

# PATENT PORTFOLIO

October 1, 2023

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**AKOUSTIS**<sup>®</sup>

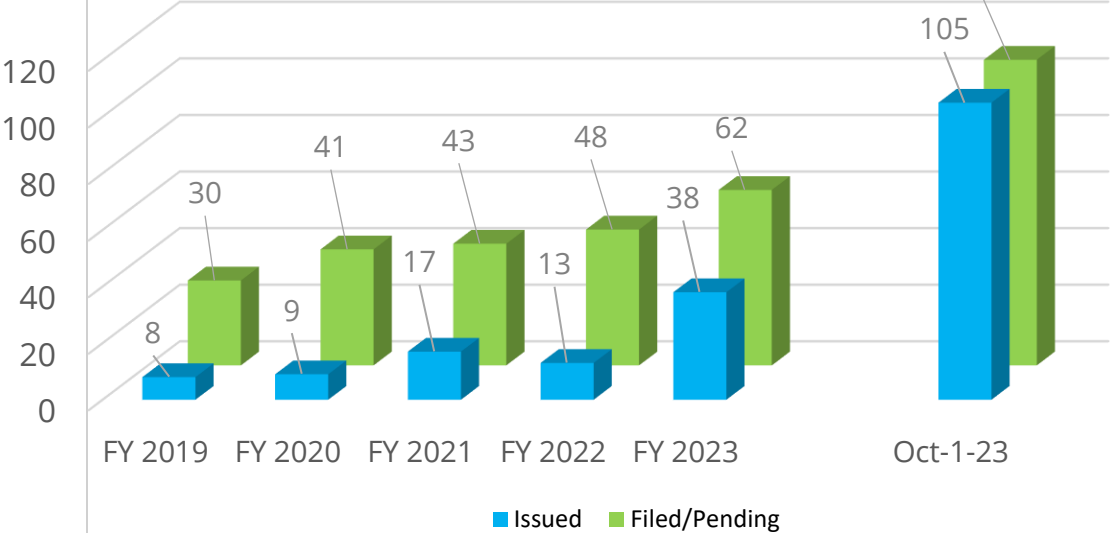
# INTELLECTUAL PROPERTY (IP) PORTFOLIO BREAKDOWN

## AKOUSTIS IP PORTFOLIO

105 patents, 108 patent applications pending, plus numerous trade secrets<sup>[1]</sup>

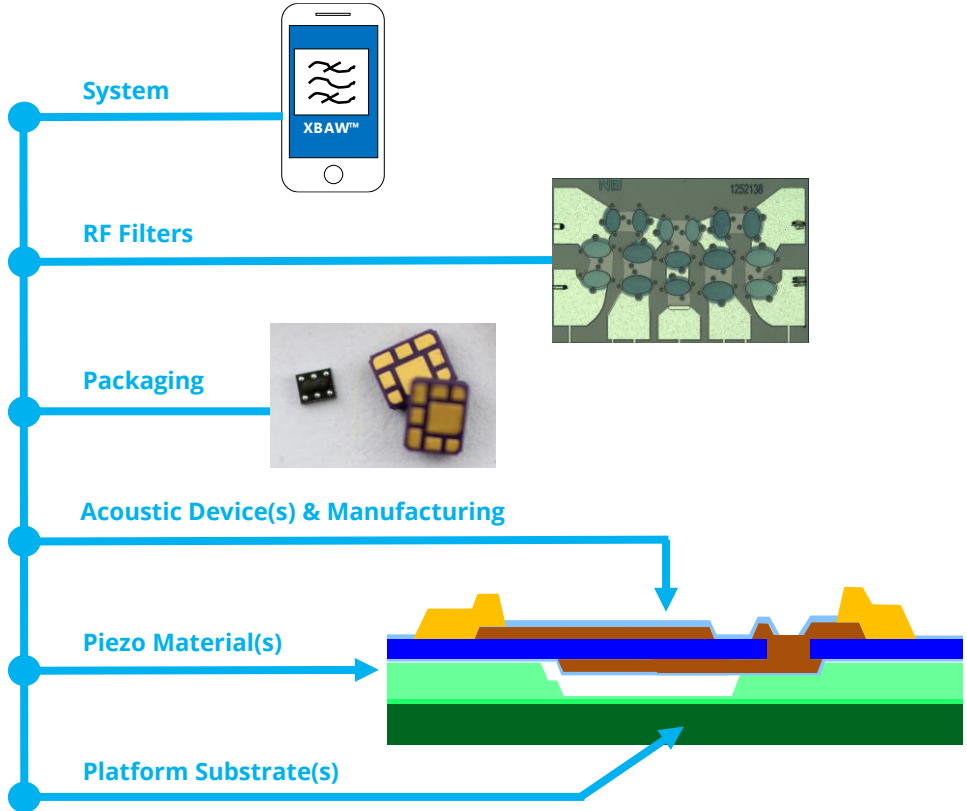
## GROWING PATENT PORTFOLIO

Fiscal Years 2019 through 2023 (Issued, Filed)  
Overall Portfolio<sup>[1]</sup> (Issued, Pending)



[1] As of October 1, 2023. Includes Akoustis issued patents and patent licensed from Cornell University (Press release dated 9-7-16).

## IP STRATEGY DESIGNED TO PROTECT KEY AREAS



# PATENT DETAIL

Patent Number	Title	Issue Date
CN 205195673 U	WAFER-LEVEL PACKAGE DEVICE	4/27/2016
CN 205195752 U	MOBILE COMMUNICATION SYSTEM	4/27/2016
CN 205212799 U	A SUBSTRATE FOR ACOUSTIC RESONATOR EQUIPMENT	5/4/2016
US 9,362,887	INTEGRATED CIRCUIT CONFIGURED WITH TWO OR MORE SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES	6/7/2016
CN 205657658 U	A SUBSTRATE AND ACOUSTIC RESONATOR EQUIPMENT FOR ACOUSTIC RESONATOR EQUIPMNET	10/19/2016
CN 205725676 U	WAFER SCALE PACKAGE APPARATUS	11/23/2016
US 9,537,465	ACOUSTIC RESONATOR DEVICE WITH SINGLE CRYSTAL PIEZO MATERIAL AND CAPACITOR ON A BULK SUBSTRATE	1/3/2017
US 9,571,061	INTEGRATED CIRCUIT CONFIGURED WITH TWO OR MORE SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES	2/14/2017
CN 206100080 U	MOBILE COMMUNICATION DEVICE CONFIGURED WITH A SINGLE CRYSTAL PIEZO RESONATOR STRUCTURE	4/12/2017
US 9,673,384	RESONANCE CIRCUIT WITH A SINGLE CRYSTAL CAPACITOR DIELECTRIC MATERIAL	6/6/2017
US 9,716,581	MOBILE COMMUNICATION DEVICE CONFIGURED WITH A SINGLE CRYSTAL PIEZO RESONATOR STRUCTURE	7/25/2017
US 9,805,966	WAFER SCALE PACKAGING	10/31/2017
US 9,912,314	SINGLE CRYSTAL ACOUSTIC RESONATOR AND BULK ACOUSTIC WAVE FILTER	3/6/2018
US 9,917,568	MEMBRANE SUBSTATE STRUCTURE FOR SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICE	3/13/2018
US 10,084,588	MOBILE COMMUNICATION DEVICE CONFIGURED WITH A SINGLE CRYSTAL PIEZO RESONATOR STRUCTURE	9/25/2018
US 10,110,188B2	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	10/23/2018
US 10,110,189B2	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	10/23/2018
US 10,110,190B2	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	10/23/2018
US 10,211,804	METHOD OF MANUFACTURING INTEGRATED CIRCUIT CONFIGURED WITH TWO OR MORE SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES	2/19/2019
US 10,217,930	METHOD OF MANUFACTURE FOR SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES USING MICRO-VIAS	2/26/2019

# PATENT DETAIL (CONT'D)

Patent Number	Title	Issue Date
US 10,256,786	COMMUNICATION FILTER USING SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES	4/9/2019
US 10,319,898	RESONANCE CIRCUIT WITH A SINGLE CRYSTAL CAPACITOR DIELECTRIC MATERIAL	6/11/2019
US 10,355,659	PIEZOELECTRIC ACOUSTIC RESONATOR MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	7/16/2019
US 10,431,490	WAFER SCALE PACKAGING	10/1/2019
US 10,431,580	MONOLITHIC SINGLE CHIP INTEGRATED RADIO FREQUENCY FRONT END MODULE CONFIGURED WITH SINGLE CRYSTAL ACOUSTIC FILTER DEVICES	10/1/2019
CN 106575957 B	INTEGRATED CIRCUIT CONFIGURED WITH A CRYSTAL ACOUSTIC RESONATOR DEVICE	12/17/2019
US 10,516,377	METHOD OF MANUFACTURE FOR SINGLE CRYSTAL CAPACITOR DIELECTRIC FOR A RESONANCE CIRCUIT	12/24/2019
US 10,523,180	METHOD AND STRUCTURE FOR SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES USING THERMAL RECRYSTALLIZATION	12/31/2019
US 10,581,398	METHOD OF MANUFACTURE FOR SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES USING MICRO-VIAS	3/3/2020
US 10,615,773	WIRELESS COMMUNICATION INFRASTRUCTURE SYSTEM CONFIGURED WITH A SINGLE CRYSTAL PIEZO RESONATOR AND FILTER STRUCTURE	4/7/2020
US 10,673,513	FRONT END MODULE FOR 5.2 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	6/2/2020
US 10,727,811	IMPROVED EFFECTIVE COUPLING COEFFICIENTS FOR STRAINED SINGLE CRYSTAL EPITAXIAL FILM BULK ACOUSTIC RESONATORS	7/28/2020
US 10,855,243	MOBILE COMMUNICATION DEVICE CONFIGURED WITH A SINGLE CRYSTAL PIEZO RESONATOR STRUCTURE	12/1/2020
US 10,855,250	COMMUNICATION FILTER FOR LTE BAND 41	12/1/2020
US 10,855,247	ELLIPTICAL STRUCTURE FOR BULK ACOUSTIC WAVE RESONATOR	12/1/2020
US 10,873,317	BULK ACOUSTIC WAVE RESONATOR FILTERS INCLUDING REJECTION-BAND RESONATORS	12/22/2020
US 10,879,872	BAW RESONATORS WITH ANTISYMMETRIC THICK ELECTRODES	12/29/2020
US 10,931,251	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	2/23/2021
US 10,957,688	MONOLITHIC SINGLE CHIP INTEGRATED RADIO FREQUENCY FRONT END MODULE CONFIGURED WITH SINGLE CRYSTAL ACOUSTIC FILTER DEVICES	3/23/2021
US 10,979,011	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	4/13/2021

# PATENT DETAIL (CONT'D)

Patent Number	Title	Issue Date
US 10,979,022	5.2 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/13/2021
US 10,979,023	5.9 GHZ C-V2X AND DSRC ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/13/2021
US 10,979,024	5.2 GHZ WI-FI COEXISTENCE ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/13/2021
US 10,979,025	5G BAND N79 ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/13/2021
US 10,979,026	5.5 GHZ WI-FI 5G COEXISTENCE ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/13/2021
US 10,985,732	5.6 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/20/2021
US 10,992,279	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE	4/27/2021
US 11,031,989	FRONT END MODULE FOR 5.2 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	6/8/2021
US 11,063,576	FRONT END MODULE FOR 5.6 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	7/13/2021
US 11,063,204	METHOD OF MANUFACTURE FOR SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES USING MICRO-VIAS	7/13/2021
US 11,070,184	PIEZOELECTRIC ACOUSTIC RESONATOR MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	7/20/2021
US 11,165,404	METHOD FOR FABRICATING AN ACOUSTIC RESONATOR DEVICE WITH PERIMETER STRUCTURES	11/2/2021
US 11,177,868	FRONT END MODULE FOR 6.5 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	11/16/2021
US 11,184,079	FRONT END MODULE FOR 5.5 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	11/23/2021
US 11,211,918	IMPROVED EFFECTIVE COUPLING COEFFICIENTS FOR STRAINED SINGLE CRYSTAL EPITAXIAL FILM BULK ACOUSTIC RESONATORS	12/28/2021
US 11,245,376	SINGLE CRYSTAL ACOUSTIC RESONATOR AND BULK ACOUSTIC WAVE FILTER	2/8/2022
US 11,245,382	METHOD AND STRUCTURE FOR SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES USING THERMAL RECRYSTALLIZATION	2/8/2022
US 11,316,496	METHOD AND STRUCTURE FOR HIGH PERFORMANCE RESONANCE CIRCUIT WITH SINGLE CRYSTAL PIEZOELECTRIC CAPACITOR DIELECTRIC MATERIAL	4/26/2022
US 11,348,798	METHODS OF FORMING INTEGRATED CIRCUIT DEVICES USING CUTTING TOOLS TO EXPOSE METALIZATION PADS THROUGH A CAP STRUCTURE AND RELATED CUTTING DEVICES	5/31/2022
US 11,349,453	BULK ACOUSTIC WAVE RESONATOR FILTERS INCLUDING REJECTION-BAND RESONATORS	5/31/2022

# PATENT DETAIL (CONT'D)

Patent Number	Title	Issue Date
US 11,356,071	PIEZOELECTRIC ACOUSTIC RESONATOR WITH IMPROVED TCF MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	6/7/2022
US 11,394,451	FRONT END MODULE FOR 6.1 GHz WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	7/19/2022
KR 10-2427297	INTEGRATED CIRCUIT CONFIGURED WITH TWO OR MORE SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES	7/26/2022
US 11,398,402	WAFER SCALE PACKAGING	7/26/2022
US 11,411,168	METHODS OF FORMING GROUP III PIEZOELECTRIC THIN FILMS VIA SPUTTERING	8/9/2022
US 11,411,169	METHODS OF FORMING GROUP III PIEZOELECTRIC THIN FILMS VIA REMOVAL OF PORTIONS OF FIRST SPUTTERED MATERIAL	8/9/2022
US 11,418,169	5G N41 2.6 GHz BAND ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	8/16/2022
US 11,424,728	PIEZOELECTRIC ACOUSTIC RESONATOR MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	8/23/2022
US 11,451,213	5G n79 WI-FI ACOUSTIC TRIPLEXER CIRCUIT	9/20/2022
US 11,456,723	ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT DEVICE	9/27/2022
US 11,456,724	ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT DEVICE	9/27/2022
US 11,476,825	5.5 GHz WI-FI COEXISTENCE ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	10/18/2022
US 11,495,734	METHOD OF MANUFACTURE FOR SINGLE CRYSTAL CAPACITOR DIELECTRIC FOR A RESONANCE CIRCUIT	11/8/2022
US 11,496,108	RF BAW RESONATOR FILTER ARCHITECTURE FOR 6.5GHZ WI-FI 6E COEXISTENCE AND OTHER ULTRA-WIDEBAND APPLICATIONS	11/8/2022
US 11,496,109	INTEGRATED CIRCUIT CONFIGURED WITH TWO OR MORE SINGLE CRYSTAL ACOUSTIC RESONATOR DEVICES	11/8/2022
US 11,552,613	RESONATOR SHAPES FOR BULK ACOUSTIC WAVE (BAW) DEVICES	1/10/2023
US 11,557,716	METHOD AND STRUCTURE OF SINGLE CRYSTAL ELECTRONIC DEVICES WITH ENHANCED STRAIN INTERFACE REGIONS BY IMPURITY INTRODUCTION	1/17/2023
US 11,558,023	METHOD FOR FABRICATING AN ACOUSTIC RESONATOR DEVICE	1/17/2023
US 11,563,412	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	1/24/2023
KR 10-2497773	MONOLITHIC SINGLE CHIP INTEGRATED RADIO FREQUENCY FRONT END MODULE CONFIGURED WITH SINGLE CRYSTAL ACOUSTIC FILTER DEVICES	2/3/2023

# PATENT DETAIL (CONT'D)

Patent Number	Title	Issue Date
US 11,581,306	MONOLITHIC SINGLE CHIP INTEGRATED RADIO FREQUENCY FRONT END MODULE CONFIGURED WITH SINGLE CRYSTAL ACOUSTIC FILTER DEVICES	2/14/2023
US 11,581,866	RF ACOUSTIC WAVE RESONATORS INTEGRATED WITH HIGH ELECTRON MOBILITY TRANSISTORS INCLUDING A SHARED PIEZOELECTRIC/BUFFER LAYER AND METHODS OF FORMING THE SAME	2/14/2023
US 11,581,872	BULK ACOUSTIC WAVE RESONATOR FILTERS INCLUDING REJECTION-BAND RESONATORS	2/14/2023
US 11,611,386	FRONT END MODULE FOR 6.1 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	3/21/2023
US 11,616,490	RF FILTER CIRCUIT INCLUDING BAW RESONATORS	3/28/2023
US 11,618,968	APPARATUS INCLUDING HORIZONTAL FLOW REACTOR WITH A CENTRAL INJECTOR COLUMN HAVING SEPARATE CONDUITS FOR LOW-VAPOR PRESSURE METALORGANIC PRECURSORS AND OTHER PRECURSORS FOR FORMATION OF PIEZOELECTRIC LAYERS ON WAFERS	4/4/2023
US 11,621,698	5.5 GHZ WI-FI 5G COEXISTENCE ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	4/4/2023
US 11,637,545	ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT AND SYSTEM	4/25/2023
US 11,646,710	PIEZOELECTRIC ACOUSTIC RESONATOR MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	5/9/2023
US 11,646,717	ACOUSTIC WAVE RESONATOR, RF FILTER CIRCUIT DEVICE AND SYSTEM	5/9/2023
US 11,646,718	ACOUSTIC WAVE RESONATOR, RF FILTER CIRCUIT DEVICE AND SYSTEM	5/9/2023
US 11,646,719	ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT AND SYSTEM	5/9/2023
US 11,652,469	HIGH POWER BULK ACOUSTIC WAVE RESONATOR FILTER DEVICES	5/16/2023
US 11,671,067	PIEZOELECTRIC ACOUSTIC RESONATOR MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	6/06/2023
KR 10-2544078	STRUCTURE AND METHOD OF MANUFACTURE FOR ACOUSTIC RESONATOR OR FILTER DEVICES USING IMPROVED FABRICATION CONDITIONS AND PERIMETER STRUCTURE MODIFICATIONS	6/12/2023
US 11,677,372	PIEZOELECTRIC ACOUSTIC RESONATOR WITH DIELECTRIC PROTECTIVE LAYER MANUFACTURED WITH PIEZOELECTRIC THIN FILM TRANSFER PROCESS	6/13/2023
US 11,683,021	4.5G 3.55-3.7 GHz BAND BULK ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	6/20/2023
US 11,689,186	5.5 GHz Wi-Fi 5G COEXISTENCE ACOUSTIC WAVE RESONATOR RF FILTER CIRCUIT	6/27/2023
CN 108023569 B	METHOD FOR MANUFACTURING ACOUSTIC RESONATOR OR FILTER DEVICE	6/30/2023
US 11,695,390	BAW RESONATORS WITH ANTISYMMETRIC THICK ELECTRODES	7/4/2023

# PATENT DETAIL (CONT'D)

Patent Number	Title	Issue Date
CN 110912529 B	MONOLITHIC LADDER NETWORK AND METHOD OF MAKING SAME	7/18/2023
US 11,711,064	ACOUSTIC WAVE RESONATOR, RF FILTER CIRCUIT AND SYSTEM	7/25/2023
US 11,728,781	METHOD FOR FABRICATING AN ACOUSTIC RESONATOR DEVICE WITH PERIMETER STRUCTURES	8/15/2023
US 11,736,177	FRONT END MODULES FOR 5.6 GHZ AND 6.6 GHZ WI-FI ACOUSTIC WAVE RESONATOR RF FILTER CIRCUITS	8/22/2023



# LICENSED/OPTIONED PATENT DETAIL

Patent Number	Title	Assignee	Patent Issue Date
US 7,250,360	SINGLE STEP, HIGH TEMPERATURE NUCLEATION PROCESS FOR A LATTICE MISMATCHED SUBSTRATE	Cornell Research Foundation, Inc.	7/31/2007