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For Car Navigation System

XV-8000CB and XV-8000LK

Application Manual

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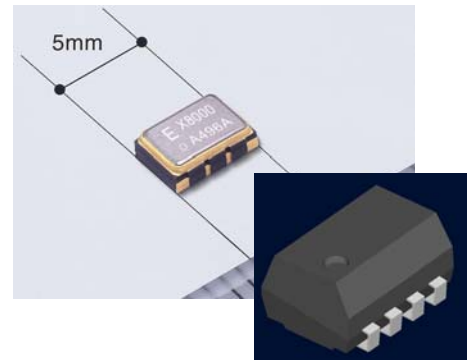
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- This manual is not the delivery specifications. Please do the taking exchanging of the specifications formally when you use this product as our company.

Ultra small package Gyro Sensor for Car Navigation System XV-8000CB/LK Specifications

XV-8000LK Under development

Ultra small package size SMD(5.0 x 3.2 x 1.3 mm)
5V operating voltage (ratio metric output)
Inclined detection (10deg., 20deg.) : XV-8000LK
High stability using with crystal element
Lead(Pb)-free : Lead free completely



Recommended Application Car navigation systems

1) Absolute maximum rating

Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Input Voltage	V _{IN}	-0.3V		+7.3V	
Storage Temperature	T _{STG}	-40°C		+85°C	

2) Operating condition

Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Supply Voltage	V _{DD}	4.75V	5.0V	5.25V	VSS=0V
Operating Temperature	T _{OPR}	-40°C		+85°C	
Output current		-0.1mA		+0.1mA	

3) Electrical characteristics

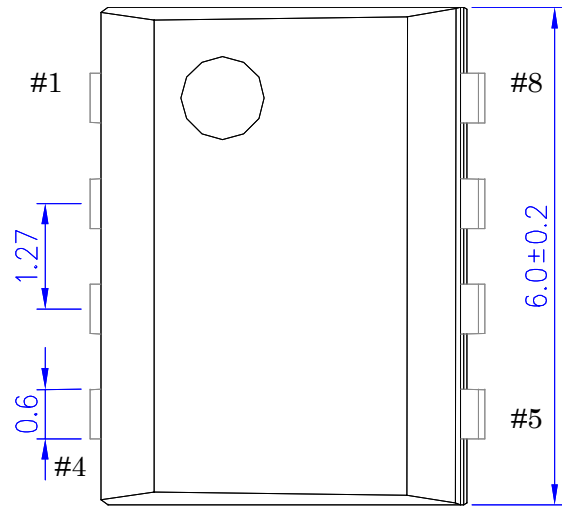
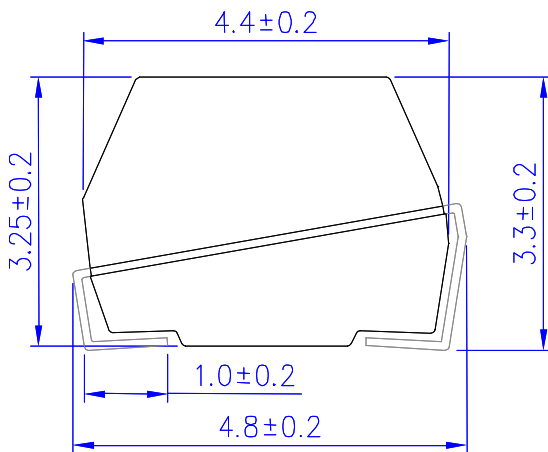
Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Drive Frequency	f _d		50.3kHz		
Scale factor	S _o		25mV/deg/s		
Initial scale factor tolerance	S _p			+/-4%	Ta=+25°C
Scale factor temperature sensitivity	S _{pt}			+/-3.5%	Based +25°C, VDD=5.0V
Bias 0 point output	V ₀		1/2VDD		Ta=+25°C
Bias variation with temperature (0 point output variation with temp.)	V _{0t}			+/-10%	Based +25°C, VDD=5.0V
Input rate limits	I	-60deg/s		+60deg/s	
Linearity error	NI			+/-0.5% FS	Ta=+25°C
Band width	BW		10Hz		Phase delay angle 90°
Cross axis sensitivity	OS			+/-5.0%	Ta=+25°C
Current Consumption	I _{op}		4mA		V _o : output No load condition
Output noise	r _N		3mV p-p		
Turn-on time	T _{act}			500ms	Ta=+25°C, VDD=5.0V

4) Temperature sensor

Item	Symbol	Specifications			Remarks
		Min.	Typ.	Max.	
Temperature output voltage	V _{TEMP}		1.76V		Ta=+25°C
Output precision	T _{ACR}			+/-5°C	Ta=+25°C No Load
Temperature sensitivity	V _{SE}		-6.7mV/°C		Ta=+25°C

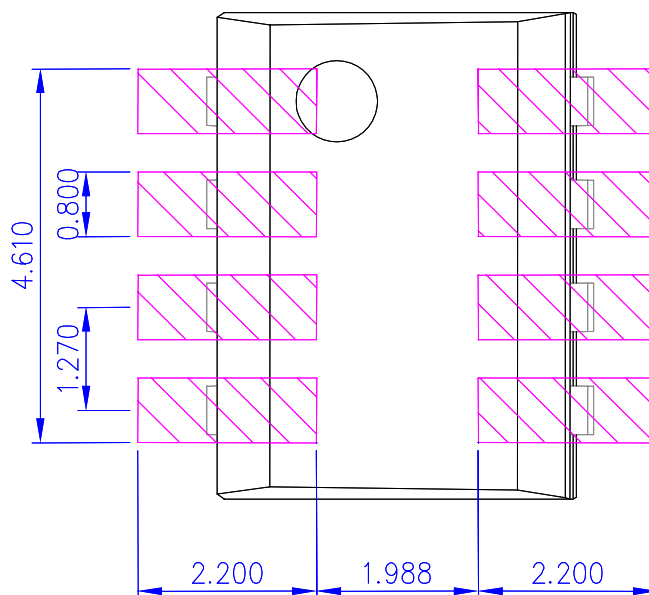
In this product, the temperature sensor output terminal exists.

XV-8000LK External dimensions



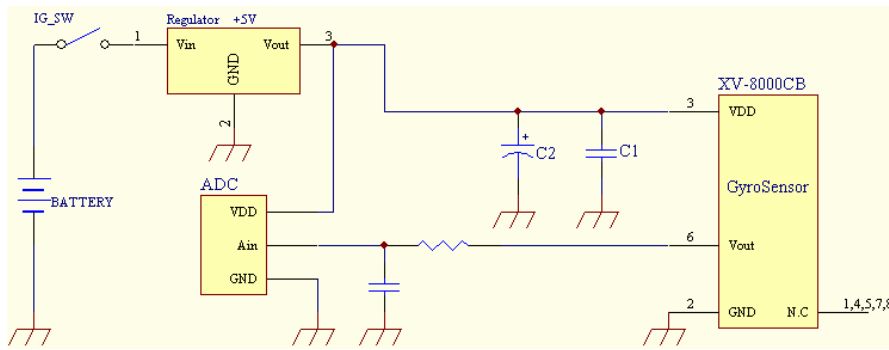
Pin No	Pin name	I/O	Function
1	NC	-	EpsonToyocom test pin. Please do not connect this pin.
2	GND	-	GND
3	VDD	-	Supply voltage
4	NC	-	EpsonToyocom test pin. Please do not connect this pin.
5	NC	-	EpsonToyocom test pin. Please do not connect this pin.
6	Vout	Output	Angular rate signal output
7	Vtemp	Output	Temp. voltage output. (Please do not connect this pin when you do not use this terminal.)
8	NC	-	EpsonToyocom test pin. Please do not connect this pin.

XV-8000LK Footprint (recommended)



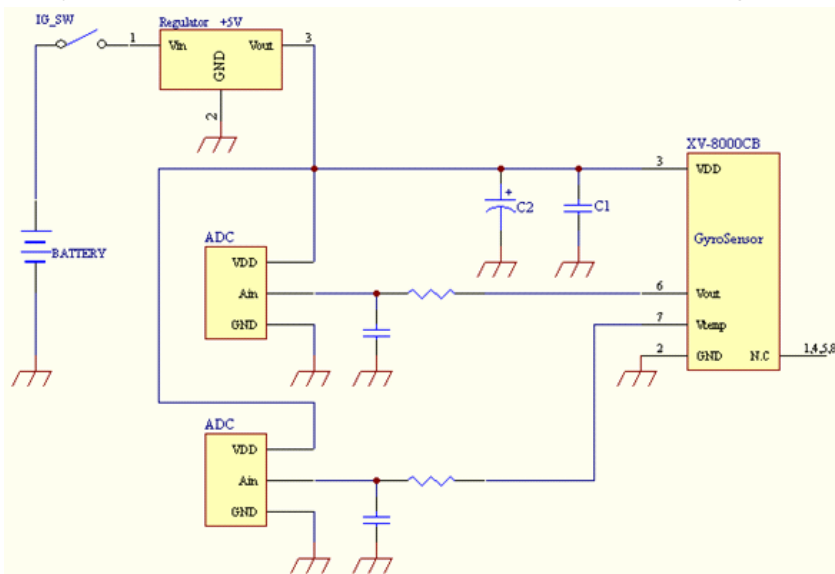
6) Recommended circuit

(1) Only using Gyro sensor output



- (1) C1: Bypass capacitor. Apply the bypass capacitor with 0.1 μ F or more and good high frequency characteristic, close to the terminal of the sensor. The ground terminal of the capacitor has to connect to analog ground using via holes.
- (2) C2: Power supply voltage back up capacitor. The sensor does not have a power supply back-up function, thus insert a back up capacitor. (recommended electrolytic capacitor with 47 uF to 100uF)
- (3) Use the same power supply(5.0V) for the sensor and A/D converter.
- (4) Do not connect NC terminals of the sensor on your electrical circuit board.

(2) Gyro sensor output and Temperature sensor output using



- (1) C1: Bypass capacitor. Apply the bypass capacitor with 0.1 μ F or more and good high frequency characteristic, close to the terminal of the sensor. The ground terminal of the capacitor has to connect to analog ground using via holes.
- (2) C2: Power supply voltage back up capacitor. The sensor does not have a power supply back-up function, thus insert a back up capacitor. (recommended electrolytic capacitor with 47 uF to 100uF)
- (3) Use the same power supply(5.0V) for the sensor and A/D converter.
- (4) Do not connect NC terminals of the sensor on your electrical circuit board.
- (5) Use the load resistance for Vtemp terminal with 2M Ω or more.
(Please inquire about the characteristic of the temperature sensor.)

The characteristics of the recommended circuits are not warranted.

When you will design the recommended circuits, be sure to confirm before use in your company.

* If not specifically indicated, GND=0 V, VDD=1.6 V to 5.5 V

7. Temperature sensor characteristics

, Ta= -40 °C to +85 °C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Temperature output voltage	VTEMP	VTEMP pin, Ta=+25 °C, VDD= 2.7 V to 5.5 V GND based output voltage		1.76		V
Output precision	TACR	Ta=+25 °C, VDD= 2.7 V to 5.5 V			± 5.0	°C
Temperature sensitivity (*1)	VSE	-40 °C ≤ Ta ≤ +85 °C, VDD= 2.7 V to 5.5 V	-6.1	-6.7	-7.3	mV / °C
Linearity (*2)	ΔNL	-40 °C ≤ Ta ≤ +85 °C, VDD= 2.7 V to 5.5 V			± 2.0	%
Temperature detection range	TSOP	ΔNL ≤ ±2.0 %, VDD= 2.7 V to 5.5 V	-40		+ 85	°C
Output resistance (*3)	RO	VTEMP pin, Ta=+25 °C, VDD= 2.7 V to 5.5 V GND standard and VDD standard		1.0	3.0	kΩ
Load condition	CL	VDD= 2.7 V to 5.5 V			100	pF
	RL	VDD= 2.7 V to 5.5 V	500			kΩ
Response time	trSP	VDD= 3.0 V, CL=100 pF, RL=500 kohm, within +/- 1 °C			200	us

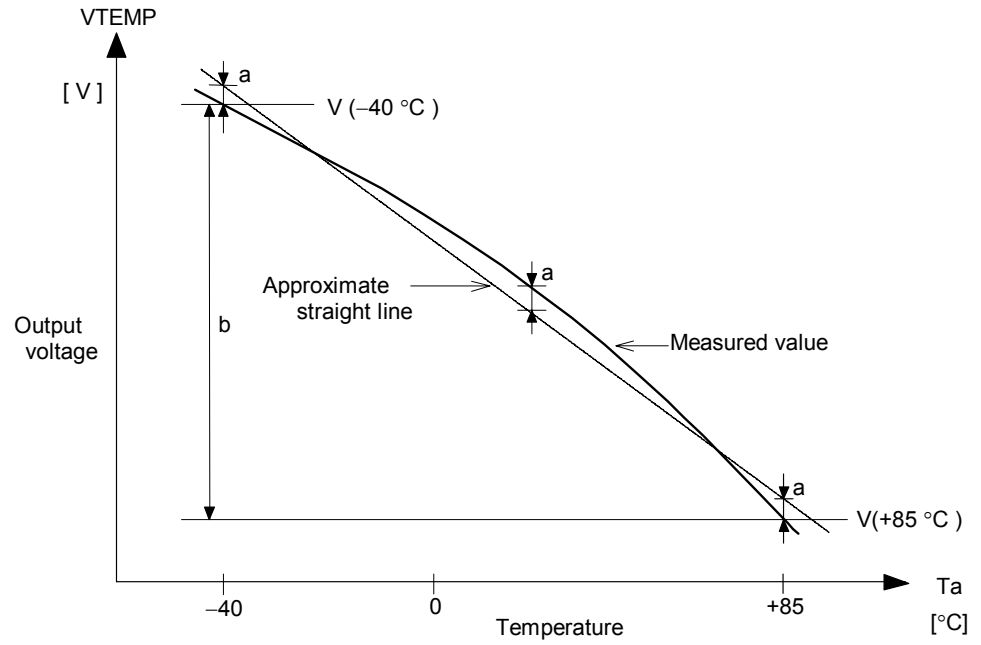
*1) Temperature sensitivity

$$VSE = (V(+85\text{ °C}) - V(-40\text{ °C})) / 125 \quad [\text{mV} / \text{°C}]$$

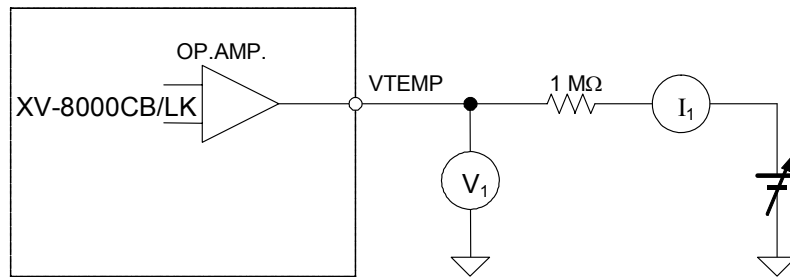
*2) Linearity

$$\Delta NL = \frac{a}{b} \times 100 \quad [\%]$$

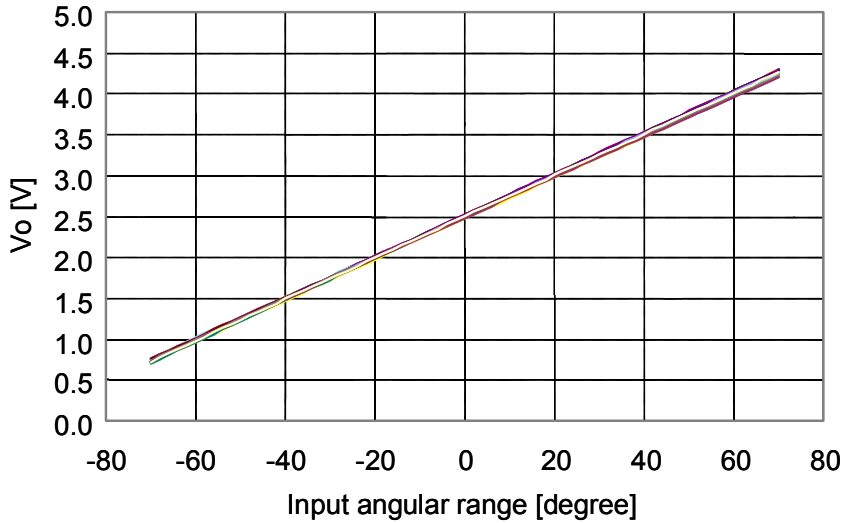
a : Maximum deviation between the measured value of VTEMP and the approximate straight line
 b : Difference between the measured values at -40 °C and +85 °C



*3) Output resistance (R_o)
$$R_o = \frac{\Delta V_1}{\Delta I_1}$$

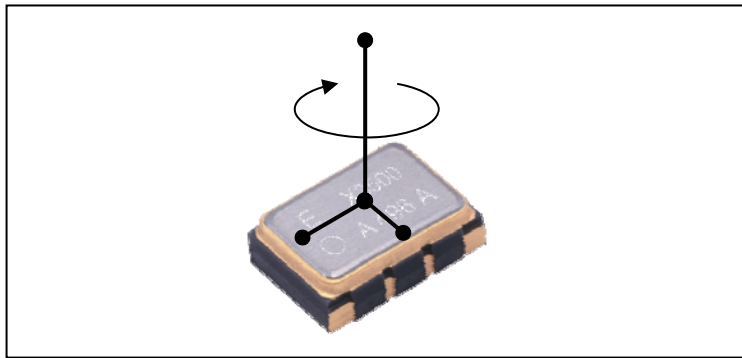


8) Input rate limit



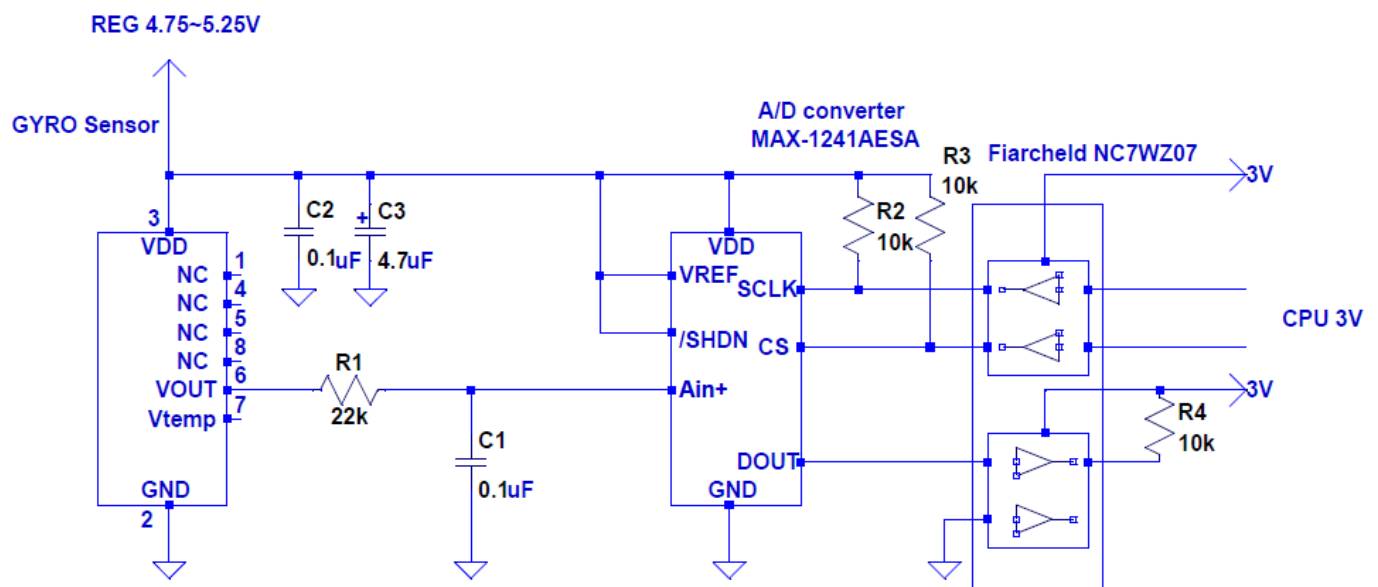
9) About detection axis

Detect direction is shown as in the following figure. Please mount carefully to detect direction.



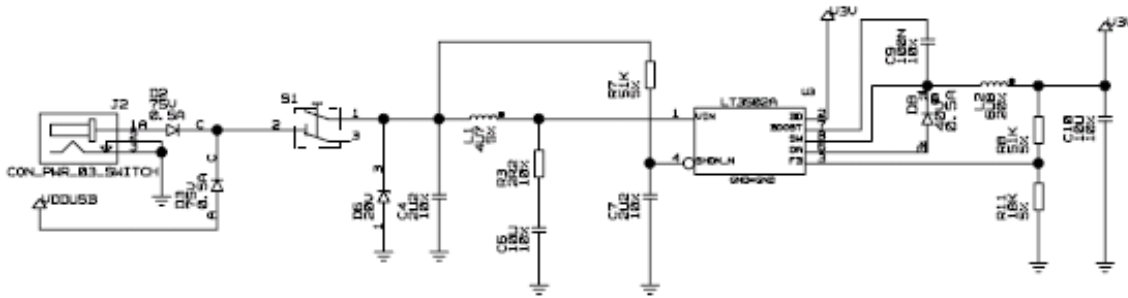
9) For example Application Circuit

Retiometric. ADC MAX1241 sampling 100Hz.

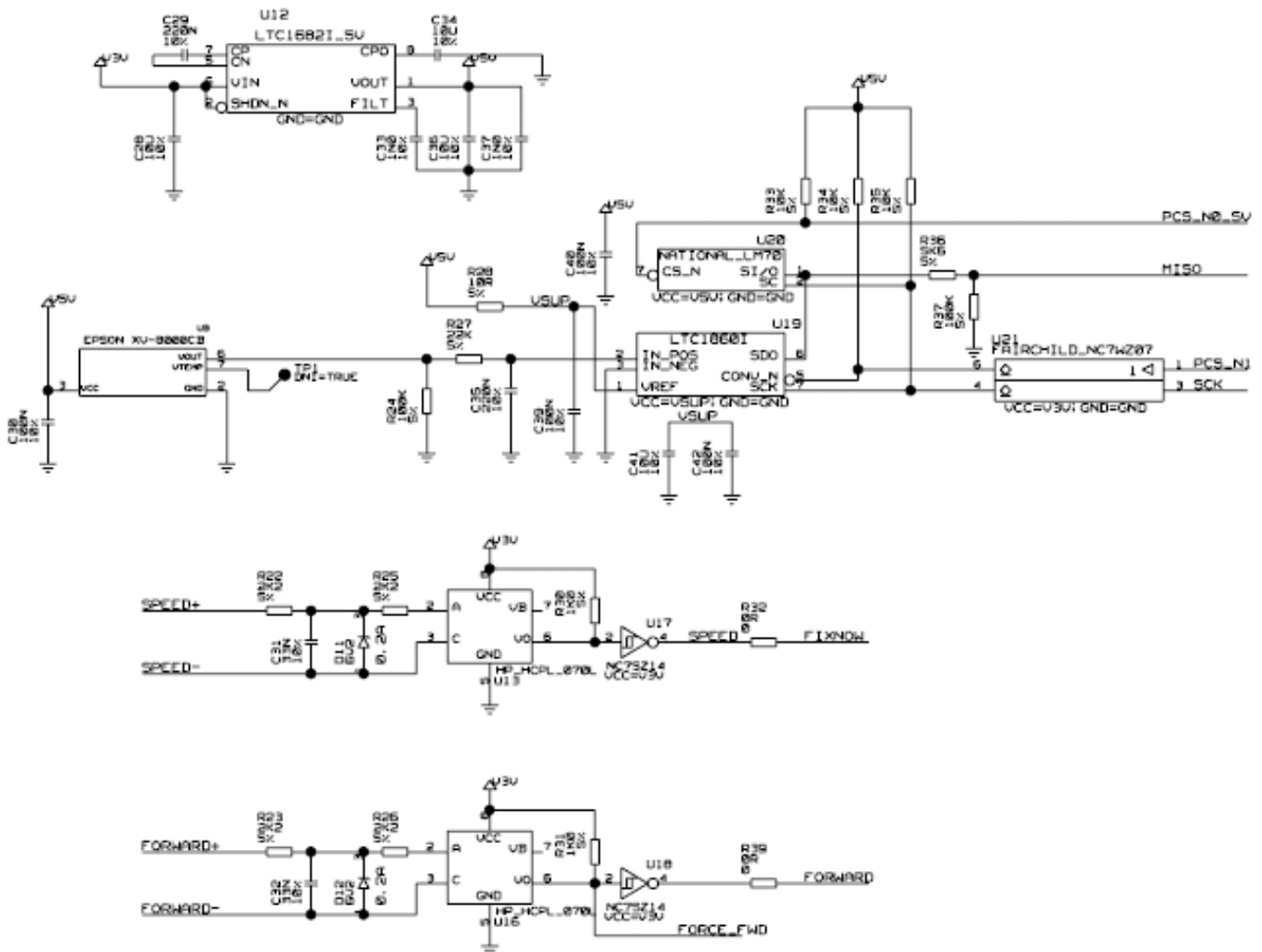


For Example Dead-Reckoning circuit. Including 12V-3V circuit, 3V-5V convert and speed Sensor.

(1) 12VDC->3VDC



(2) 3V-DC->5VDC



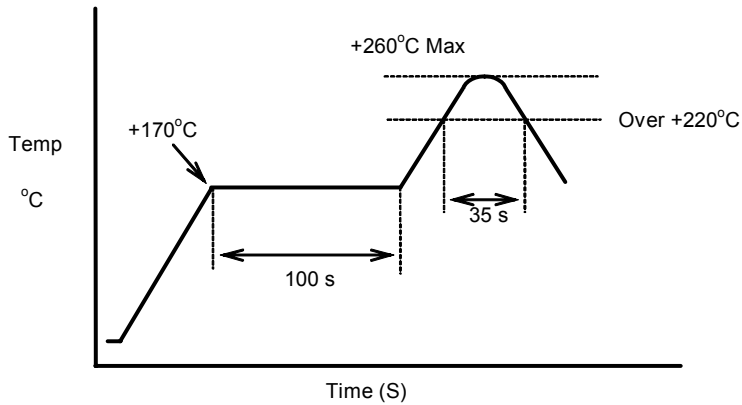
10) Reflow profile

Heat testment condition of reflow oven

Preheating temperature: +170 °C Preheating time: 100 s

Heating temperature: +220 °C Heating time : 35 s

Peak temperature must not exceed +260 °C.



11) Recommended Reference EVA-KIT with DeadReckoning.

(1) Trimble LassenDR-GPS http://www.trimble.com/lassendrgps_ts.asp

(2) U-Blox ANTARIS4 http://www.u-blox.com/products/aek_4r.html

(3) SiRF DRive <http://www.sirf.com/products/GSC3LPPProductInsert.pdf>

12) Handling precautions

1. Handling our gyro sensor

- (1) This crystal product is designed in consideration of shock resistance. However, it may be destroyed by the conditions of a shock. In case product is dropped, and too much shock are added, please be sure to check the characteristic.
- (2) If too much shock is added when a crystal product is mounted automatically, it will lead to change or degradation of the characteristic (In the case of product adsorption, chucking, and substrate mounting) Therefore, please set up the conditions that a shock is small if possible. Please be sure to test before use in your company, and check that there is no influence in the characteristic. Please confirm similarly at the time of condition change. Please be careful after mounting for a crystal product to collide neither with a machine object nor other substrates at the time of mounting.
- (3) This product contains the circuit that protects static electricity destruction. However, if static electricity is added superfluously, IC may break. Therefore, packing and the container to carry should use a conductive thing. Moreover, a soldering iron and a measurement circuit should use a thing without high-voltage leak, and work should take the measures against static electricity.
- (4) Please do not use it under the environment where the short-circuit between terminals of condensing is generated.
- (5) Please keep a gyro sensor by normal temperature and normal moisture. Refer to the packing standard document for the management method of a packing state.

2. About washing

- (1) Ultrasonic washing may lead to destruction of a crystal. Our company cannot guarantee it. When used unavoidably in your company, be sure to confirm before use in your company.

3. About soldering

- (1) Reflow is to 2 times. Please use soldering iron, when there is a soldering mistake. In this case, 350 degrees C or less and the conditions for less than 3 seconds are required.
- (2) We will recommend the substrate to be designed by the footprint that our recommends.

4. About Gyro sensor layout

- (1) This product has the noise of the same frequency as drive frequency. Therefore, it is necessary to remove in a suitable filter circuit.
- (2) Please confirm the vibration absorption the influence, when there is a resonance point in the place where the sensor is installed or an excessive vibration joins the sensor.
- (3) Another high level signal line may cause irregular output, Please take care to design output line is as short as possible, and also keeps high level signal source away from this device.
- (4) Even if this sensor approaches and operates, it does not interfere in it in sound. However, it may interfere by the common impedance of a power supply. Please be sure to check in your company.
- (5) Please do not arrange the Gyro sensor in the place where a rapid temperature change is generated.

5. Other

- (1) This Product is the designed one in the car navigation usage.
- (2) These products are intended for general use in electronic equipment. When using them in specific applications that require extremely high reliability, such as the applications stated below, you must obtain permission from EPSONTOYOCOM in advance.
 - /Space equipment (artificial satellites, rockets, etc.)
 - /Transportation vehicles and related (automobiles, aircraft, trains, vessels, etc.)
 - /Medical instruments to sustain life /Submarine transmitters
 - /Power stations and related /fire work equipment and security equipment
 - /Traffic control equipment /and others requiring equivalent reliability.

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