SNP705X DATASHEET

Version 2.3

Description

The SNP705X is a sensor for air pressure measurements designed for TPMS (Tire Pressure Monitoring System) applications.

Features

• Calibrated pressure sensor for absolute pressure measurement
• Temperature and supply voltage sensor
• 8051 based microcontroller
• Standby current 0.25uA
• RF Transmitter 433MHz/315MHz integrated
• External accelerometer
• Support LF programming
• Absolute Pressure range: 450kPa/900kPa/1500kPa

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	OOK & PWM also supported
Format speed		3.9/6.5	Kbps
Pressure			
Sensor resistance		20 to 3.3	kOhm
Main measure		ADC	12 bit
Temperature		-40~125℃	
Main measure		ADC	12 bit
On chip oscillator			
frequency		8/39/2000	KHz
Micro			
LF decoder		Fuzzy	Improves noise and distortion performance.
Flash		16	Kbytes
RAM		384	Bytes
GPIO		3	
Other			
Package		LGA 24Pin	SIP (System In Package)
Battery Supply		2.1~3.6	Volts

Applications
- Tire Pressure Monitoring System
- MEMs sensor

Functional Description

SNP705X 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 pressure, temperature, 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. The circuitry can be programmed to wake up at regular intervals or it can be woken up by the integrated LF Receiver, 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.

The accelerometer interface can support external dual-axis accelerometer to detect tire roll status.

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.

SNP705X ORDERING INFORMAITON	
Part number	Absolute Pressure range
SNP705G	450kPa
SNP705H	900kPa
SNP705N	1500kPa

Block Diagram
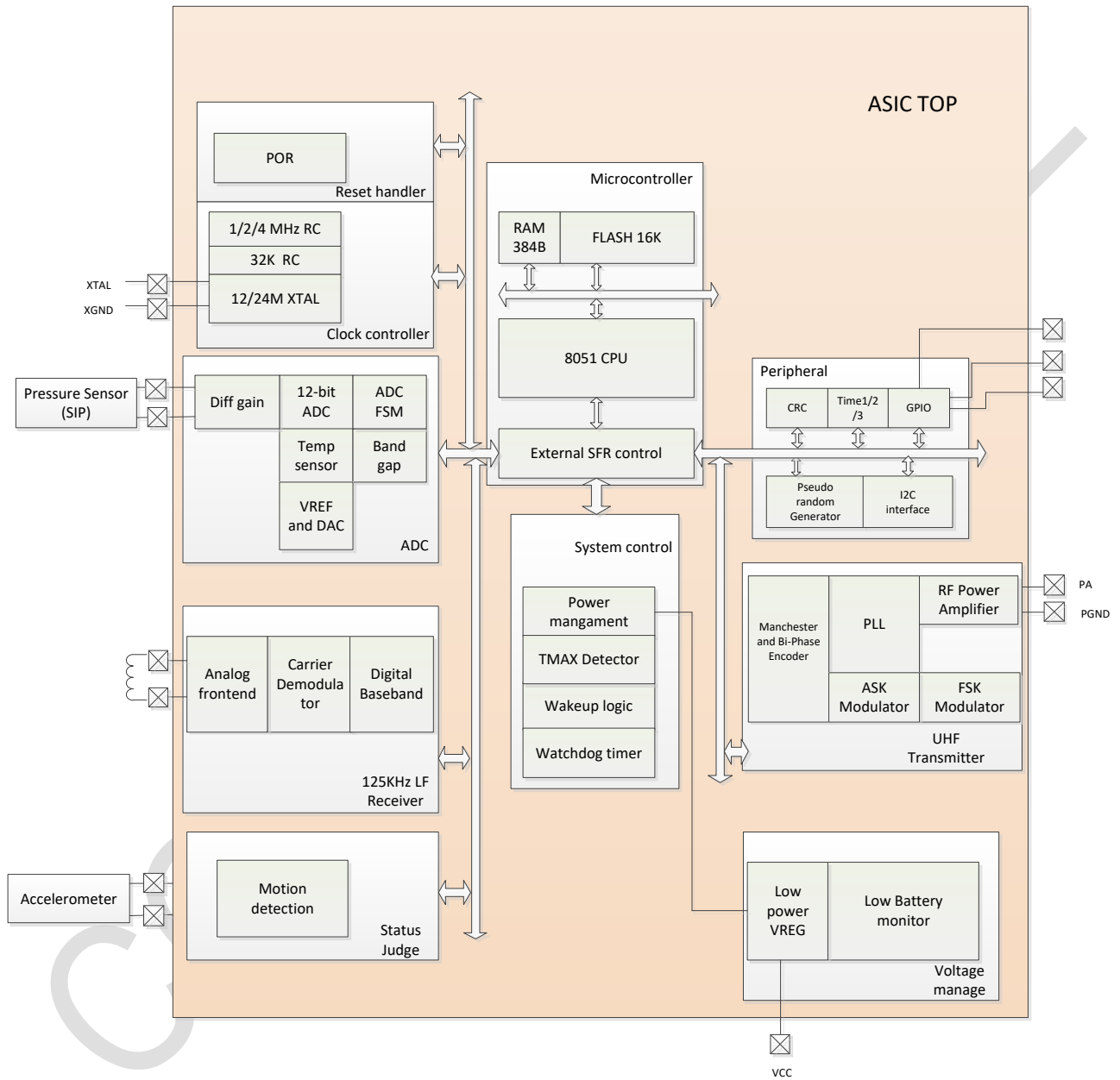
SNP705X Function Diagram for ASIC

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	℃	Normal mode	1.2
		-40	—	+150	℃	Idle mode	1.3
Storage Temperature	$T_{storage}$	-40	—	+150	℃	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	Vin	-0.3	—	V_{bat}+0.3	V	GPIO0, GPIO1, GPIO2	1.10
		-0.3	—	V_{bat}+0.3	V	XTAL, PSA, PSB	1.11
		-0.3	—	V_{bat}+0.3	V	LFA, LFB	1.12
		-0.3	—	+0.3	V	SA, SB	1.13
Input and Output Current (digital IO pins)	$I_{io,dig}$	-10	—	+10	mA	GPIO0, GPIO1, GPIO2	1.14
	I_{in}	-10	—	+10	mA	LFA, LFB, XTAL, SA, SB	1.15

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	℃	Normal operation	2.6
	T_{Flash}	-20	—	90	℃	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℃, V_{bat}=2.1….3.6V	3.2
		-15	—	+15	KPa	T = -40…125℃, V_{bat}=2.1….3.6V	3.5
RAW LSB resolution	$P_{LSB, RAW}$		—	2.1	KPa	T = -40℃, V_{bat}=2.1….3.6V	3.6
			—	2.3	KPa	T = 25℃, V_{bat}=2.1….3.6V	3.7
			—	2.5	KPa	T = 125℃, 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 SNP705H,SNP705N has a larger pressure error due to large pressure range ;about more information of SNP705N ,please contact with SENASIC FAE

2) SNP705H (900Kpa)detail pressure error is as below :

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

3）SNP705N (1500Kpa)detail pressure error is as below :

Temperature condition	0℃~70℃			'-40~0℃；70~125℃		
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 Temperature Sensor

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

Table 5 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 6 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℃, Z_{load}= X ohm, RFout matched P_{out} ~ 8dBm	8.8
			9.38		mA	V_{bat}=3V, T=25℃, Z_{load}=X ohm, RFout matched P_{out} ~ 8dBm	8.9
			8.89		mA	V_{bat}=3V, T=125℃, Z_{load}= X ohm, RFout matched P_{out} ~ 8dBm	8.10
Supply current at RF transmission (FSK, 433.92MHz)	$I_{RF433\_L1\_3V}$		6.1		mA	V_{bat}=3V, T=-40℃, Z_{load}= X ohm, RFout matched P_{out} ~ 5dBm	8.3
			5.9		mA	V_{bat}=3V, T=25℃, Z_{load}= X ohm, RFout matched P_{out} ~ 5dBm	8.4
			5.6		mA	V_{bat}=3V, T=125℃, Z_{load}= X ohm, RFout matched P_{out} ~ 5dBm	8.5
Supply current at RF transmission (FSK, 433.92MHz)	$I_{RF433\_L3\_3V}$		12.5		mA	V_{bat}=3V, T=-40℃, Z_{load}= X ohm, RFout matched P_{out} ~ 10dBm	--
			11.8		mA	V_{bat}=3V, T=25℃, Z_{load}= X ohm, RFout matched P_{out} ~ 10dBm	--
			11.3		mA	V_{bat}=3V, T=125℃, Z_{load}= X ohm, RFout matched P_{out} ~ 10dBm	--

Table 6.1 Supply Currents(cont'd)

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Supply current in power down state	I_{PWD_3V}		-	0.3	uA	V_{bat}=3V, T=25℃	8.13
			-	0.9	uA	V_{bat}=3V, T=90℃	8.14
			1.6	3.5	uA	V_{bat}=3V, T=125℃	8.15
				0.2	uA	V_{bat}=3V, T=-40℃	
Supply current in idle state	I_{IDLE_3V}		-	59	uA	V_{bat}=3V, T=25℃	8.21
			-	77	uA	V_{bat}=3V, T=90℃	
			88	152	uA	V_{bat}=3V, T=125℃	8.22
			-	64	uA	V_{bat}=3V, T=-40℃	
Supply current in run state (Peripheral units in active state, 32KHz)	I_{RUN_3V}		-	618	uA	V_{bat}=3V, T=25℃	8.23
			-	566	uA	V_{bat}=3V, T=90℃	
			-	576	uA	V_{bat}=3V, T=125℃	8.24
			-	695	uA	V_{bat}=3V, T=-40℃	
Supply current in run state (PLL enabled)	$I_{RUN\_3V,PLL}$		2.6		mA	V_{bat}=3V, T=25℃, P_{out} ~ 8dBm, Power Level 2	8.25
					mA	V_{bat}=3V, T=90℃, P_{out} ~ 8dBm, Power Level 2	
			2.4		mA	V_{bat}=3V, T=125℃, P_{out} ~ 8dBm, Power Level 2	8.26
			2.2		mA	V_{bat}=3V, T=-40℃, P_{out} ~ 8dBm, Power Level 2	
Supply current in thermal shutdown	I_{TSHD_3V}		2.8	4.6	uA	V_{bat}=3V, T=125℃	8.19
LF Receiver current	I_{LF_3V}			9	uA	V_{bat}=3V, T=25℃	8.27
				11	uA	V_{bat}=3V, T=90℃	
				12	uA	V_{bat}=3V, T=125℃	
				8	uA	V_{bat}=3V, T=-40℃	

Table 7   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℃ Z_{load}=50 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℃ Z_{load}=50 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℃ Z_{load}=50 ohm RF matched Power Level=3	
Output Power change over temp.	$dP_{-40℃}$		0.6		dB	V_{bat}=3.0V, T=-40℃	9.13
Output Power change over temp.	$dP_{125℃}$		-1.1		dB	V_{bat}=3.0V, T=125℃	9.14
Output Power change over supply	$dP_{1.9V}$	-10.1	-7.1		dB	V_{bat}=1.9V, T=25℃	9.15
Output Power change over supply	$dP_{2.1V}$	-5.5	-4.8		dB	V_{bat}=2.1V, T=25℃	9.17
Output Power change over supply	$dP_{3.6V}$	1.6	1.9		dB	V_{bat}=3.6V, T=25℃	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	2nd 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 8　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℃ to 90℃	
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℃ to 90℃	
				2	mVpp	DR_{LF}=3.9KHz, 100% modulation depth, -40℃ to 125℃	10.13

Table 9　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 10　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 11   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 12   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 13   FLASH Memory

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Erase/Program temperature	T_{FL}	-20		90	℃		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			cycles	Programming/erase cycles per wordline	19.3
Flash line write time	t_{write_line}			7.8	ms		19.5

Table 14 Thermal Shutdown

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

Table 15 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 16 I²C Interface

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
I²C bitrate	DR_{I2C}			400	Kb/s		23.1

Pin Assignment Table

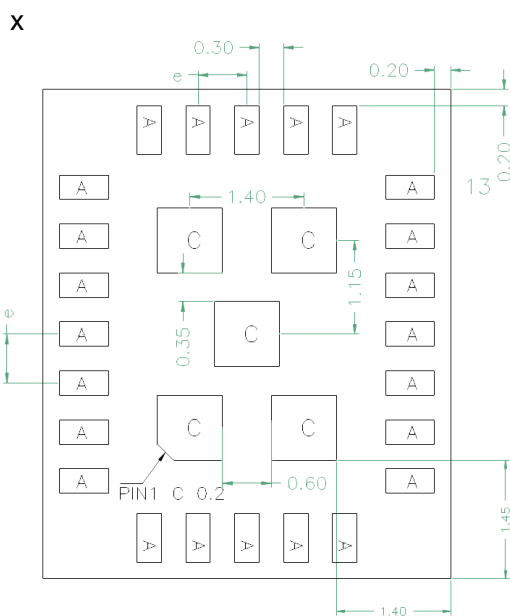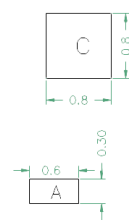| Pin	Name	Type	Function
1	VSS2	Supply	Ground
2	LFA	Analog IO	LF channel coil connection
3	LFB	Analog IO	LF channel coil connection
4	TESTN	Digital In	Active high, test mode entry. Pull down by default
5	TP1		N.C., just place a test point on board
6	TP0		N.C., just place a test point on board
7	GPIO2	Digital IO	GPIO / Test mode output
8	GPIO1	Digital IO	GPIO / I2C data
9	GPIO0	Digital IO	GPIO / I2C Clock
10	TP2		N.C., just place a test point on board
11	VREG	Supply	Supply 1.8V from internal regulator
12	TP3		N.C., just place a test point on board
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	TP4		N.C., just place a test point on board
20	TP5		N.C., just place a test point on board
21	TP6		N.C., just place a test point on board
22	VREF2G	Analog IO	Accelerometer common end
23	GSB	Analog IO	Differential input from accelerometer
24	GSA	Analog IO	Differential input from accelerometer
25~29	EPAD	Supply	Ground

Package Dimensions

24 GSA
23 GSB
22 VREF2G
21 TP6
20 TP5

1 VSS2
2 LFA
3 LFB
4 TESTN
5 TP1
6 TP0
7 GPIO2

EPAD

SENASIC
SNP705X

19 TP4
18 VREF1
17 VDD
16 XTAL
15 VDDP
14 RF
13 VSSP

8 GPIO1
9 GPIO0
10 TP2
11 VREG
12 TP3
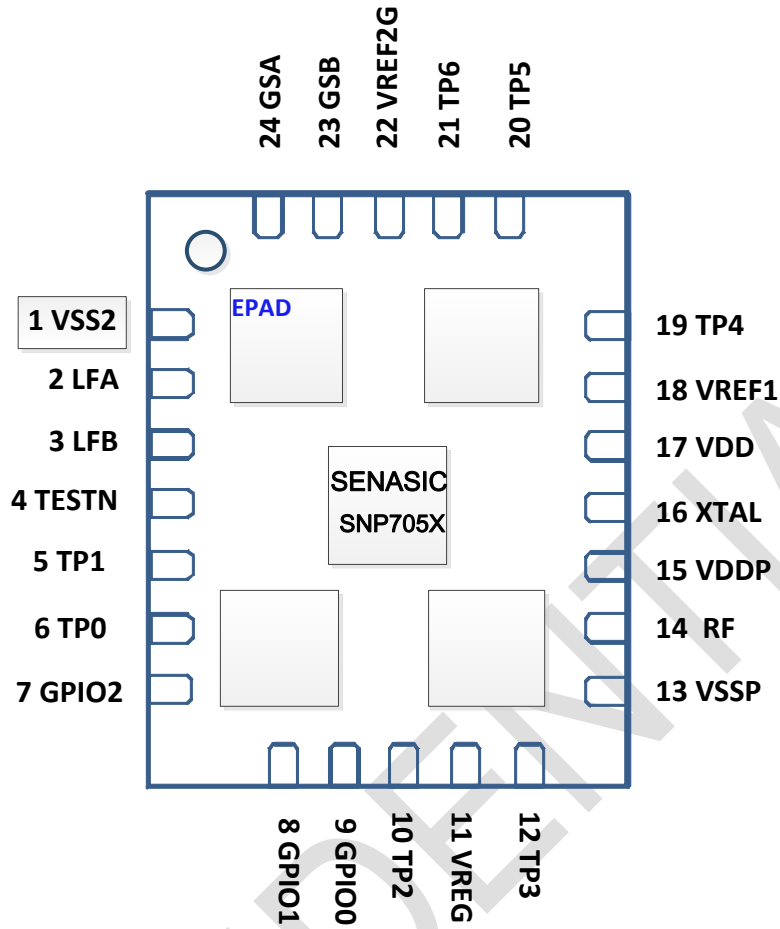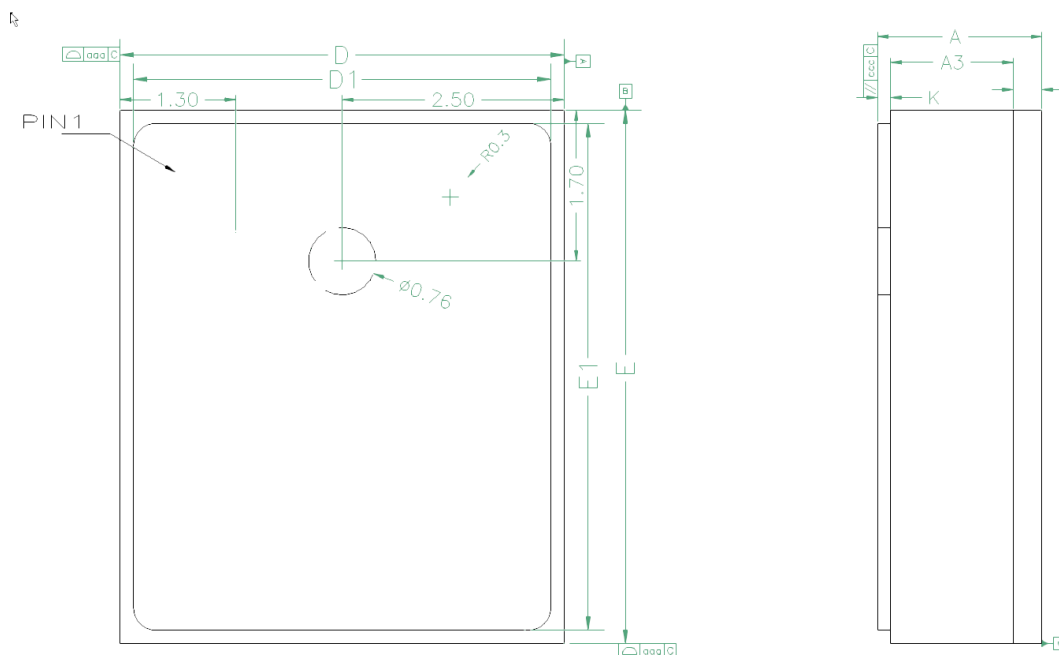
SIDE VIEW

BOTTOM VIEW

MILLIMETER			
SYMBOL	MIN	NOR	MAX
A	1.75	1.85	1.95
A2	0.27	0.32	0.37
A3	1.33	1.38	1.43
K	¬¬	0.15	¬¬¬
D	4.90	5.00	5.10
D1	4.65	4.70	4.75
E	5.90	6.00	6.10
E1	5.65	5.70	5.75
e	BSC 0.6		
aaa	0.10		
ccc	0.05		

Application Circuit
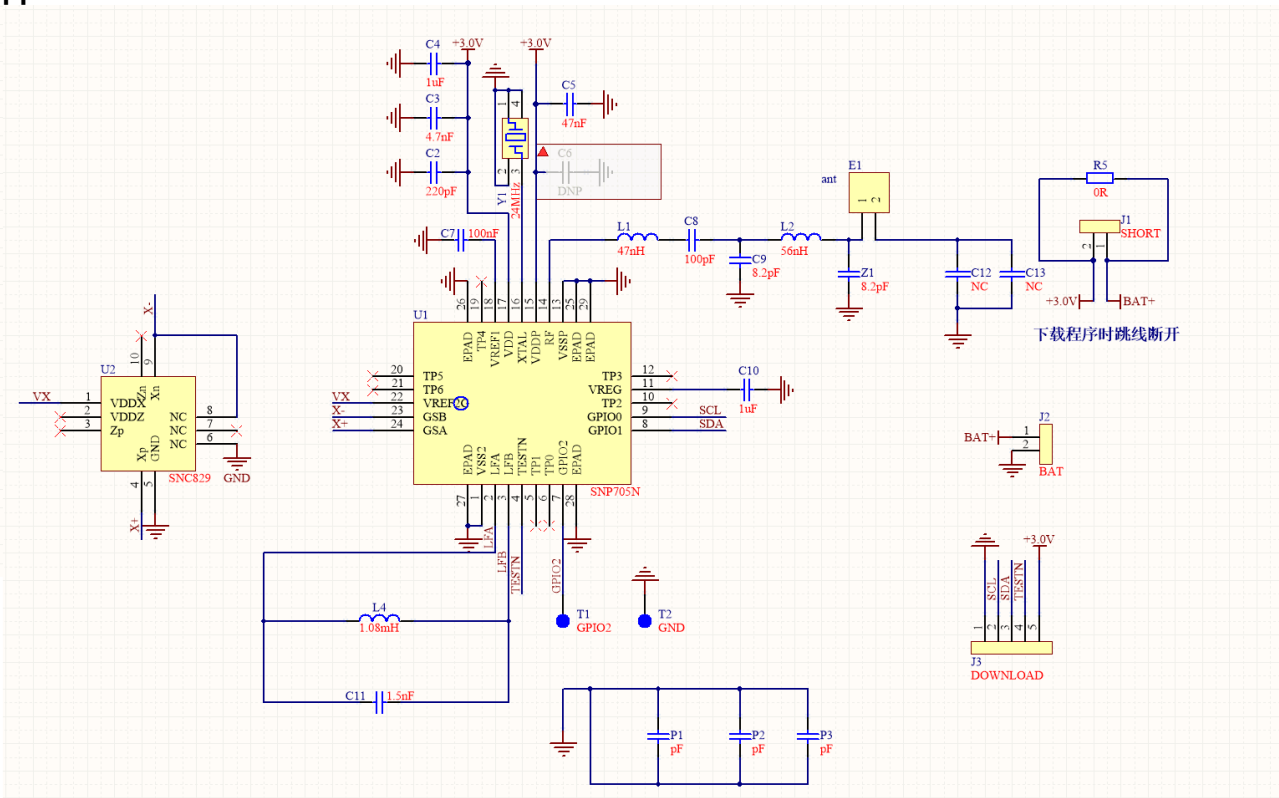
Note：1 L1/L2/C8/C9 value might be changed according to different antenna ，P1/P2/P3 is for loop antenna design.

2 SNC829 is a dual axis accelerometer that designed by SENASIC ,it is specialized designed for TPMS application