

Ultrasonic Range Sensor (URS) - Preliminary

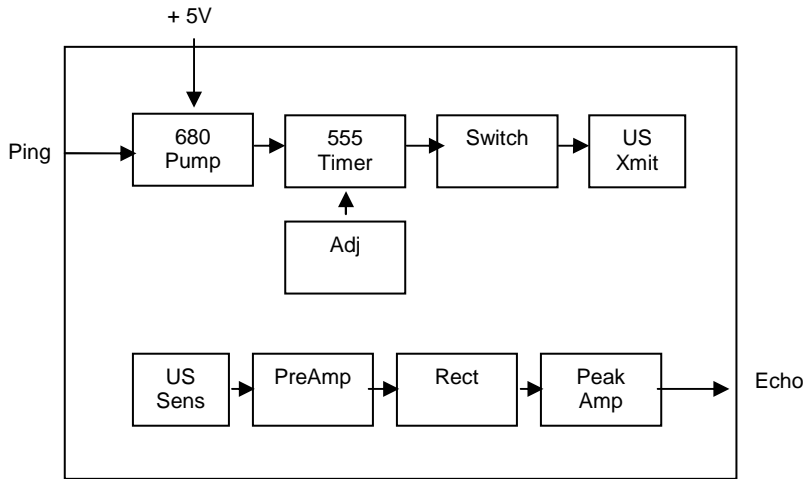
The Multi Motions Ultrasonic Range Sensor is a simple, yet versatile ultrasonic sensor that may be used for robotics and many other applications.

The sensor consists of a piggyback board for the Multi Motions Universal Processor Board (UPB) that interacts directly with this board and may be plugged into the bus. A total of 8 URS sensors may be connected to the UPB. Every URS consumes one A/D input and one pin on the D port.

Operation

The URS board is capable of operating in continuous mode and in echo mode. Continuous mode is used if a sonic beam is used that generates a signal when the beam is disturbed. Echo mode is when the sensor is used as a sonar device or when using it as a range sensor.

The URS consists of the following subcomponents:



The unit is powered by a single +5V source. A 680 charge pump is used to generate + and – 10V, used to power the amplifiers and Ultrasonic Transmitter voltage. The Ultrasonic Transmitter and Sensor operate at a frequency of 40 Khz. The Adjustment circuit is used to fine tune the 40 Khz signal to optimally match the transmitter/receiver pair. This is done in the factory and should not be adjusted.

A 40 Khz signal is generated by a 555 timer and the output is fed into a switching amplifier that boosts the voltage to 20V p/p and feeds this signal into the Ultrasonic transmitter.

An external Ping signal must be provided to generate approximately 8 periods. This signal is generated by the UPB. During a Ping, all input is suppressed. A jumper on the URS board may be used to generate a continuous Ping signal, allowing a continuous signal, used for applications where the through signal is used instead of an echo system.

The signal received by the sensor is first amplified to a level of approximately 1V p/p and then fed into a rectifier stage that makes it a +1V signal. This is then fed into a peak detection circuit that is finally amplified to the +5V level and fed into the A/D input of the UPB.

Depending on the mode, this signal is used to signal the presence of an object or it can calculate the position and size of the object.

Signals

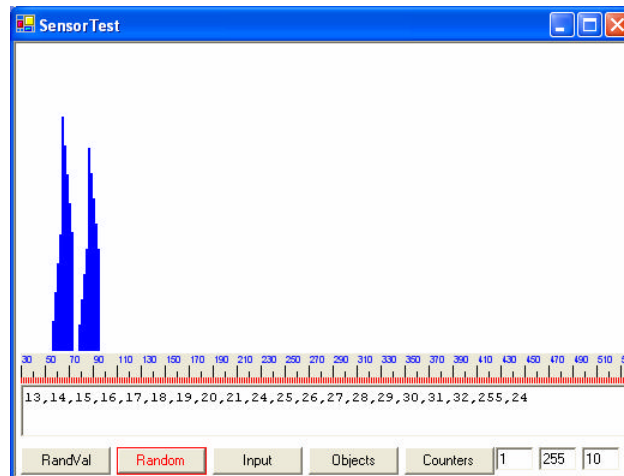
When operating in Echo mode, the UPB needs to send a pulse that activates the 40 kHz generator. The Ping signal is about 90 μ s. After that the echo is suppressed for about 200 μ s to allow the ping pulse to settle and to prevent short range echos. As a result any echo less than 10 cm cannot be detected. This short burst is later on detected as an echo and amplified. The UPB samples the incoming signal every 66 μ s, resulting in a resolution of about 2 cm. Because the Ping is about 8 pulses, any echo will be about the same size and therefore covers an area of 16 cm.

A threshold can be set in software. During processing of the echo signal, all echos below the set threshold are ignored. The UPB keeps a buffer in which every 2 cm tick will either record the number of silent ticks or records the level of that particular slot. A maximum buffer size of 64 bytes is kept. The total range, covered is 256 ticks after the first 16 cm, resulting in a total covered area of 512 cm.

At the end of the echo timing, the buffer is transmitted to the UPB, its contents depending on the mode that is set during initialisation. The following modes are supported:

1. *Continuous*. In this mode the average level of the entire period is returned. In most cases this will result in a value between 0 and 255.
2. *Test mode*. In this mode the entire buffer is transmitted for verification. Since this is the most uncompressed signal, a total of 64 bytes may be insufficient to transmit the entire echo signal.
3. *Compressed mode*. In this mode the peak value of each echo is returned, along with its position.
4. *Counter mode*. In this mode only the number of distinct echo's is returned.

A simple test program is provided that shows the contents of all transmitted signals. This may be used for development purposes or when calibrating the sensor.



This program continually monitors the incoming RS232 signal and graphically displays the incoming signals.

URS Board

The URS board is a small piggyback board that may be plugged into the UPB. This is generally only useful if only one sensor is used. If a range of sensors is used, they are usually connected to the UPB with a 4 wire cable, providing power and a Ping and Echo signal.



The board contains a bus connector area that may be used for a cable connector or the standard Multi Motions bus connector.

The Ultrasonic Transmitter and Receivers may be soldered onto the board directly in either a horizontal or a vertical position, or may be connected through a cable.

Interfaces

The table underneath shows the UPB bus connections, required to use one sensor. Every additional sensor requires extra connections, that need to be provided, using a cable to the UPB.

UPB Bus Pin	UPB	Signal	Descr
25	RC5	SDI	SPI Data in
27	RC4	SDO	SPI Data out
23	RC3	SCK	SPI Clock
18	RD0	ADCS	A/D converter magnetic sensor SPI select
22	RD2	MS S/R	Magnetic sensor set/reset pulse
20	RD1	CAN CS	CAN interface SPI select
11	INT/RB0	CAN INT	CAN interrupt
9	RB1	CAN RS	CAN reset
21	CCP1/RC2	MS X	Motion sensor X counter input
19	CCP2/RC1	MS Y	Motion sensor Y counter input
24	RD3	MS H/V	Motion sensor Hor / Vert select
17	RC0	MS RS	Motion sensor reset

Versions

The following versions are available:

Code	Omschrijving	Prijs
0	Standard version	

All piggyback boards use the standard 32 pin UPB bus. Underneath the bus connections are listed for completeness.

Bus Pin	Bus ID	Proc Pen	Descr	Alt Function	Bus Pin	Bus ID	Proc Pin	Descr	Alt Function
1	Vcc		+5v Reg		2	AD0	RA0		
3		RA4	T0CKI – Timer 0		4	AD1	RA1		
5	Int	RB0	Int		6	AD2	RA2	Vref-	
7	LD1	RB1		Led Red	8	AD3	RA3	Vref +	
9	LD2	RB2		Led Yel	10	AD4	RA5	SS	Slave Select
11	LD3	RB3		Led Grn	12	AD5	RE0		PSP RD
13	SW0	RB4		Switch 0 / RB6 = SW2	14	AD6	RE1		PSP WR
15	SW1	RB5		Switch 1 / RB7 = SW3	16	AD7	RE2		PSP CS
17	TIM1	RC0	T1OSO/T1CKI	Timer1 I/O	18	RD0	RD0		PSP0
19	PWM2	RC1	T1OSI/CCP2	Timer1 I / Capt2 / PWM2	20	RD1	RD1		PSP1
21	PWM1	RC2	CCP1	Capt1 / PWM1	22	RD2	RD2		PSP2
23	SPIC	RC3	SCK/SCL	SPI / I2C Clk – USB Clk	24	RD3	RD3		PSP3
25	SPII	RC4	SDI/SDA	SPI / I2C Data – D-USB	26	RD4	RD4		PSP4
27	SPIO	RC5	SD0	SPI Data out – D+ USB	28	RD5	RD5		PSP5
29	nc				30	RD6	RD6		PSP6
31	Vss		Ground		32	RD7	RD7		PSP7

For additional information, please contact:

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