

November 2010

AKU2002C Digital Output Microphone

NOT RECOMMENDED FOR NEW DESIGNS. REFER TO AKU230**GENERAL DESCRIPTION**

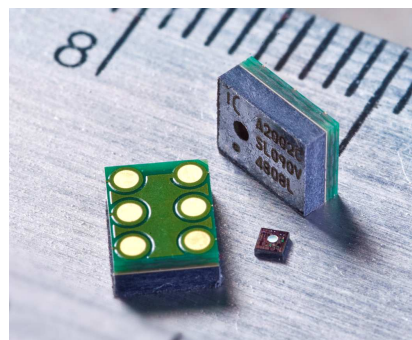
The AKU2002C is a surface-mountable CMOS MEMS Digital-Output Microphone which is ideal for use in microphone array applications where a high degree of noise immunity is required. The AKU2002C integrates an acoustic transducer, pre-amplifier, and a sigma-delta modulator on a single chip. The output of the microphone is pulse density modulation (PDM); a single-bit digital output stream that can be decimated by a digital filter in downstream electronics such as an audio CODEC, DSP, or baseband processor for a high degree of design flexibility and freedom.

The digital output is more robust than the low-level analog output signals of a standard ECM and therefore saves significant time and expense in system design and eliminates the dependence on shielded cables for signal routing. Additionally, the small form factor of the AKU2002C allows placement of the microphone in the acoustically optimal position in portable electronic devices. The AKU2002C therefore enables simple, robust design and a reduction of external components.

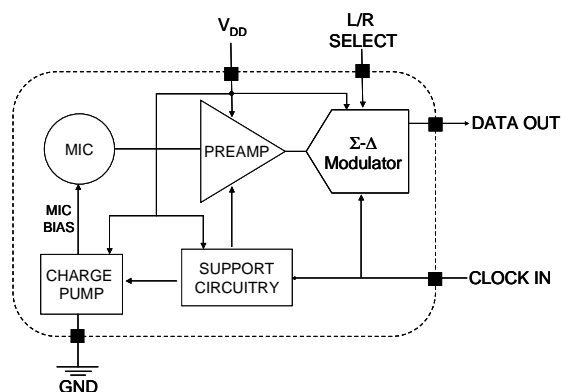
The tri-state output of the AKU2002C allows two microphones to be multiplexed together, thus allowing the two devices to share a single data line. The user can select which will be the left and the right microphones ($Data_L$ and $Data_R$) for multiplexing by applying GND or V_{DD} to the L/R select pin. During each full clock cycle, $Data_L$ and $Data_R$ are each valid for only half of the time, allowing the two separate sets of data to share one data line. To avoid overlap, one microphone enters a high impedance state before the other microphone's data becomes valid.

The AKU2002C will enter power-down mode when there is no clock input to the microphone, minimizing power consumption in battery powered applications.

The AKU2002C is ideal for microphone array applications where the two microphones will be used together to perform noise cancellation and/or beam steering. Additionally, the AKU2002C is suited for other portable applications requiring RF/EM noise immunity and low power including cell phones and digital cameras.

**FEATURES**

- High performance monolithic CMOS MEMS Digital-Output Microphone Chip with PDM (pulse density modulation) output
- Highly matched microphones in frequency and phase response for array applications
- Meets Microsoft Vista™ microphone array performance requirements
- Robust digital-output immune to RF/EM interference
- Output supports dual-microphone, single-wire multiplexing
- Industry standard microphone interface compatible with multiple CODECs
- Power down mode
- Lead-free surface mountable and RoHS compliant
- Thin profile, SMT packaging
- Drop-in replacement for AKU2002A/B
- Robust design for manufacturability

FUNCTIONAL BLOCK DIAGRAM

AKU2002C Datasheet

ABSOLUTE MAXIMUM RATINGS

Supply voltage, V_{DD} to GND	5.5V
ESD Tolerance	
Human Body Model	2000V
Machine Model	200V
Storage temperature range	-40°C to 105°C

STANDARD OPERATING CONDITIONS

Operating temperature range	-40°C to 85°C
Supply Voltage (V_{DD})	1.8V to 3.6V
Input clock frequency	1 MHz to 4 MHz
Clock duty cycle	40% to 60%

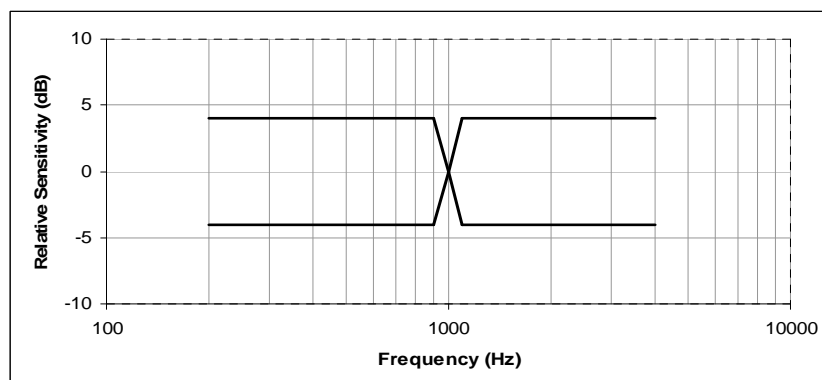
ELECTRICAL SPECIFICATIONS

Unless otherwise noted, test conditions are: $V_{DD}=3V$, $T_a=25^\circ C$, Room Humidity = 50%, Clock = 2.8224 MHz

ELECTRO-ACOUSTIC CHARACTERISTICS

Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Directivity		Omni-directional			
Frequency Range		50		22k	Hz
Signal to Noise Ratio (SNR)	$f_{in} = 1$ kHz, A-weighted, 20Hz-10kHz		56		dB
Sensitivity	1kHz, 94 dB SPL, full-scale=100% 1's density at PDM output of microphone	-32	-28	-24	dBFS
Total Harmonic Distortion + Noise (THD + N)	@ 115dB SPL, $f_{in} = 1$ kHz		2	10	%
Acoustic Overload Point	< 10% THD		118		dB SPL
Power Supply Rejection (PSR)	Test signal on $V_{DD}=217$ Hz, 100 mV _{pp}		-57		dBFS
Part-to-part phase matching from nominal	$f_{in} = 1$ kHz			± 10	°
Current Consumption (with no load)	Clock > 1MHz			1	mA
	Clock off		11		μA
Power-up initialization	Data invalid time from clock on			200	ms

FREQUENCY RESPONSE MASK



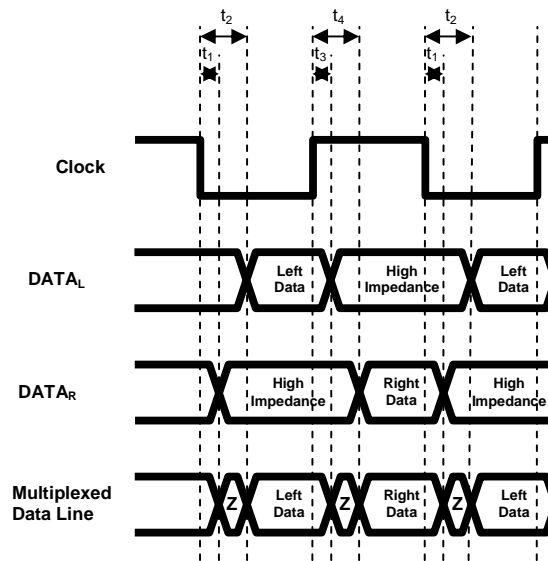
AKU2002C Datasheet

ELECTRICAL SPECIFICATIONS (cont.)

TIMING CHARACTERISTICS

(Typical performance with load capacitance <20pF and a clock frequency of 2.8224 MHz)

	Data Valid	Data Sampled	L/R_SELECT Connected to
DATA _L	Falling clock	Rising clock	GND
DATA _R	Rising clock	Falling clock	V _{DD}



Output	Parameter	Typical Value	Description
DATA _R	t ₁	6ns	Time from falling edge of clock until data becomes high impedance
DATA _L	t ₂	33ns	Time from falling edge of clock until data becomes valid
DATA _L	t ₃	6ns	Time from rising edge of clock until data becomes high impedance
DATA _R	t ₄	29ns	Time from rising edge of clock until data becomes valid

AKU2002C Datasheet

ELECTRICAL SPECIFICATIONS (cont.)

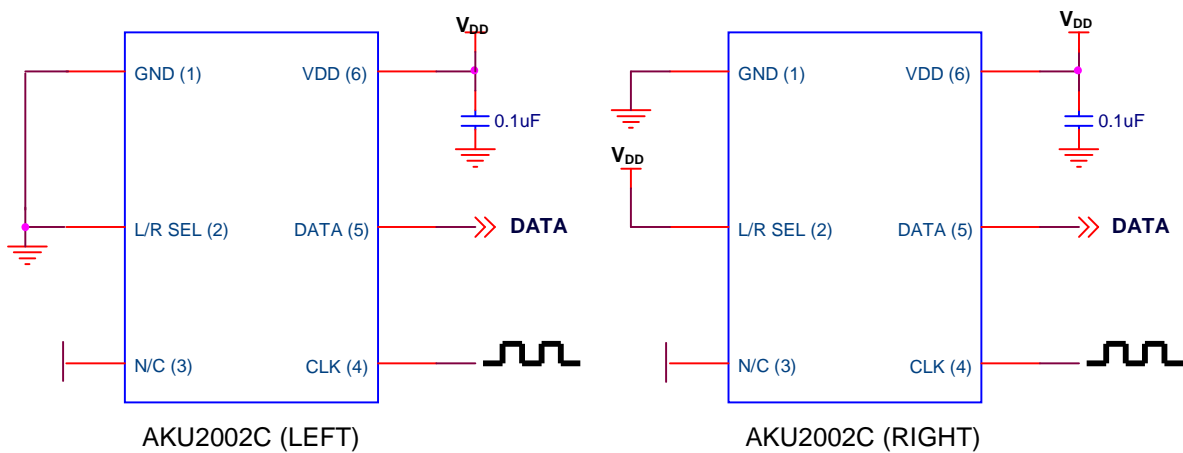
DIGITAL LOGIC CHARACTERISTICS

(Typical performance with load capacitance <20pF and a clock frequency of 2.8224 MHz)

Symbol	Parameter	Min	Typical	Max	Units
V_{IT+}	Positive-going input threshold voltage		1.82*		V
V_{IT-}	Negative-going input threshold voltage		1.27*		V
ΔV_{IT}	Input hysteresis		0.55*		V
V_{IOL}	Data input/output logic low level	-0.3		$0.35 \cdot V_{DD}$	V
V_{IOH}	Data input/output logic high level	$0.65 \cdot V_{DD}$		$V_{DD} + 0.3$	V

* $V_{DD}=3V$

TYPICAL APPLICATION SCHEMATICS



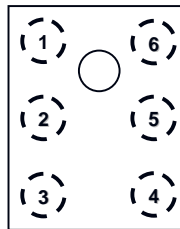
AKU2002C Datasheet

PACKAGE

PIN OUT

(As viewed from **top** of package)

6-Pad LGA

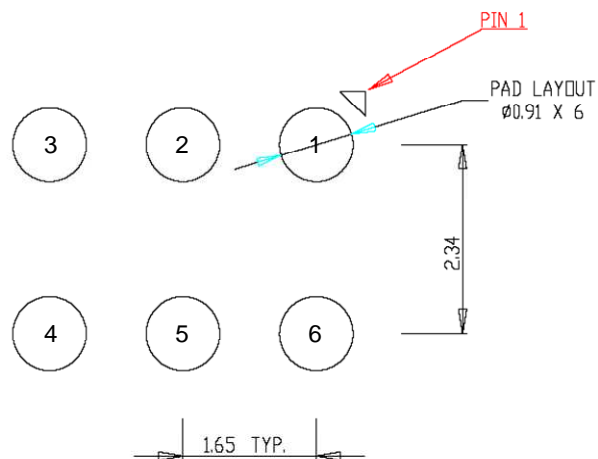


PIN DESCRIPTION

Pin	Name	Function
1	GND	Ground
2	L/R SELECT	Left/right select
3	N/C	Not connected (tie to ground)
4	CLK	Clock input to microphone
5	DATA	PDM data output
6	V _{DD}	Power supply and I/O voltage for microphone

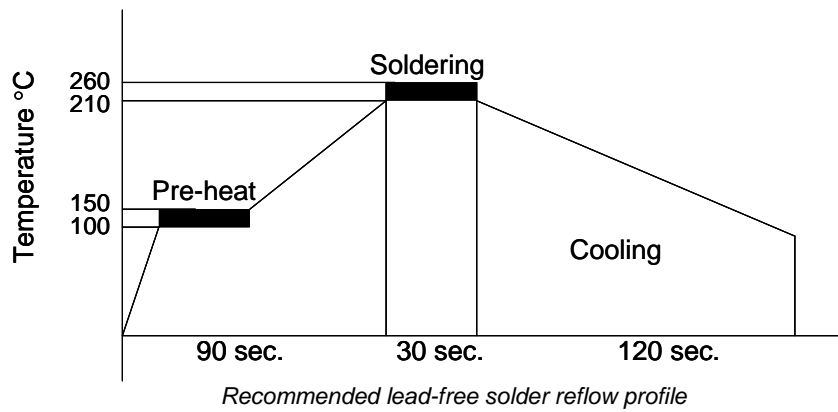
RECOMMENDED CUSTOMER PCB LAYOUT

(all dimensions in mm)



AKU2002C Datasheet

MANUFACTURING NOTES

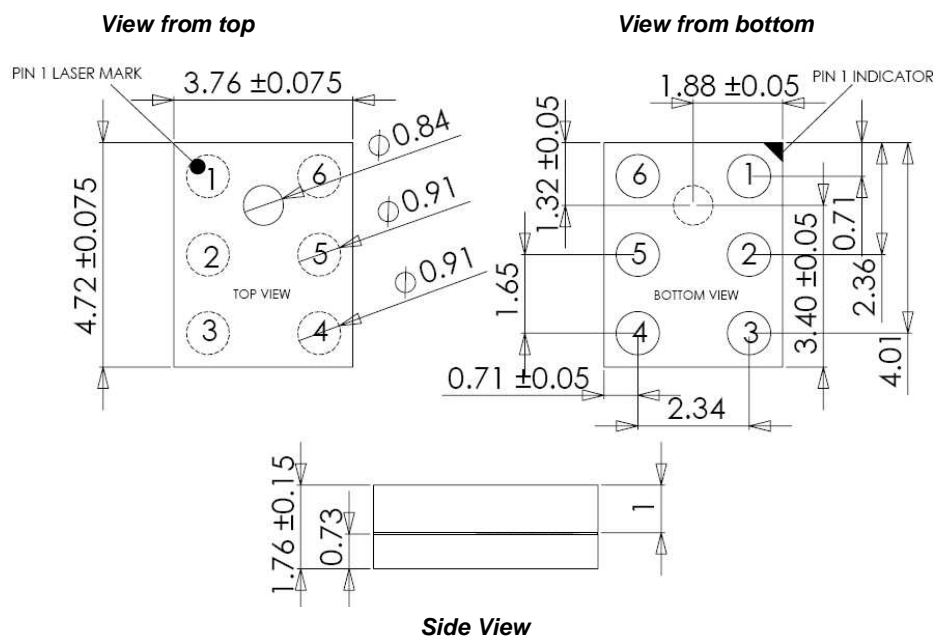


Assembly notes:

Solder reflow	260°C maximum for a maximum of 30 seconds
Cleaning	Do not wash after reflow. Do not use pressurized air to clean or aid in assembly.
Part Handling	Do not blow air into acoustic port or use vacuum pick-up head over acoustic port in package.

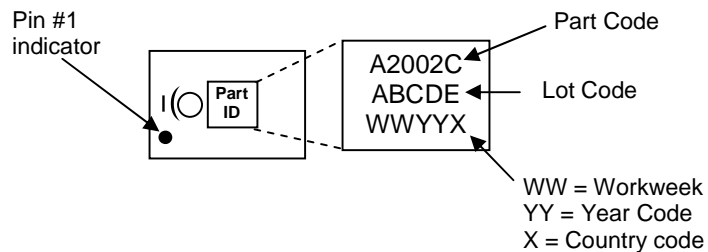
MECHANICAL SPECIFICATIONS

(all dimensions in mm)



AKU2002C Datasheet

PART MARKING INFORMATION



ORDERING INFORMATION

Part Number	Description	Part Code	Package	Shipping Method	Standard Quantity
AKU2002CR	Digital MEMS Microphone	A2002C	6 Pad LGA	13" Reel	2500

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Akustica, Inc.
2835 East Carson Street
Suite 301
Pittsburgh, PA 15203
Ph: (412) 390-1730
For technical support contact support@akustica.com
www.akustica.com