

## SEARCH HISTORY

<b>Application Number</b>	PCT/US 19/64839
<b>Search Conducted By</b>	MBO
<b>Search Approved By</b>	ALK

<b>CPC/IPC Classifications Searched</b>	IPC(8): G06K 9/00; A61B 5/117 (2020.01) CPC:G06K 9/0002; G06K 9/00006; G06K 9/0012; G06K 9/00013; G06K 9/00107; A61B 5/1172; A61B 8/4483
<b>Date Conducted</b>	04 February 2020 (04.02.2020)

<b>Documentation Searched</b>	IPC(8): G06K 9/00; A61B 5/117 (2020.01) CPC:G06K 9/0002; G06K 9/00006; G06K 9/0012; G06K 9/00013; G06K 9/00107; A61B 5/1172; A61B 8/4483
<b>Search Terms Used</b>	Ultrasound, ultrasonic, ultrasonically Fingerprint, Print Cmut, micromachine, micro machine Sense, detect, transducer, monitor, measure Substrate, wafer, chip Cavity, hollow, chamber Membrane, diaphragm Electrode, contact, pad Within, inside, interior, interdigitate First, second, dual, two, different, multi, plural Frequencies, frequency, spectrum, spectral Device, handheld, phone, cellphone, tablet, display
<b>Date Conducted</b>	04 February 2020 (04.02.2020)

<b>Electronic Database Searched</b>	Google
<b>Files Searched</b>	Web
<b>Date Conducted</b>	04 February 2020 (04.02.2020)

<b>Search Logic:</b>	
"ultrasound fingerprint" (micromachine AROUND(5) transducer) About 6 results	
(ultrasound AND fingerprint) (micromachine AROUND(5) transducer) (substrate AROUND(5) cavity) About 14,200 results	

(ultrasound AND fingerprint) (micromachine AROUND(5) transducer) (substrate AROUND(5) cavity) "second electrode"  
 About 8 results

"ultrasound fingerprint" "multiple frequencies"  
 About 40 results

"mobile device" (fingerprint AROUND(3) detection) (ultrasound AROUND(5) chip)  
 About 137,000 results

"mobile device" (fingerprint AROUND(3) detection) (ultrasound AROUND(5) chip) "frequency spectrum"  
 About 10 results

"micromachined ultrasonic transducer" (fingerprint AROUND(5) detection)  
 About 5,380 results

"micromachined ultrasonic transducer" (fingerprint AROUND(5) detection) "multiple frequencies"  
 About 234 results

"micromachined ultrasonic transducer" (fingerprint AROUND(5) detection) "multiple frequencies" (display AND electrode)  
 About 268 results

<b>Electronic Database Searched</b>	Google
<b>Files Searched</b>	Patents
<b>Date Conducted</b>	04 February 2020 (04.02.2020)

**Search Logic:**

"ultrasound fingerprint" (micromachine NEAR transducer)  
 About 0 results

(ultrasound AND fingerprint) (micromachine NEAR transducer) (substrate NEAR cavity)  
 About 33 results

(ultrasound AND fingerprint) (micromachine NEAR transducer) (substrate NEAR cavity) "second electrode"  
 About 7 results

"ultrasound fingerprint" "multiple frequencies"  
 About 3 results

"mobile device" (fingerprint NEAR detection) (ultrasound NEAR chip)  
 About 2.129 results

"mobile device" (fingerprint NEAR detection) (ultrasound NEAR chip) "frequency spectrum"  
 About 75 results

"micromachined ultrasonic transducer" (fingerprint NEAR detection)  
 About 147 results

"micromachined ultrasonic transducer" (fingerprint NEAR detection) "multiple frequencies"  
About 6 results

"micromachined ultrasonic transducer" (fingerprint NEAR detection) "multiple frequencies"  
(display AND electrode)  
About 6 results

<b>Electronic Database Searched</b>	PatBase
<b>Files Searched</b>	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (Europe) AT BAKey BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
<b>Date Conducted</b>	04 February 2020 (04.02.2020)
<b>Search Logic:</b>	
<p>Search 1: PN=(WO2015134816) (Results 1)  Search 2: CTF 1 OR CTB 1 (Results 47)  Search 3: PN=(US9132693 OR US2016117541 OR US9424456) (Results 3)  Search 4: CTF 3 OR CTB 3 (Results 122)  Search 5: TAC=((ultrasound* OR ultrason*) NEAR (fingerprint* OR print*)) (Results 1427)  Search 6: 5 AND (CMUT OR micromachin* OR (micro* W2 machin*)) (Results 12)  Search 7: 5 AND (membrane* OR diaphragm* OR thin) (Results 142)  Search 8: 7 AND (substrat* OR wafer* OR chip*) (Results 49)  Search 9: 7 AND ((second* OR dual* OR two* OR differ* OR multi* OR plural*) NEAR (electrod* OR contact* OR pad*)) (Results 33)  Search 10: 5 AND ((second* OR dual* OR two* OR differ* OR multi* OR plural*) NEAR (frequenc* OR spectrum* OR spectra*)) (Results 53)  Search 11: TAC=(ultrasound* OR ultrason*) (Results 398210)  Search 12: 11 AND (fingerprint* OR print*) (Results 13547)  Search 13: 12 AND (membrane* OR diaphragm* OR thin) (Results 1905)  Search 14: 13 AND (substrat* OR wafer* OR chip*) (Results 778)  Search 15: 14 AND (electrod* OR contact* OR pad*) (Results 571)  Search 16: 15 AND (frequenc* OR spectrum* OR spectra*) (Results 220)  Search 17: 16 AND (CMUT OR micromachin* OR (micro* W2 machin*)) (Results 19)  Search 18: IC=(G06K9/00 OR A61B5/117) (Results 178186)  Search 19: CPC=(G06K9/0002 OR G06K9/00006 OR G06K9/0012 OR G06K9/00013 OR G06K9/00107 OR A61B5/1172 OR A61B8/4483) (Results 10025)  Search 20: (18 OR 19) (Results 180587)  Search 21: 20 AND FT=((ultrasound* OR ultrason*) NEAR (fingerprint* OR print*)) (Results 788)  Search 22: 21 AND FT=(CMUT OR micromachin* OR (micro* W2 machin*)) (Results 63)  Search 23: 21 AND FT=(membrane* OR diaphragm* OR thin) (Results 282)  Search 24: 23 AND FT=(substrat* OR wafer* OR chip*) (Results 231)  Search 25: 24 AND FT=((second* OR dual* OR two* OR differ* OR multi* OR plural*) NEAR</p>	

(electrod\* OR contact\* OR pad\*) (Results 174)  
 Search 26: 25 AND FT=((second\* OR dual\* OR two\* OR differ\* OR multi\* OR plural\*) NEAR (frequenc\* OR spectrum\* OR spectra\*)) (Results 52)  
 Search 27: 22 AND FT=((substrat\* OR wafer\* OR chip\*) NEAR (cavit\* OR opening\* OR hole\* OR groov\* OR hollow\* OR chamber\*)) (Results 26)  
 Search 28: 20 AND FT=((finger\* OR hand\* OR palm\* OR touch\*) W2 print\*) OR fingerprint\*) (Results 28592)  
 Search 29: 28 AND FT=(ultrasound\* OR ultrason\*) (Results 2661)  
 Search 30: 29 AND FT=(CMUT OR micromachin\* OR (micro\* W2 machin\*) OR micromech\* OR PMUT) (Results 154)  
 Search 31: 30 AND FT=((substrat\* OR wafer\* OR chip\*) NEAR (cavit\* OR opening\* OR hole\* OR groov\* OR hollow\* OR chamber\*)) (Results 31)  
 Search 32: 30 AND FT=((inner\* OR interior\* OR insid\* OR outer\* OR outsid\* OR extern\* OR intern\*) NEAR (electrod\*)) (Results 24)  
 Search 33: FT=((inner\* OR interior\* OR insid\* OR intern\* OR within\*) NEAR electrode\*) (Results 260786)  
 Search 34: 33 AND FT=((extern\* OR exterior\* OR outer\* OR outsid\*) NEAR electrode\*) (Results 94150)  
 Search 35: 34 AND FT=((ultrasound\* OR ultrason\*) NEAR (transducer\* OR sens\* OR detect\* OR determin\* OR monitor\* OR measur\*)) (Results 2550)  
 Search 36: 35 AND FT=((substrat\* OR wafer\* OR chip\*) NEAR (cavit\* OR opening\* OR hole\* OR groov\* OR hollow\* OR chamber\*)) (Results 220)  
 Search 37: 36 AND FT=(membrane\* OR diaphragm\* OR thin) (Results 181)  
 Search 38: 37 AND FT=((second\* OR dual\* OR two\* OR differ\* OR multi\* OR plural\*) NEAR (frequenc\* OR spectrum\* OR spectra\*)) (Results 64)  
 Search 39: PN=(US20120206585) (Results 1)  
 Search 40: PN=(US20170330012) (Results 1)  
 Search 41: PN=(US2007164631) (Results 1)  
 Search 42: RF=(PCT\_US19\_64839) (Results 17)  
 Search 43: 42 AND FT=((multi\* OR plural\* OR second\* OR two OR dual\* OR doubl\*) NEAR frequenc\*) (Results 8)  
 Search 44: FT=((second\* OR dual\* OR two\* OR differ\* OR multi\* OR plural\*) NEAR (frequenc\* OR spectrum\* OR spectra\*)) (Results 1000000)  
 Search 45: 44 AND FT=((first\* OR second\* OR dual\* OR two OR multi\* OR plural\*) NEAR driv\*) (Results 100262)  
 Search 46: 45 AND FT=((ultrasound\* OR ultrason\*) NEAR (fingerprint\* OR print\*)) (Results 119)  
 Search 47: 46 AND FT=(CMUT OR micromachin\* OR (micro\* W2 machin\*)) (Results 16)  
 Search 48: PN=(US20170328866 OR US20120206585 OR US20180129849) (Results 3)  
 Search 49: PN=(US20170110504 OR US20170328866 OR US20120206585 OR US20180129849) (Results 4)

Supplemental SAO searching:

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (Europe) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE

	MA MW OA ZA ZM ZW
<b>Date Conducted</b>	07 February 2020 (07.02.2020)
<b>Search Logic:</b>	

- Search 1: (ultrasound or ultrasonic\*) (Results 748403)
- Search 2: 1 and (fingerprint% or fingerprinting) (Results 15760)
- Search 3: 2 and (micromachined or CMUT or PMUT) (Results 465)
- Search 4: 3 and membrane (Results 279)
- Search 5: 3 and (membrane or diaphragm) (Results 337)
- Search 6: 5 and (cavity or cutout or hollow) (Results 303)
- Search 7: 6 and (electrode%) (Results 154)
- Search 8: 7 and ((coaxial or coaxially or concentric or concentrically or within or nest~) near electrode%) (Results 20)
- Search 9: 7 and ((opposite or oppositely or substrate or wafer) near electrode%) (Results 40)
- Search 10: 7 and ((substrate or wafer) near electrode%) (Results 31)
- Search 11: 7 and (((opposite or oppositely) near (membrane or diaphragm)) near electrode%) (Results 0)
- Search 12: 3 and (((opposite or oppositely) near (membrane or diaphragm)) near electrode%) (Results 0)
- Search 13: 1 and (CMUT or PMUT or micromachine~) (Results 8012)
- Search 14: 13 and (((opposite or oppositely) near (membrane or diaphragm)) near electrode%) (Results 12)
- Search 15: 13 and ((wafer or substrate) near electrode%) (Results 1318)
- Search 16: 15 and ((coaxial or coaxially or concentric or concentrically or nest~) near electrode%) (Results 61)
- Search 17: 16 and PD<20181207 (Results 58)
- Search 18: 16 or 14 (Results 73)
- Search 19: 18 and PD<20181207 (Results 70)
- Search 20: 19 and (fingerprint\* or (finger% and print%)) (Results 10)