-20		+20	g	200g ≤ a _{in} < 250g, -40°C ≤ T < 90°C	12.8
		-22		+22	g	200g ≤ a _{in} < 250g, 90°C ≤ T < 125°C	12.9

Random error	arandom	-0.8		+0.8	g	95% of all measurements $ \sigma_{in} =0$	12.10
		-1.2		+1.2	g	99.8% of all measurements $ \sigma_{in} =0$	12.11

Table 5 Temperature Sensor

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Measurement Error	T_{Error}	-2	—	+2	°C	$T = -20...70^{\circ}C, V_{bat}=2.1...3.6V$	6.1
		-3	—	+3	°C	$T = -40...125^{\circ}C, V_{bat}=2.1...3.6V$	6.2
Temp Measurement Stability Range	T_{stab}	-1	—	+1	°C	Minimum 95% of the measurement	6.3

Table 6 Battery Sensor

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Measurement Error	V_{Error}	-3	—	+3	%	Percentage of measurement value	7.1

Table 7 Supply Currents

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Supply current at RF transmission (FSK, 433.92MHz)	$I_{RF433_L2_3V}$		9.67		mA	$V_{bat}=3V, T=-40^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 8dBm$	8.8
			9.38		mA	$V_{bat}=3V, T=25^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 8dBm$	8.9
			8.89		mA	$V_{bat}=3V, T=125^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 8dBm$	8.10
Supply current at RF transmission (FSK, 433.92MHz)	$I_{RF433_L1_3V}$		6.1		mA	$V_{bat}=3V, T=-40^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 5dBm$	8.3
			5.9		mA	$V_{bat}=3V, T=25^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 5dBm$	8.4
			5.6		mA	$V_{bat}=3V, T=125^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 5dBm$	8.5
Supply current at RF transmission (FSK, 433.92MHz)	$I_{RF433_L3_3V}$		12.5		mA	$V_{bat}=3V, T=-40^{\circ}C, Z_{load}=X\ ohm, R_{fout}\ matched, P_{out} \sim 10dBm$	--
			11.8		mA	$V_{bat}=3V, T=25^{\circ}C,$	--

						Z _{load} = X ohm, R _{fout} matched P _{out} ~ 10dBm	
			11.3		mA	V _{bat} =3V, T=125°C, Z _{load} = X ohm, R _{fout} matched P _{out} ~ 10dBm	--

Table 7.1 Supply Currents(cont'd)

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Supply current in power down state (LF wake off)	I _{PWD1_3V}		-	0.3	uA	V _{bat} =3V, T=25°C	8.13
			-	0.9	uA	V _{bat} =3V, T=90°C	8.14
			1.6	3.5	uA	V _{bat} =3V, T=125°C	8.15
				0.2	uA	V _{bat} =3V, T=-40°C	
Supply current in power down state (LF wake on)	I _{PWD2_3V}		-	5.2	uA	V _{bat} =3V, T=25°C	8.16
			-	8	uA	V _{bat} =3V, T=90°C	8.17
			10	15	uA	V _{bat} =3V, T=125°C	8.18
				4	uA	V _{bat} =3V, T=-40°C	
Supply current in idle state	I _{IDLE_3V}		-	59	uA	V _{bat} =3V, T=25°C	8.21
			-	77	uA	V _{bat} =3V, T=90°C	
			88	152	uA	V _{bat} =3V, T=125°C	8.22
			-	64	uA	V _{bat} =3V, T=-40°C	
Supply current in run state (Peripheral units in active state, 32KHz)	I _{RUN_3V}		-	618	uA	V _{bat} =3V, T=25°C	8.23
			-	566	uA	V _{bat} =3V, T=90°C	
			-	576	uA	V _{bat} =3V, T=125°C	8.24
			-	695	uA	V _{bat} =3V, T=-40°C	
Supply current in run state (PLL enabled)	I _{RUN_3V,PLL}		2.6		mA	V _{bat} =3V, T=25°C, P _{out} ~ 8dBm, Power Level 2	8.25
					mA	V _{bat} =3V, T=90°C, P _{out} ~ 8dBm, Power Level 2	
			2.4		mA	V _{bat} =3V, T=125°C, P _{out} ~ 8dBm, Power Level 2	8.26
			2.2		mA	V _{bat} =3V, T=-40°C, P _{out} ~ 8dBm, Power Level 2	
Supply current in thermal shutdown	I _{TSHD_3V}		2.8	4.6	uA	V _{bat} =3V, T=125°C	8.19
LF Receiver current	I _{LF_3V}			9	uA	V _{bat} =3V, T=25°C	8.27
				11	uA	V _{bat} =3V, T=90°C	
				12	uA	V _{bat} =3V, T=125°C	
				8	uA	V _{bat} =3V, T=-40°C	

Table 8 RF Transmitter

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Transmit Frequency	$f_{TX,433.92MHz}$	432	433.92	444	MHz		9.2
Output Power transformed into 50 Ohm	$P_{O,L1,433.92MHz}$		5.6		dBm	$V_{bat}=3.0V, T=25^{\circ}C$ $Z_{load}=50\text{ ohm RF matched}$ Power Level=1	9.5
Output Power transformed into 50 Ohm	$P_{O,L2,433.92MHz}$		7.7		dBm	$V_{bat}=3.0V, T=25^{\circ}C$ $Z_{load}=50\text{ ohm RF matched}$ Power Level=2	9.6
Output Power transformed into 50 Ohm	$P_{O,L3,433.92MHz}$		9.8		dBm	$V_{bat}=3.0V, T=25^{\circ}C$ $Z_{load}=50\text{ ohm RF matched}$ Power Level=3	
Output Power change over temp.	$dP_{-40^{\circ}C}$		0.6		dB	$V_{bat}=3.0V, T=-40^{\circ}C$	9.13
Output Power change over temp.	$dP_{125^{\circ}C}$		-1.1		dB	$V_{bat}=3.0V, T=125^{\circ}C$	9.14
Output Power change over supply	$dP_{1.9V}$	-10.1	-7.1		dB	$V_{bat}=1.9V, T=25^{\circ}C$	9.15
Output Power change over supply	$dP_{2.1V}$	-5.5	-4.8		dB	$V_{bat}=2.1V, T=25^{\circ}C$	9.17
Output Power change over supply	$dP_{3.6V}$	1.6	1.9		dB	$V_{bat}=3.6V, T=25^{\circ}C$	9.18
Datarate	DR_{RF}			19.6	Kbit/s	Manchester coded	9.19
Datarate accuracy	dDR_{RF}	-1		+1	%		9.20
Reference Spur	$P_{spur,433.92MHz}$			-50	dBc		9.22
Carrier Harmonics	$P_{h2,433.92MHz}$	-33		-28	dBc	2 nd harmonics	9.21
Phase Noise	$P_{PN,10KHz}$			-80	dBc/Hz		9.25
	$P_{PN,100KHz}$			-80	dBc/Hz		9.26
	$P_{PN,1MHz}$			-90	dBc/Hz		9.27
	$P_{PN,10MHz}$			-120	dBc/Hz		9.28
FSK frequency shift		0	+/-45		KHz	Programmable	
RF Data Duty Cycle	$DC_{RF,ASK}$	45	50	55	%	Valid only for ASK ¹⁾	
ASK Mod depth	$MD_{RF,ASK}$	90			%		

1) ASK duty cycle is defined at -3dB of the max. RF power during ASK is on

Table 9 LF Receiver Characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
LF Carrier Frequency	f_{LF}	-5%	125	+5%	KHz		
LF Data Rate	DR_{LF}	-3%	3.9	+5%	Kbit/s		10.6
LF input differential capacitance	$C_{LF,diff}$	2	3.9	10	pF	At 125KHz	
LF input differential resistance	$R_{LF,diff}$	1			Mohm	At 125KHz, -40°C to 90°C	
LF Receiver settling time after power on	t_{ON_set}			15	ms	After LF receiver power-on till passing MLF preamble	
LF Detection Sensitivity	S_{nodet}	0.1			mVpp	$DR_{LF}=3.9KHz$, 100% modulation depth	10.12
	S_{det}				mVpp	$DR_{LF}=3.9KHz$, 100% modulation depth, -20°C to 90°C	
				2		mVpp	$DR_{LF}=3.9KHz$, 100% modulation depth, -40°C to 125°C

Table 10 Crystal Oscillator

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Crystal frequency range	f_{XTAL}		24		MHz	12MHz optional	12.0
Crystal tolerance		-50		+50	ppm		
Crystal load capacitance			6		pF		12.2
Crystal Oscillator startup time	t_{XTAL_start}			2	ms		12.1

Table 11 Power On Reset

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Power on reset level	V_{POR}	1.0		1.65	V	Measured at Pin V_{bat}	16.1
Power on reset release level	V_{THR}	1.1		1.7	V	Measured at Pin V_{bat}	16.3
Power on reset time	t_{POR}			0.5	ms		16.4

Table 12 Voltage Regulator

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Regulated output voltage	V _{REG}		1.8		V	V _{bat} =2.1V – 3.6V	17.1
External Capacitance at Vreg Pin	C _{VREG}		1		uF		17.6

Table 13 Battery Monitor

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Low battery threshold warning level	TH _{LBAT}	2.2	2.3	2.4	V	Used by ROM Library functions only	18.1

Table 14 FLASH Memory

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Erase/Program temperature	T _{FL}	-20		90	°C		19.1
Erase/Program supply voltage	V _{bat}	2.1	3.0	3.6	V		19.2
Flash memory data retention time	t _{RetFlash}	10			y	Defect rate < 1ppm over lifetime for typical mission temperature profile	
Flash write cycles (Endurance)	N _{write}	1K			cycle s	Programming/erase cycles per wordline	19.3
Flash line write time	t _{write_line}			7.8	ms		19.5

Table 15 Thermal Shutdown

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Thermal shutdown HOT threshold	T _{HOT,TH}			125	°C	Used by Library functions only	20.2
Thermal shutdown HOT release	T _{HOT,RE}	95			°C		20.1

Table 16 Digital I/O pins

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Input Low voltage	V _{IL}			0.2V _{bat}	V		22.1
Input High voltage	V _{IH}	0.8V _{bat}			V		22.2
Output Low voltage	V _{OL}			0.2V _{bat}	V	I _{OL} =4mA/6mA	22.3
Output High voltage	V _{OH}	0.8V _{bat}			V	I _{OL} =4mA/6mA	22.4
Digital Pin Output Current	I _{in,DIG}	-4		4	mA	Programmable, 6mA optional	
Digital Pin Input Capacitance	C _{in,DIG}			10	pF		22.6

 Table 17 I²C Interface

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
I ² C bitrate	DR _{I2C}			400	Kb/s		23.1

Package Dimensions

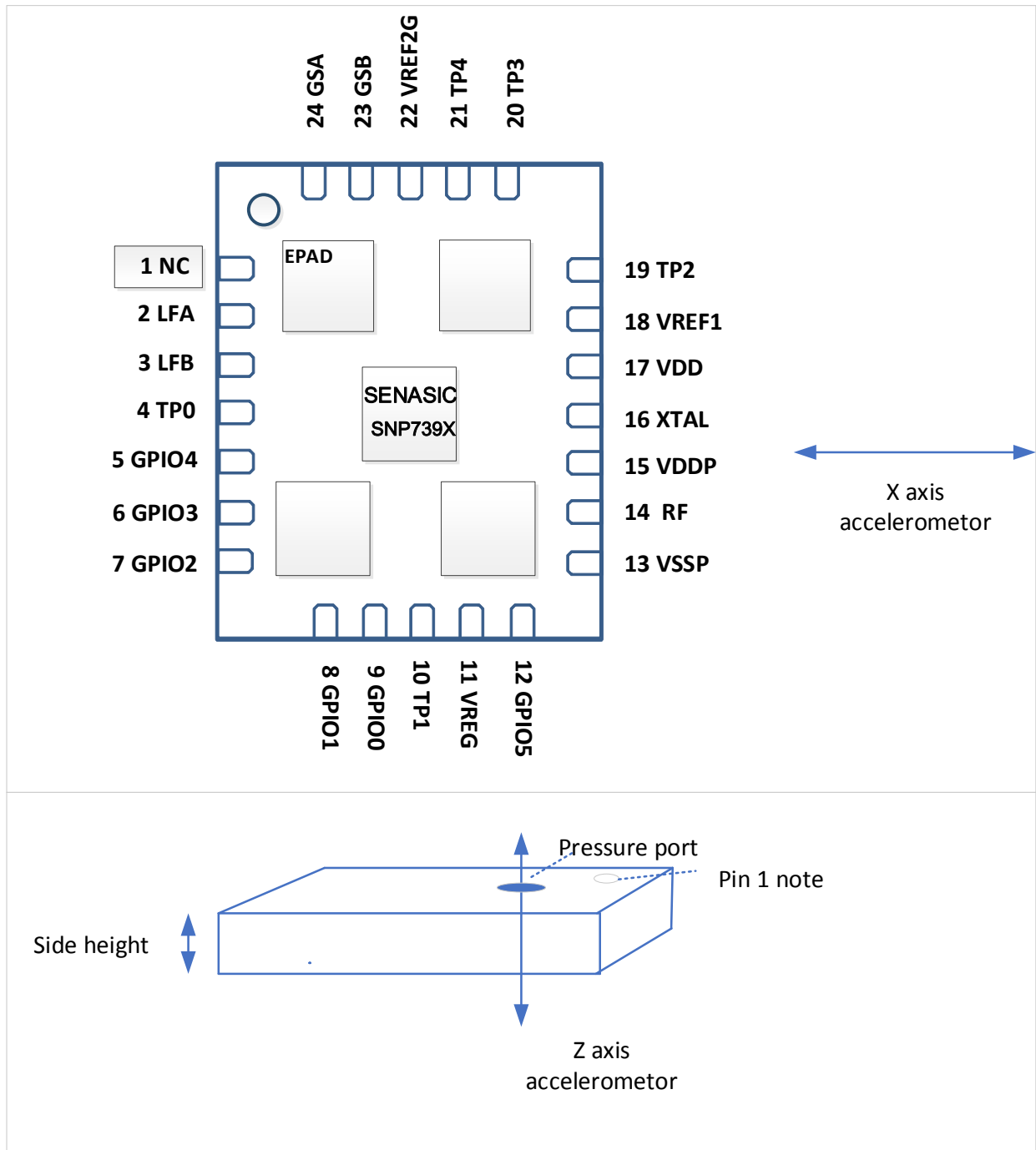
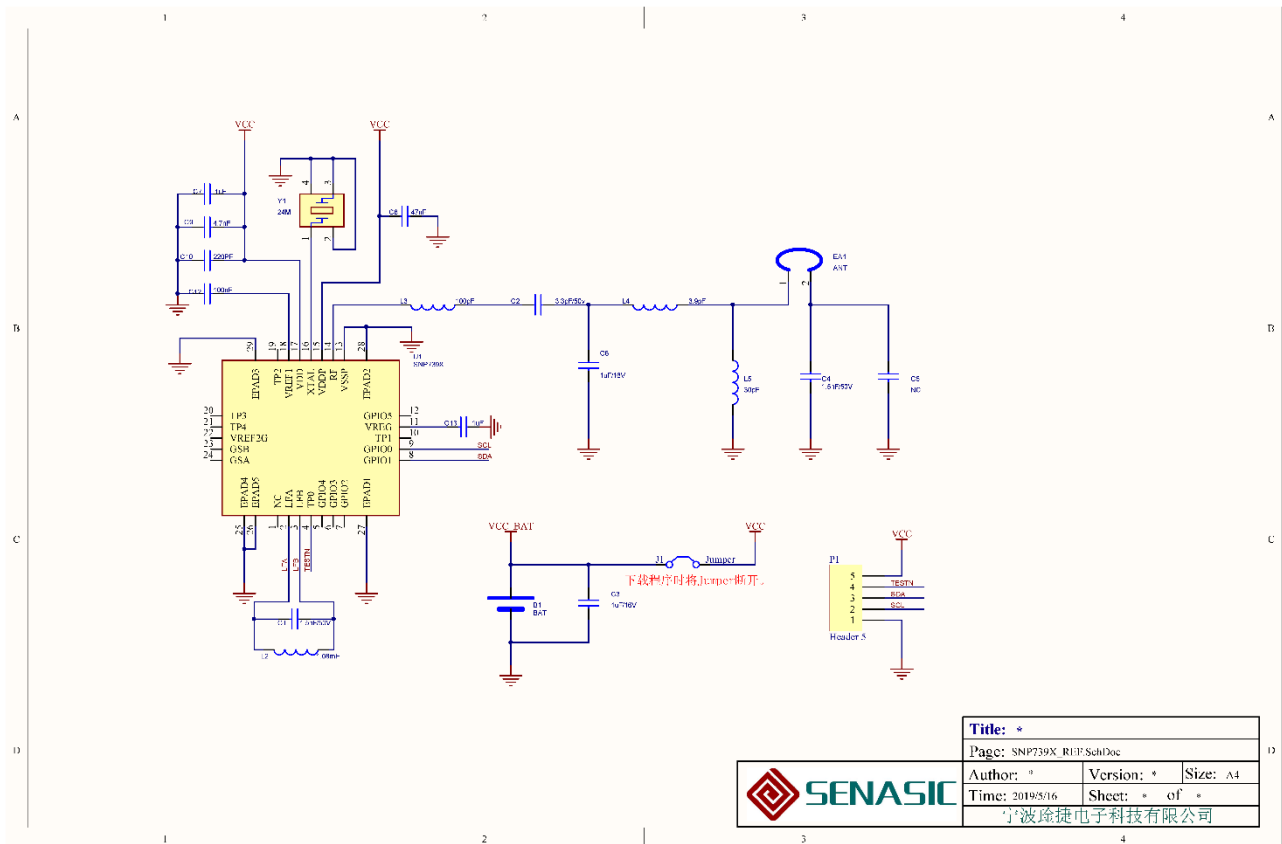


Figure 2 package and accelerometer direction

Pin Assignment Table

Pin	Name	Type	Function
1	NC		Not connect
2	LFA	Analog IO	LF channel coil connection
3	LFB	Analog IO	LF channel coil connection
4	TP0		N.C., just place a test point on board
5	GPIO4	Digital IO	GPIO / SPI MISO/UART RXD
6	GPIO3	Digital IO	GPIO / SPI MOSI/UART TXD
7	GPIO2	Digital IO	GPIO / SPI CSN
8	GPIO1	Digital IO	GPIO / I2C data
9	GPIO0	Digital IO	GPIO / I2C Clock
10	TP1		N.C., just place a test point on board
11	VREG	Supply	Supply 1.8V from internal regulator
12	GPIO5	Digital IO	GPIO / SPI CLK
13	VSSP	Supply	Ground
14	RF	Analog IO	RF output
15	VDDP	Supply	Battery supply 3V
16	XTAL	Analog IO	XTAL pin(12/24MHz)
17	VDD	Supply	Battery supply 3V
18	VREF1	Analog IO	100nF to ground
19	TP2		N.C., just place a test point on board
20	TP3		N.C., just place a test point on board
21	TP4		N.C., just place a test point on board
22	VREF2G	Analog IO	Accelerometer common end
23	GSB	Analog IO	accelerometer differ test pin B.
24	GSA	Analog IO	Accelerometer differ test pin A
25~29	EPAD	Supply	Ground

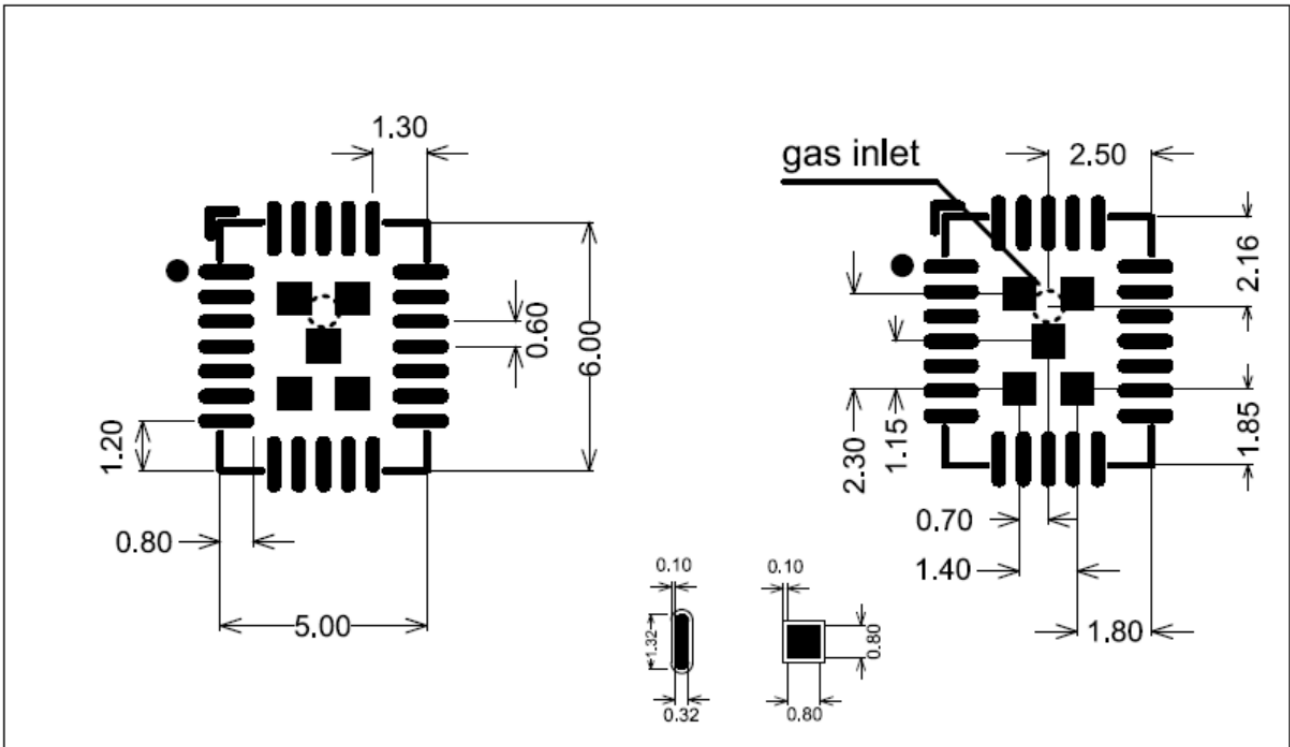
Application Circuit



Note:

1. L3/C2/C6/L4//L5/C4/C5 value might be changed according to different antenna.

Footprint



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Revision history

VERSION	DATE	NOTE
1.0	2019/05/15	Initial version
1.1	2019/05/21	<ol style="list-style-type: none">1. add support XTAL 16M/24M/26M to list.2. Add chip size description to elemental page.3. Application page add note for ease
1.2	2019/05/30	<ol style="list-style-type: none">1. Update footprint figure on page 16.
1.3	2019/7/9	<ol style="list-style-type: none">1. Update block diagram for show 3 sensor in one package.2. update accelerometer description.3. Update pin assignment table for accelerometer pin description.
1.5	2020/2/20	<ol style="list-style-type: none">1. update accelerometer spec.

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