



ADX920Q, AD921Q, AD922Q, AD923Q

Low-Power, 2-Channel, 24-Bit Analog Front-End for Biopotential Measurements

1. FEATURES

- Three low-noise PGAs and two high-resolution ADCs (ADX921Q, ADX922Q and ADX923Q)
- High Resolution mode and low power mode (ADX923Q, ADX923Q)
 - High Resolution: 385uW/channel
 - Low Power: 320uW/channel
- Input-referred noise: 6 μ V_{PP} (150Hz BW, G = 6)
- Input bias current: 50pA
- Data rate: 125SPS to 8kSPS
- CMRR: 122dB; THD: 115dB
- Programmable gain: 1, 2, 3, 4, 6, 8, or 12
- Supplies: unipolar or bipolar
 - Analog: 2.7V to 5.5V
 - Digital: 1.7V to 3.6V
- Built-in right leg drive amplifier, lead-off detection, test signals
- Integrated respiration impedance measurement (ADX922Q and ADX923Q)
- Electrode Rotation mode (ERM) to implement time-division multiplexing LEAD-I, LEAD-II, and LEAD-III measurements (ADX923Q)
- Integrated digital AC Lead-Off measurement and software AC Lead-Off measurement
- Integrated analog PACE measurement (ADX921Q, ADX922Q, ADX923Q)
- Built-in oscillator and reference
- Supply monitor, internal temp sensor, OSC fault detection, overrange detection
- Flexible power-down, standby mode
- SPI™-compatible serial interface, timeout reset
- Cyclic redundancy check (CRC) on communications, checksum
- Support ADC data FIFO with max depth 12 with 24 ECG samples. (ADX920Q, ADX923Q)
- Support EFUSE ECC to improve the product life cycle
- Functional safety features to support automotive application
- Operating temperature range: -40°C to +125°C
- AEC-Q100

2. APPLICATIONS

- Electroencephalogram (EEG)
- Medical instrumentation (ECG) including:
 - Patient monitoring: Holter, event, stress, and vital signs including ECG, AED, and telemedicine
 - Personal care and fitness monitors (heart rate, respiration, and ECG, EEG)
- High-precision, simultaneous, multichannel data acquisition

3. DESCRIPTION

The ADX921Q, ADX922Q, and ADX923Q are multichannel, simultaneous sampling, 24-bit, delta-sigma ($\Delta\Sigma$) analog-to-digital converters (ADCs) with a built-in programmable gain amplifier (PGA), internal reference, and an onboard oscillator.

The ADX921Q, ADX922Q, and ADX923Q incorporate all features commonly required in portable, low-power medical electrocardiogram (ECG), sports, and fitness applications.

With high levels of integration and exceptional performance, the ADX921Q, ADX922Q, and ADX923Q enable the creation of scalable medical instrumentation systems at significantly reduced size, power, and overall cost.

The ADX921Q, ADX922Q, and ADX923Q have a flexible input multiplexer per channel that can be independently connected to the internally-generated signals for test, temperature, and lead-off detection. Additionally, any configuration of input channels can be selected for derivation of the right leg drive (RLD) output signal. The ADX921Q, ADX922Q, and ADX923Q operate at data rates up to 8kSPS. Lead-off detection can be implemented internal to the device, using the device internal excitation current sink or source. The ADX922Q and ADX923Q versions include a fully integrated respiration impedance measurement function. Operating temperature is specified from -40°C to +125°C. See [Table 1](#) for the device information.

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Table 1. Device Information

PART NUMBER	PACKAGE	BODY SIZE (NOM)
ADX921Q	QFN32	4.00mm × 4.00mm
ADX922Q	QFN32	4.00mm × 4.00mm
ADX923Q	QFN32	4.00mm × 4.00mm

Figure 1 shows the simplified block diagram.

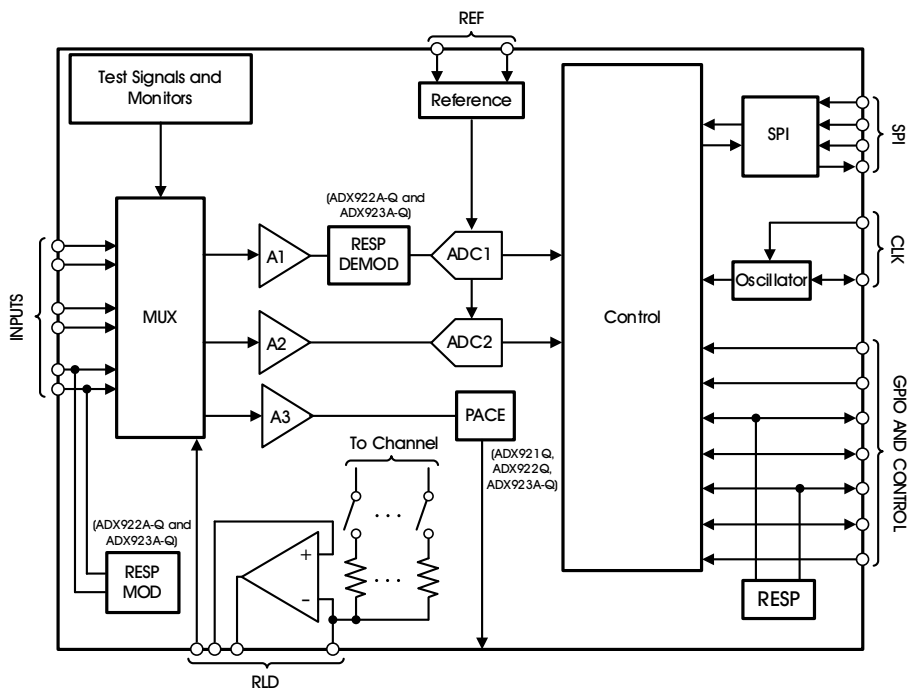


Figure 1. Simplified Block Diagram

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Table 2. Order Information

ORDER NUMBER ⁽¹⁾	CH (#)	BITS	MARKING INFO. ⁽²⁾	RESPIRATION	PACE	AC LEAD-OFF	ERM	DHPF	FIFO	OP. TEMP (°C)	RATING	PKG. OPTION
ADX920QAQFN32	1	24	ADX920Q	No	No	Yes	No	No	Yes	-40-125	Q	T/R-5000
ADX921QAQFN32	2	24	ADX921Q	No	Yes	Yes	No	No	No	-40-125	Q	T/R-5000
ADX922QAQFN32	2	24	ADX922Q	Yes	Yes	Yes	No	No	No	-40-125	Q	T/R-5000
ADX923QAQFN32	2	24	ADX923Q	Yes	Yes	Yes	Yes	Yes	Yes	-40-125	Q	T/R-5000

4. PIN CONFIGURATION AND FUNCTIONS

Figure 2 illustrates the pin configuration.

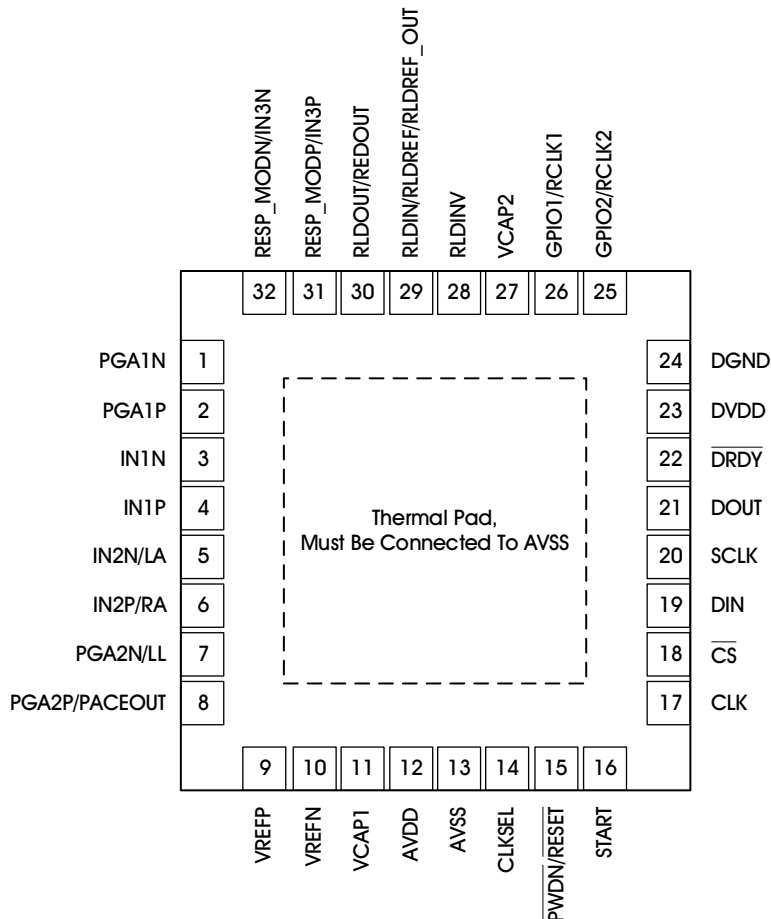


Figure 2. Pin Configuration

Table 3 lists the pin functions.

Table 3. Pin Functions

PIN	POSITION	FUNCTION	DESCRIPTION
PGA1N	1	Analog output	PGA1 inverting output
PGA1P	2	Analog output	PGA1 noninverting output
IN1N ⁽¹⁾	3	Analog input	Differential analog negative input 1
IN1P ⁽¹⁾	4	Analog input	Differential analog positive input 1
IN2N ⁽¹⁾ /LA	5	Analog input	Differential analog negative input 2; Left arm in electrode rotation mode
IN2P ⁽¹⁾ /RA	6	Analog input	Differential analog positive input 2; right arm in electrode rotation mode
PGA2N/LL	7	Analog output/input	PGA2 inverting output; left leg in electrode rotation mode
PGA2P/PACEOUT	8	Analog output	PGA2 noninverting output; pace output in analog pace mode
VREFP	9	Analog input/output	Positive reference voltage
VREFN	10	Supply	Negative reference voltage; must be connected to AVSS; Analog ground
VCAP1	11	---	Analog bypass capacitor, bandgap output
AVDD	12	Supply	Analog supply
AVSS	13	Supply	Analog ground
CLKSEL	14	Digital input	Master clock select

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PIN	POSITION	FUNCTION	DESCRIPTION
$\overline{\text{PWDN/RESET}}$	15	Digital input	Power-down or system reset; active low
START	16	Digital input	Start conversion
CLK	17	Digital input	Master clock input
$\overline{\text{CS}}$	18	Digital input	Chip select
DIN	19	Digital input	SPI data in
SCLK	20	Digital input	SPI clock
DOUT	21	Digital output	SPI data out
$\overline{\text{DRDY}}$	22	Digital output	Data ready; active low
DVDD	23	Supply	Digital power supply
DGND	24	Supply	Digital ground
GPIO2/RCLK2	25	Digital input/output	General-purpose I/O 2 or respiration clock 2 (ADX922Q and ADX923Q)
GPIO1/RCLK1	26	Digital input/output	General-purpose I/O 1 or respiration clock 1 (ADX922Q and ADX923Q)
VCAP2	27	Supply	Analog bypass capacitor, AVDD + 2V
RLDINV	28	Analog input	Right leg drive inverting input; connect to AVDD if not used
RLDIN/RLDREF/RLDREF_OUT	29	Analog input/output	RLDIN/RLDREF: Right leg drive input to MUX or RLD amplifier noninverting input; connect to AVDD if not used. RLDREF_OUT: Build an external bandpass filter on PACE_OUT and RLDREF_OUT.
RLDOUT/REDOUT	30	Analog output	Right leg drive output; reference electrode driver output in electrode rotation mode
RESP_MODP/IN3P ⁽¹⁾	31	Analog output/input	P-side respiration excitation signal for respiration (analog output) or auxiliary input 3P (analog input)
RESP_MODN/IN3N ⁽¹⁾	32	Analog output/input	N-side respiration excitation signal for respiration (analog output) or auxiliary input 3N (analog input)
Pad	Power Pad	---	Thermal pad; must be connected to AVSS

Note: Connect unused analog pins to AVDD.

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5. ESD RATINGS

Table 4 lists the ESD ratings of the ADX920Q, ADX921Q, ADX922Q, and ADX923Q.

Table 4. ESD Ratings

PARAMETER	SYMBOL	DESCRIPTION	VALUE	UNITS	
Electrostatic Discharge	V _(ESD)	Human-body model (HBM), per AEC Q100-002 ⁽¹⁾	±4000	V	
		Charged device model (CDM), per AEC Q100-011	Corner pins for PWP (1, 12, 13, and 24)		±1000
			Other pins		±500

Note: AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

6. PACKAGE INFORMATION

The ADX920Q, ADX921Q, ADX922Q, and ADX923Q are available in the QFN32 package. Figure 3 shows the package view.

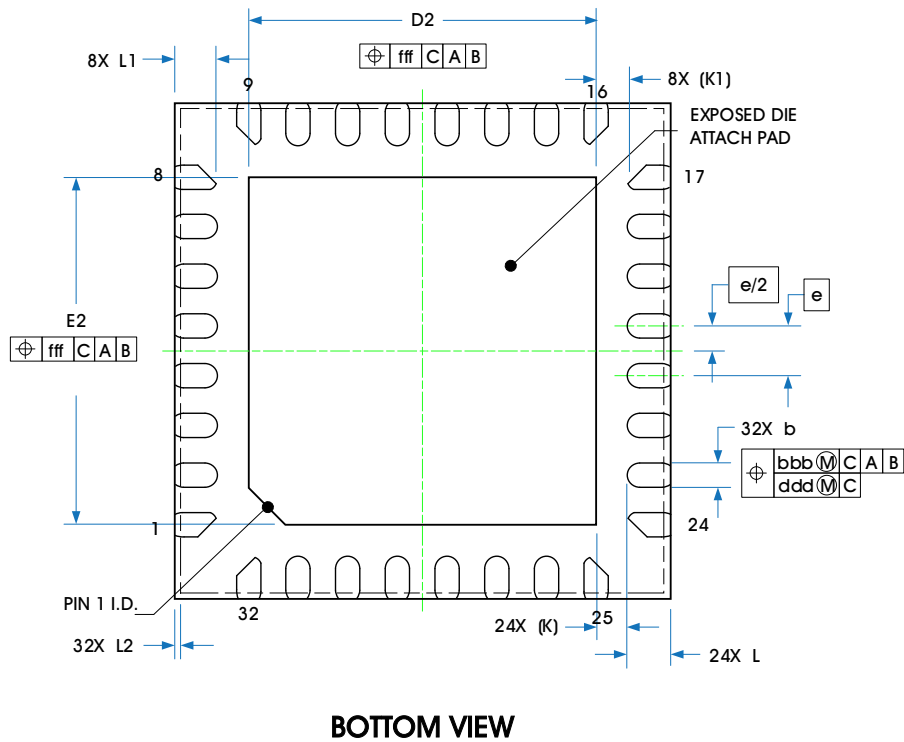
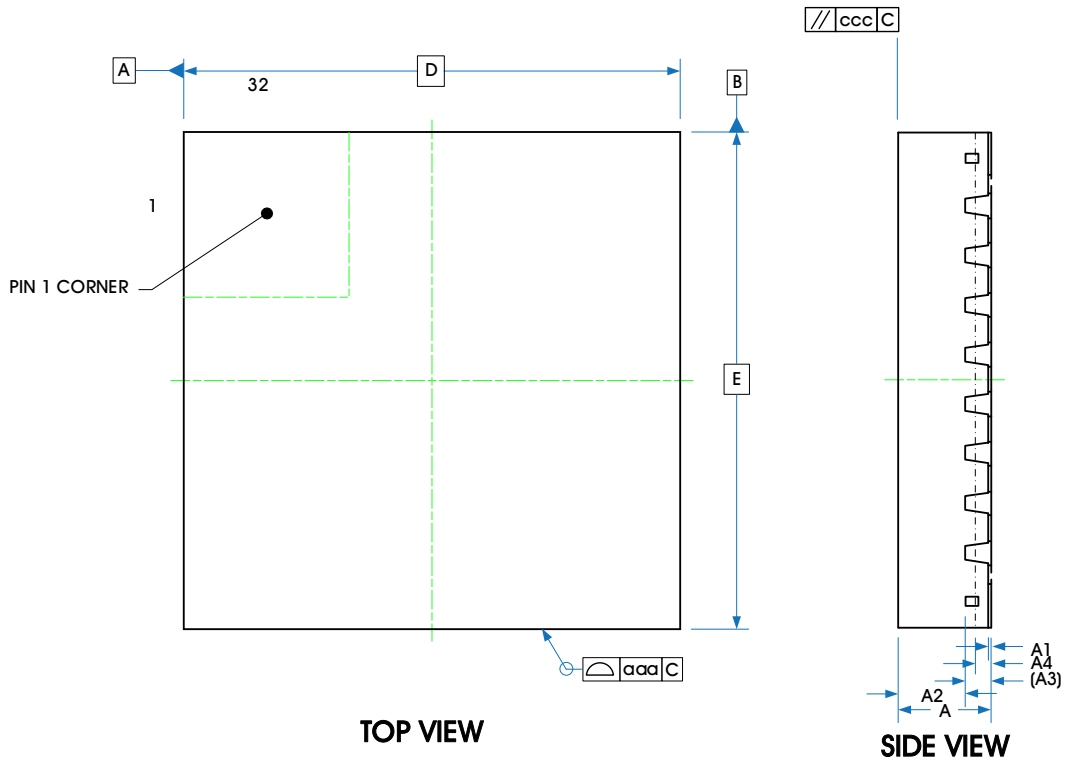


Figure 3. Package View

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		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.55	---
L/F THICKNESS		A3	0.203 REF		
SIDE WETTABLE DEPTH		A4	0.075	---	0.18
LEAD WIDTH		b	0.15	0.2	0.25
BODY SIZE	X	D	4 BSC		
	Y	E	4 BSC		
LEAD PITCH		e	0.4 BSC		
EP SIZE	X	D2	2.7	2.8	2.9
	Y	E2	2.7	2.8	2.9
LEAD LENGTH		L	0.25	0.35	0.45
		L1	0.235	0.335	0.435
SIDE WETTABLE WIDTH		L2	0.01	---	0.09
LEAD TIP TO EXPOSED PAD EDGE		K	0.25 REF		
		K1	0.265 REF		
PACKAGE EDGE TOLERANCE		aaa	0.1		
MOLD FLATNESS		ccc	0.1		
LEAD OFFSET		bbb	0.07		
		ddd	0.05		
EXPOSED PAD OFFSET		fff	0.1		

REVISION HISTORY

REVISION	DATE	DESCRIPTION
Rel 1.0	31 Dec 2021	Initial release.