MEASUREMENT SPECIALTIES

Application Specification 21-02

PRELIMINARY

80 kHz Cylindrical Ultrasound Transducer
US80KS-01

29 DEC 03 Rev 1

DESCRIPTION

Piezoelectric film (PVDF) ultrasound transducers offer unique advantages for air ranging applications. Cylindrical 80kHz PVDF transducers exhibit omni-directional horizontal beam directivity and broadband characteristics. These characteristics lend unique solutions in many applications such as two-dimensional positioning, digitizer, object detection, and distance measurement. Depending on the applications, resonance frequency and vertical beam directivity can easily be customized by changing the diameter and length of the PVDF cylinder. PVDF ultrasound transducers also have very low resonance "Q" values. This means that the signal rise and decay times are much shorter than conventional ceramic ultrasound transducers. This characteristic is ideal for positioning applications.

Model No.	Part No.
US80KS-01	1005919-1

APPLICATIONS

- Distance measurement
- Object detection
- Position detection
- Digitizers
- Ultrasonic mouse

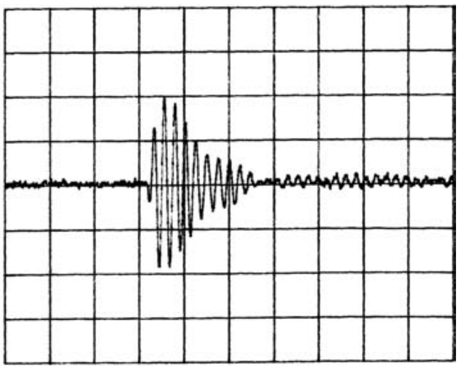
FEATURES

- Omni-directional horizontal beam directivity
- Broad bandwidth
- Low Q resonance
- Excellent impact resistance
- Lightweight
- Low cost

SPECIFICATIONS (1)

Characteristics	Transmitter Mode	Receiver Mode	Units
PVDF Thickness	30	30	μm
Resonance Frequency	80 - 100	80 - 100	kHz
Resonance Q (2)	4 - 9	4 - 9	
Sound Pressure Output (3)	6		mPa/V
	102		dB
Sensitivity (4)		0.3	mV/Pa
		-90	dB
Horizontal Beam Directivity	360	360	Degree
Vertical Beam Directivity (5)	±25	±25	Degree
Capacitance	200	200	pF
Drive voltage	max 400 (6)		Vp
	max 100 (7)		
Storage Temperature	-20 to +85	-20 to +85	°C
Operating Temperature	+5 to +60	+5 to +60	°C

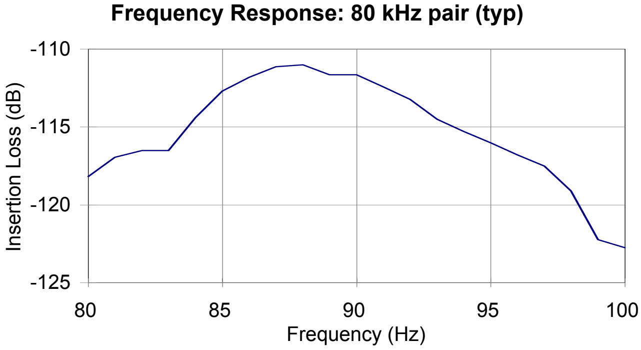
(1) Typical values
(2) Resonance Q may vary depending on receiver housing design
(3) Continuous drive. 0dB = 2 x 10^{-4} μbar (20 μPa) @30cm distance
(4) Continuous drive. 0dB =1V/μbar (10V/Pa)
(5) @ –6dB
(6) For burst drive
(7) For continuous drive



Typical time response of PVDF transmitter and receiver system

The plot at left shows the time-domain response obtained when one device is driven as a transmitter, and another is used as receiver at a distance of 30 cm. The drive signal comprised a single cycle at 400 V pk-pk. Receiver gain was +26 dB.

[Scale: time (X) 50us/div, amplitude (Y) 2mV/div]

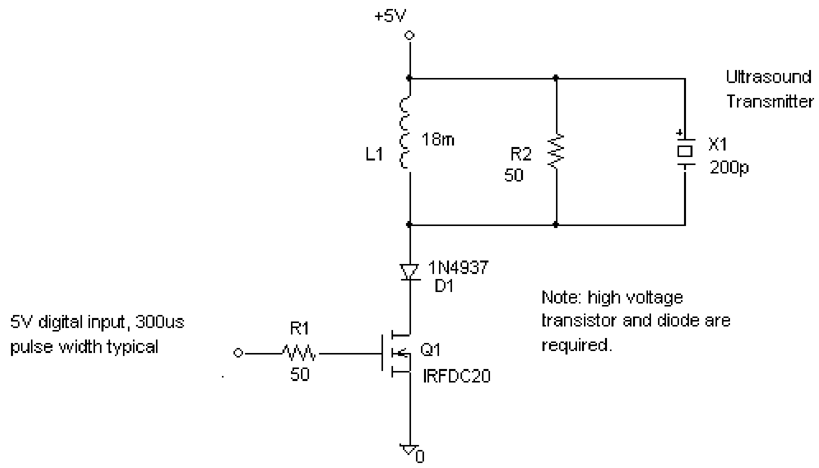


The above plot shows an estimate of the frequency response curve for two identical units, one driven as transmitter, the other acting as a receiver. The spectrum of the received signal was divided by that of the drive signal and gain stage, giving the overall insertion loss as a function of frequency (measured at 30 cm distance, in air).

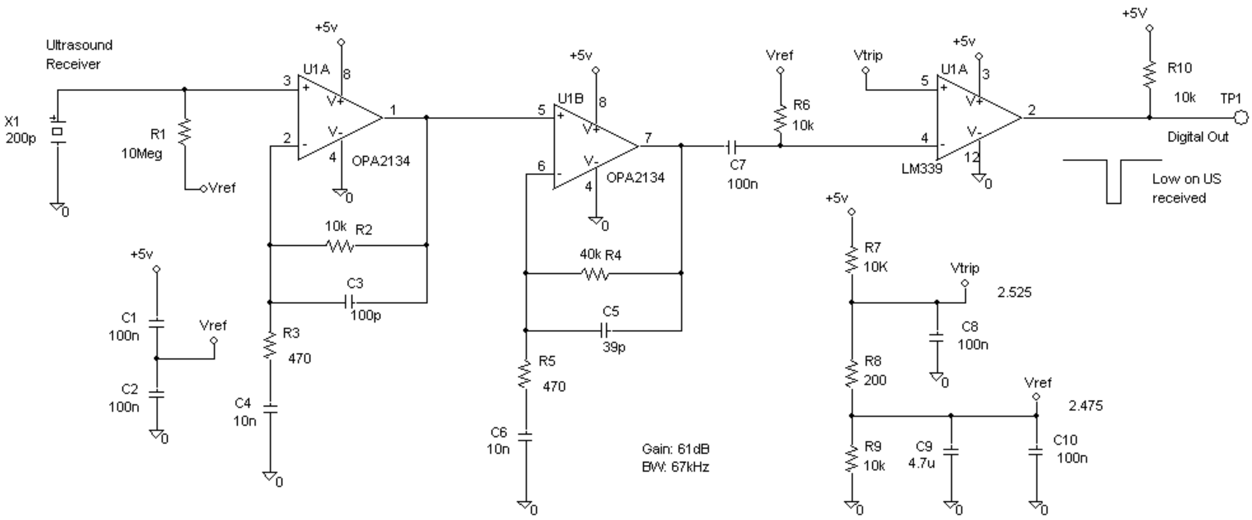
Note that the Q factor (center frequency divided by –6 dB bandwidth) for the complete system is very low: around 5.4 in the plot shown above. The minimum value of insertion loss was –113 dB, at 87 kHz. This means that a 1 V rms drive signal at this frequency would create a 2.2 μVrms response. Thus, higher voltage drive signals are preferred (see section entitled "Design Notes" below), and relatively high gain may be required in the receiver electronics.

Typical Interface Circuits

(a) Transmitter Drive Circuit Example



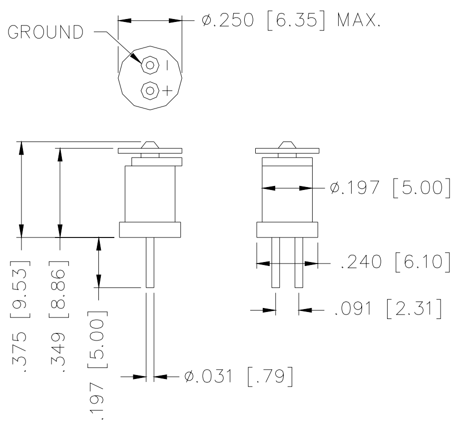
(b) Receiver Amplifier Circuit Example



Design Notes

- Transmitter sound pressure output is linearly proportional to the drive voltage.
- Maximum drive voltage for PVDF transmitter is 400 Vpeak for a single pulse and 100 Vpeak for continuous pulses.
- Operating frequency may be selected in the range 80KHz to 90KHz (low Q transducer).
- Shielding is necessary for the ultrasound receiver and preamplifier circuit to minimize electromagnetic pick-up. Make sure the outer electrode of PVDF receiver is grounded.
- Input capacitance of preamplifier should be less then PVDF receiver capacitance (200pF typical) to minimize loading effects.
- To maximize S/N ratio, a narrow band-pass filter is recommended. On the other hand, if the filter has too narrow a pass-band, signal strength may be decreased. An example of pass band is 70KHz - 100K.
- Selection of input resistance is important to maximize the S/N (10M ohm is used in the above preamplifier circuit example).
- Low noise amplifiers are recommended.

Outline Mechanical Dimensions



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