



- (51) International Patent Classification:
H01G 5/16 (2006.01)
- (21) International Application Number:
PCT/US2012/068401
- (22) International Filing Date:
7 December 2012 (07.12.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
13/348,541 11 January 2012 (11.01.2012) US
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,

KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

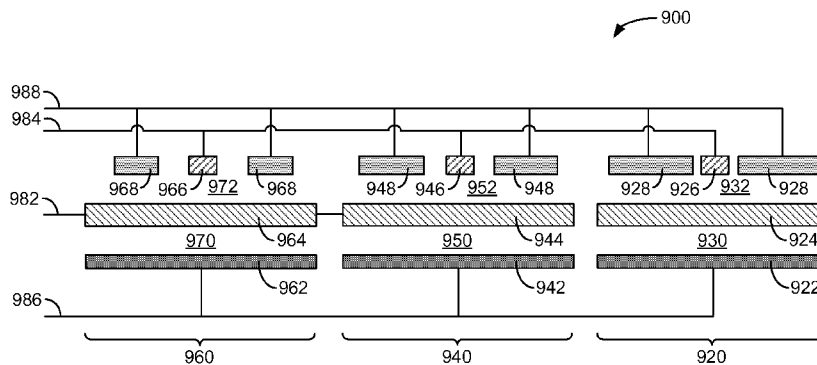
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

- (88) Date of publication of the international search report:
28 November 2013

(54) Title: ELECTROMECHANICAL SYSTEMS VARIABLE CAPACITANCE ASSEMBLY



(57) Abstract: This disclosure provides systems, methods and apparatus for a variable capacitance apparatus. In one aspect, an apparatus includes a plurality of electromechanical systems varactors connected in parallel. Each of the plurality of electromechanical systems varactors includes a first, a second, and a third metal layer. The first metal layer includes a first bias electrode. The second metal layer is spaced apart from the first metal layer to define a first air gap, and includes a first radio frequency electrode. A third metal layer is spaced apart from the second metal layer to define a second air gap, and includes a second radio frequency electrode and a second bias electrode. The second bias electrode of each of the plurality of electromechanical systems varactors has a different projected area perpendicular to a surface of the second metal layer and onto the surface of the second metal layer.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/068401

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01G5/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
H01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/149374 A1 (LAN JE-HSIUNG [US] ET AL) 23 June 2011 (2011-06-23) figure 4 paragraph [0027] - paragraph [0030] -----	1-22
Y	US 2002/079743 A1 (MA QING [US] ET AL) 27 June 2002 (2002-06-27) figures 2-5 paragraph [0036] ----- -/--	1-22

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

8 October 2013

Date of mailing of the international search report

16/10/2013

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/068401

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>SHAKHRAI M V: "Microelectromechanical (mems) varactors for mobile communications", ELECTRON DEVICES AND MATERIALS, 2003. PROCEEDINGS. 4TH ANNUAL 2003 SIB ERIAN RUSSIAN WORKSHOP ON JULY 1-4, 2003, PISCATAWAY, NJ, USA, IEEE, 1 July 2003 (2003-07-01), pages 3-9, XP010654351, ISBN: 978-5-7782-0412-6 figures 8,9,13,15 -----</p>	1,17,20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/068401

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2011149374	A1	23-06-2011	CN 102656649 A	05-09-2012
			EP 2513929 A1	24-10-2012
			JP 2013519104 A	23-05-2013
			KR 20120115305 A	17-10-2012
			TW 201142884 A	01-12-2011
			US 2011149374 A1	23-06-2011
			WO 2011075366 A1	23-06-2011

US 2002079743	A1	27-06-2002	AT 341822 T	15-10-2006
			AU 2002217909 A1	08-07-2002
			CN 1529890 A	15-09-2004
			DE 60123659 T2	16-08-2007
			EP 1346382 A2	24-09-2003
			HK 1058259 A1	04-05-2007
			JP 2004519845 A	02-07-2004
			TW 575887 B	11-02-2004
			US 2002079743 A1	27-06-2002
WO 02052592 A2	04-07-2002			
