SNJ306 DATASHEET

V1.0

Description

The SNJ306 is a highly integrated sensor interface chip that integrated very low power MCU,RF and sensor interface unit ,designed for automotive(TPMS or other applications) /industry/IoT applications

Applications

• Tire Pressure Monitoring System

• Liquid/air pressure sensor

• Other industrial and agricultural monitoring application

.....

Features

• Interfacing pressure sensor for ambient pressure measurement

• Temperature and supply voltage sensor

• 8051 based microcontroller

• Standby current 0.25uA

• RF Transmitter 433MHz/315MHz integrated, 0~10 dBm adjustable with low power consumption

• Support 125K LF wireless programming

Main Feature

RF			Comment
Frequency		315 / 433.92	MHz – programmable about centre freq
PA		On chip	0 ~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
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		QFN 24Pin	SIP (System In Package)
Supply Voltage		2.1~3.6	Volts

Functional Description:

SNJ306 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 G sensor while the pressure readings are obtained by using an external pressure sensor.

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 ASIC 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 consumption 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 ASIC and the calibration data for the sensor. Additionally flash embedded library functions developed by SENASIC covers standard tasks used by the application.

Block diagram

Brown out detector
POR
Reset handler

1/2/4 MHz RC
32K RC
12/24MHz XTAL
Clock controller

XTAL
XGND

Microcontroller
RAM 256B | FLASH 16K
8051 CPU
External SFR control

CHIP_TOP

pressure Sensor

Diff gain | 12-bit ADC | ADC FSM
Temp sensor | Band gap
VREF and fsel DAC | ADC

Peripheral
CRC | Time1/2/3 | GPIO
Pseudo random Generator | I2C interface

System control
Power mangament
TMAX Detector
Wakeup logic
Watchdog timer

Manchester and Bi-Phase Encoder | PLL | RF Power Amplifier
ASK Modulator | FSK Modulator
UHF Transmitter

PA
PGND

Analog frontend | Carrier detector | Digital Baseband
125KHz LF Receiver

G Sensor

Roll Detect
Status Judge

Low power VREG | Low Battery monitor
Voltage manage

VCC

SNJ306 Functional Diagram

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	TESTN, GPIO0, GPIO1, GPIO2, EXCLK	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	
Input and Output Current (digital IO pins)	$I_{io,dig}$	-10	—	+10	mA	GPIO0, GPIO1, GPIO2	1.13
Input Current	I_{in}	-10	—	+10	mA	LFA, LFB	1.14
		-10	—	+10	mA	EXCLK	
		-10	—	+10	mA	XTAL	
		-10	—	+10	mA	TESTN	

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.			
Input Pres Range	P_{in}	100		700	KPa	T = -40…125℃ V_{bat}=2.1….3.6V	3.1
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
Pres Measurement Stability Range	P_{sta}	-2.75		2.75	KPa	Minimum 95% of the measurement	3.9

1)　Based on pressure sensor model of Amphenol NPP301

Table 6　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
		-4	—	+4	℃	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 7   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

Table8   Supply Currents

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note/Test Condition	Num.
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 8.1   Supply Currents(cont'd)

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note/Test Condition	Num.
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 9 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	+/-40		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 10 LF Receiver Characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note/Test Condition	Num.
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}			5	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℃	
				1.2	mVpp	DR_{LF}=3.9KHz, 100% modulation depth, -40℃ to 125℃	10.13

Table 12   Crystal Oscillator

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Crystal frequency range	f_{XTAL}		24		MHz	12MHz optionally	12.0
Crystal tolerance		-50		+50	ppm		
Crystal load capacitance			6		pF		12.2
Crystal Oscillator startup time	t_{XTAL_start}			1	ms		12.1

Table 16   Power On Reset

Parameter	Symbol	Values			Unit	Note/Test Condition	Num.
		Min.	Typ.	Max.			
Power on reset level	V_{POR}	0.3		1.7	V	Measured at Pin V_{bat}	16.1
Power on reset release level	V_{THR}	1.5		1.7	V	Measured at Pin V_{bat}	16.3
Power on reset time	t_{POR}			15	ms		16.4

Table 4   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	Maximum ESR Ohm	17.6

Table 5   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 19   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$_{write}$	100			cycles	Programming/erase cycles per wordline	19.3
Flash line write time	t$_{write\_line}$				ms		19.5

Table 20   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 22 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}			0.35	V	I_{OL}=4mA	22.3
Output High voltage	V_{OH}	V_{bat}-0.35			V	I_{OL}=4mA	22.4
Digital Pin Output Current	$I_{in,DIG}$	-4		4	mA	Programmable	
Digital Pin Input Capacitance	$C_{in,DIG}$			10	pF		22.6

Table 23 I^{2}C Interface

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

Pin Assignment Table

Pin	Name	Type	Function

1	VSSP	Supply	Ground
2	RF	Analog out	RF output.
3	VDDP	Supply	Battery supply
4	XTAL	Analog IO	XTAL pin(12/24MHz)
5	VDD	Digital IO	Battery supply
6	VCAP	Analog IO	ADC reference voltage, 100nF to ground
7	VREF1	Analog Out	the driving voltage for external sensor
8	SB1	Analog In	Negative input from the pressure sensor
9	SA1	Analog In	Positive input from the pressure sensor
10	VREF2	Analog Out	the driving voltage for external sensor
11	SB2	Analog In	Negative input from the pressure sensor
12	SA2	Analog In	Positive input from the pressure sensor
13	VSS2	Supply	Ground
14	LFA	Analog IO	LF channel coil connection
15	LFB	Analog IO	LF channel coil connection
16	GND	Supply In	Ground
17	TESTN	Digital In	Active low, test mode entry. Pull down by default
18	TEST1	Digital out	Test mode output
19	GPIO2	Digital IO	GPIO / Test mode output
20	GPIO1	Digital IO	GPIO / I2C data
21	GPIO0	Digital IO	GPIO / I2C Clock
22	TEST0	Digital out	Test mode output
23	GND	Supply	Ground
24	VREG	Supply	Supply

Package Dimensions

PIN 1 DOT
BY MARKING

TOP VIEW

SIDE VIEW

A

A1

A3

e

b

PIN #1 IDENTIFICATION
MOUSEBITE 0.2MM

E2

D2

L

BOTTOM VIEW
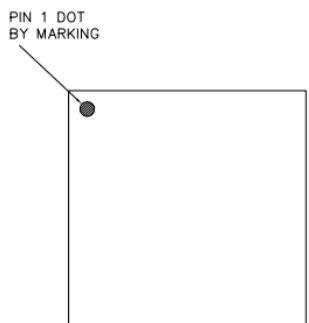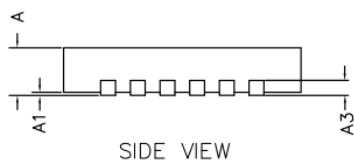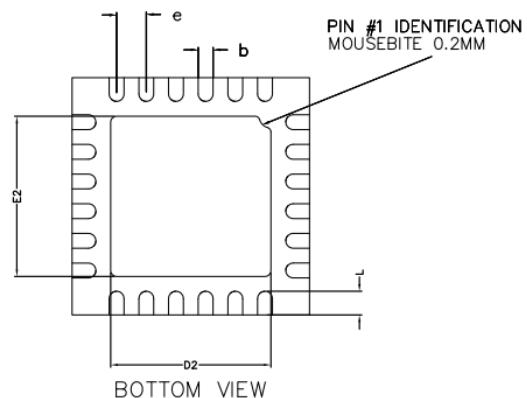
COMMON DIMENSIONS(MM)		
PKG.	W: VERY VERY THIN		
REF.	MIN.	NOM.	MAX
A	0.70	0.75	0.80
A1	0.00	–	0.05
A3	0.2 REF.		
D	3.95	4.00	4.05
E	3.95	4.00	4.05
b	0.18	0.23	0.28
L	0.30	0.40	0.50
D2	2.55	2.70	2.80
E2	2.55	2.70	2.80
e	0.50 BSC		

Typical Application Circuit
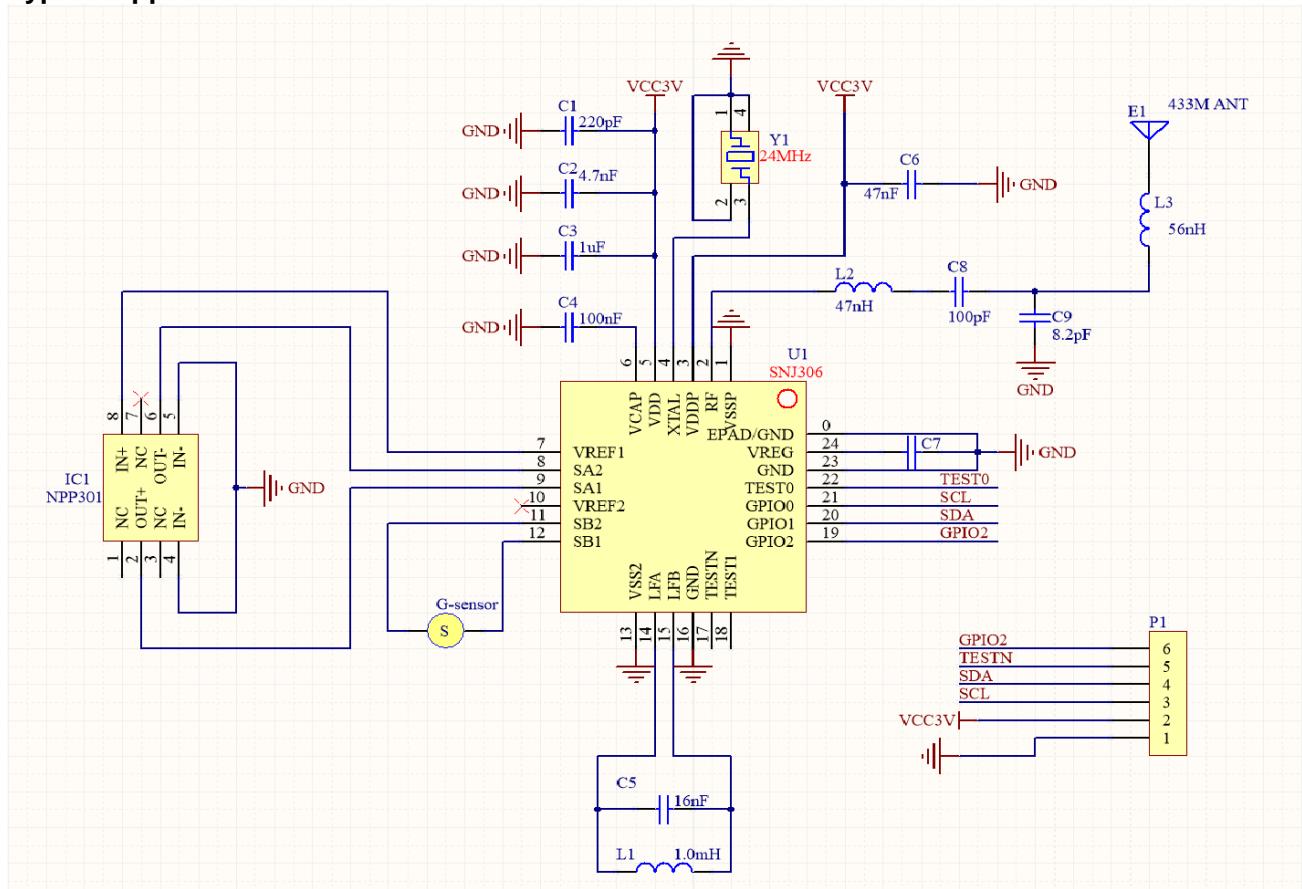
Note：
1 L2/L3/C8/C9 value might be changed according to different antenna .
2 NPP301 is an external Pressure Sensor.