



US007750850B2

(12) **United States Patent**
Mei

(10) **Patent No.:** **US 7,750,850 B2**
(45) **Date of Patent:** **Jul. 6, 2010**

- (54) **PRINTED ANTENNA**
- (75) Inventor: **Chia-Hao Mei**, Taipei Hsien (TW)
- (73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, Taipei Hsien (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 365 days.

6,246,371 B1 * 6/2001 Kurz et al. 343/702
 6,388,626 B1 * 5/2002 Gamalielsson et al. 343/702
 6,642,893 B1 * 11/2003 Hebron et al. 343/702

FOREIGN PATENT DOCUMENTS

CN 2689482 Y 3/2005

* cited by examiner

Primary Examiner—Tho G Phan

(74) *Attorney, Agent, or Firm*—Frank R. Niranjana

(21) Appl. No.: **11/752,314**

(22) Filed: **May 23, 2007**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2008/0169982 A1 Jul. 17, 2008

(30) **Foreign Application Priority Data**

Jan. 12, 2007 (CN) 2007 1 0200052

(51) **Int. Cl.**
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/700 MS**; 343/846;
343/895

(58) **Field of Classification Search** 343/700 MS,
343/702, 829, 846, 895
See application file for complete search history.

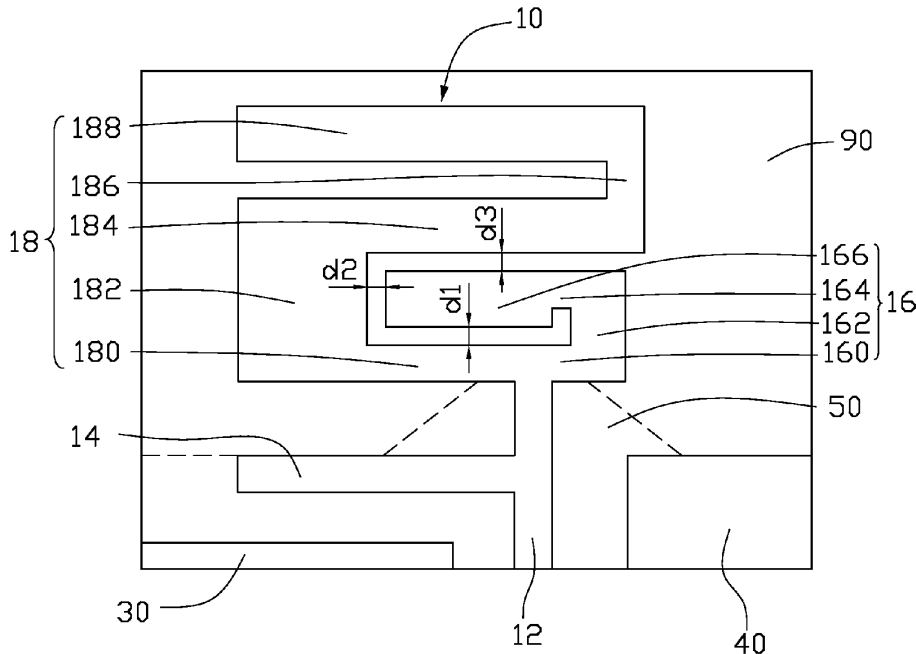
(56) **References Cited**

U.S. PATENT DOCUMENTS

6,069,592 A * 5/2000 Wass 343/895

16 Claims, 8 Drawing Sheets

A printed antenna (10) disposed on a substrate (90) includes a feeding portion (12), a first radiation portion (16), a second radiation portion (18), a matching portion (14), and a grounded portion. The feeding portion feeds electromagnetic signals. One end of the first radiation portion is electronically connected to the feeding portion, and the other end of the first radiation portion is a free end. One end of the second radiation portion is electronically connected to the feeding portion and the first radiation portion, and the other end of the second radiation portion is a free end. The second radiation portion includes a plurality of radiation segments forming at least one space, and the first radiation portion is accommodated in the space formed by the radiation segments. The matching portion is electronically connected to the feeding portion, for impedance matching. The grounded portion is located adjacent to the feeding portion.





US007750854B2

(12) **United States Patent**
Wedel et al.

(10) **Patent No.:** **US 7,750,854 B2**
(45) **Date of Patent:** **Jul. 6, 2010**

(54) **COMBINED SPEAKER AND ANTENNA COMPONENT**

(75) Inventors: **Martin Wedel**, Malmö (SE); **Georgeta Anton**, Malmö (SE)

(73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/544,121**

(22) PCT Filed: **Feb. 4, 2004**

(86) PCT No.: **PCT/EP2004/001003**

§ 371 (c)(1),
(2), (4) Date: **Aug. 2, 2005**

(87) PCT Pub. No.: **WO2004/070871**

PCT Pub. Date: **Aug. 19, 2004**

(65) **Prior Publication Data**

US 2006/0038733 A1 Feb. 23, 2006

Related U.S. Application Data

(60) Provisional application No. 60/449,701, filed on Feb. 24, 2003.

(30) **Foreign Application Priority Data**

Feb. 10, 2003 (EP) 03445020

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702**

(58) **Field of Classification Search** **343/702,**
343/795, 846; 455/575.1-575.9, 90.1-90.3

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,031,505 A 2/2000 Qi et al. 343/795
6,208,874 B1 * 3/2001 Rudisill et al. 455/575.4
6,297,778 B1 * 10/2001 Phillips et al. 343/702
6,360,105 B2 * 3/2002 Nakada et al. 455/575.7

(Continued)

FOREIGN PATENT DOCUMENTS

DE 10052909 A1 5/2002

(Continued)

OTHER PUBLICATIONS

*International Search Report dated May 13, 2004 for corresponding PCT application No. PCT/EP2004/001003.

Primary Examiner—Hoang V Nguyen

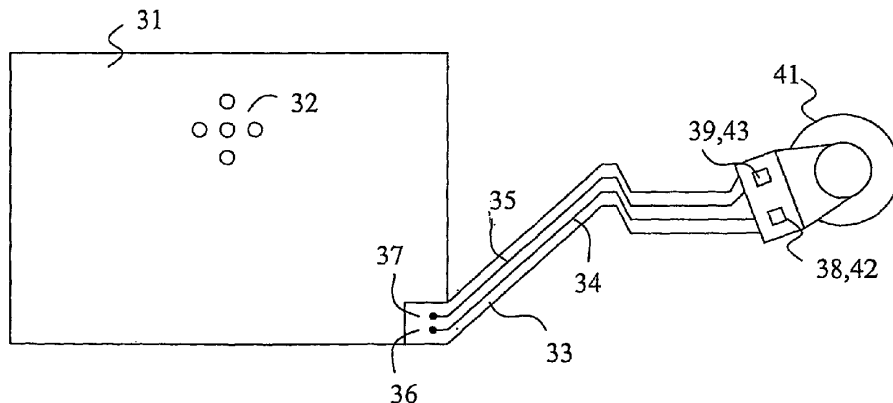
Assistant Examiner—Robert Karacsony

(74) *Attorney, Agent, or Firm*—Myers Bigel Sibley & Sajovec, P.A.

(57) **ABSTRACT**

A combined speaker and antenna arrangement for a communication terminal, includes a support structure carrying a first antenna element, and a second antenna element arranged at a predetermined distance from said first antenna element. The second antenna element is a conductive first portion of a sheet of flexible film. An elongated second portion of the flexible film, carrying a conductive lead, extends from adjacent to the first portion to a speaker connected to an outer end of the elongated second portion. The second, elongated portion, is bent such that the speaker is positioned between the film and the support structure, adjacent to an aperture in the first portion.

21 Claims, 5 Drawing Sheets





US007750865B2

(12) **United States Patent**
Hilgers

(10) **Patent No.:** **US 7,750,865 B2**
(45) **Date of Patent:** **Jul. 6, 2010**

(54) **MULTIPURPOSE ANTENNA CONFIGURATION FOR A CONTACTLESS DATA CARRIER**
(75) Inventor: **Achim Hilgers**, Alsdorf (DE)
(73) Assignee: **NXP B.V.**, Eindhoven (NL)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 680 days.

(52) **U.S. Cl.** **343/806; 343/807**
(58) **Field of Classification Search** 343/795, 343/805, 806, 807, 808, 809, 792.5, 828, 343/700 MS, 726, 857, 735, 736, 743
See application file for complete search history.

(21) Appl. No.: **11/658,225**
(22) PCT Filed: **Jul. 14, 2005**
(86) PCT No.: **PCT/IB2005/052336**
§ 371 (c)(1),
(2), (4) Date: **Jan. 22, 2007**
(87) PCT Pub. No.: **WO2006/011091**
PCT Pub. Date: **Feb. 2, 2006**

(56) **References Cited**
U.S. PATENT DOCUMENTS
3,928,854 A * 12/1975 Tacussel 343/735
5,966,098 A * 10/1999 Qi et al. 343/702
6,940,455 B2 * 9/2005 Plettner 343/700 MS
6,975,278 B2 * 12/2005 Song et al. 343/795
6,999,028 B2 * 2/2006 Egbert 343/700 MS
2004/0036655 A1 * 2/2004 Sainati et al. 343/702

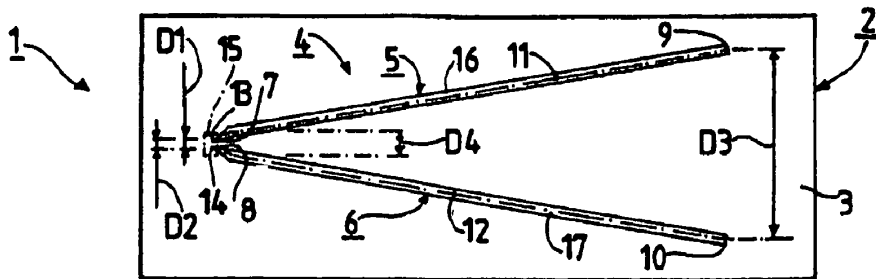
* cited by examiner
Primary Examiner—Michael C Wimer
Assistant Examiner—Kyana R Robinson

(65) **Prior Publication Data**
US 2009/0002253 A1 Jan. 1, 2009
(30) **Foreign Application Priority Data**
Jul. 20, 2004 (EP) 04103456

(57) **ABSTRACT**
In an antenna configuration (4) with two antenna arms (5, 6) arranged in a V-shape, two coupling zones (13, 14) for electrically coupling to respective terminals of an integrated component (15) are provided in the region of the ends (7, 8) of the antenna arms (5, 6) lying close together, wherein each of the two antenna arms (5, 6) in addition comprises a coupling region (20, 21) at a distance from its coupling zone (13, 14), and each coupling region (20, 21) is designed for electrically coupling to a terminal of a further electronic component (22).

(51) **Int. Cl.**
H01Q 9/16 (2006.01)

4 Claims, 2 Drawing Sheets





US007750866B2

(12) **United States Patent**
Rambeau et al.

(10) **Patent No.:** **US 7,750,866 B2**
(45) **Date of Patent:** **Jul. 6, 2010**

(54) **DIVERSITY ANTENNA ASSEMBLY FOR WIRELESS COMMUNICATION EQUIPMENT**

(75) Inventors: **Vincent Rambeau**, Cormelles le Royal (FR); **Jan Van Sinderen**, Liempde (NL); **Johannes H. A. Brekelmans**, Nederweert (NL); **Marc G. M Notten**, Elsloo (NL)

(73) Assignee: **NXP B.V.**, Eindhoven (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/915,812**

(22) PCT Filed: **May 16, 2006**

(86) PCT No.: **PCT/IB2006/051527**

§ 371 (c)(1),
(2), (4) Date: **Apr. 8, 2009**

(87) PCT Pub. No.: **WO2006/129210**

PCT Pub. Date: **Dec. 7, 2006**

(65) **Prior Publication Data**
US 2009/0195472 A1 Aug. 6, 2009

(30) **Foreign Application Priority Data**
May 30, 2005 (EP) 05300431

(51) **Int. Cl.**
H01Q 7/00 (2006.01)
H01Q 9/16 (2006.01)
H01Q 3/24 (2006.01)

(52) **U.S. Cl.** **343/866**; 343/793; 343/876

(58) **Field of Classification Search** 343/793,
343/846, 866, 876, 893
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,589,344 A	6/1926	Akers	
H1571 H	8/1996	Hansen et al.	
6,909,401 B2 *	6/2005	Rutfors et al.	343/702
7,212,164 B2 *	5/2007	Miyano et al.	343/702
2006/0114159 A1 *	6/2006	Yoshikawa et al.	343/702

FOREIGN PATENT DOCUMENTS

WO 9812773 A1 3/1998

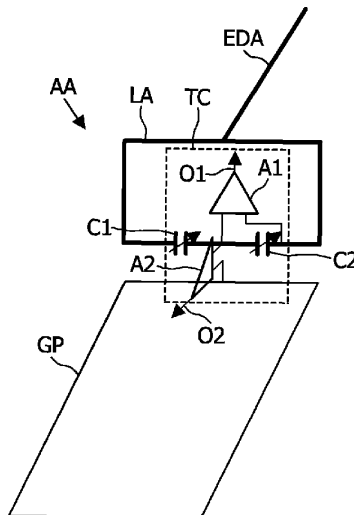
* cited by examiner

Primary Examiner—Shih-Chao Chen

(57) **ABSTRACT**

An antenna assembly for wireless communication equipment comprises an antenna structure comprising at least a loop type antenna arranged to deliver a first current when it is used in a balanced mode and/or a second current when it is used in an unbalanced mode with respect to a ground plane from received radio signals, and current extraction device coupled to the antenna structure and arranged to be placed in at least a first state in which the current extraction device delivers the first or second current and a second state in which the current extraction device simultaneously delivers the first and second currents either separately or mixed together.

10 Claims, 5 Drawing Sheets





US007755546B2

(12) **United States Patent**
Ishimiya

(10) **Patent No.:** **US 7,755,546 B2**
(45) **Date of Patent:** **Jul. 13, 2010**

(54) **ANTENNA DEVICE AND MOBILE
TERMINAL APPARATUS EQUIPPED WITH
THE ANTENNA DEVICE**

(75) Inventor: **Katsunori Ishimiya**, Tokyo (JP)

(73) Assignee: **Sony Ericsson Mobile
Communications Japan, Inc.**, Tokyo
(JP)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 334 days.

(21) Appl. No.: **11/322,339**

(22) Filed: **Jan. 3, 2006**

(65) **Prior Publication Data**
US 2006/0158379 A1 Jul. 20, 2006

(30) **Foreign Application Priority Data**
Jan. 20, 2005 (JP) 2005-013005

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/700 MS**

(58) **Field of Classification Search** **343/700 MS,**
343/702, 846, 848
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS

6,054,954 A 4/2000 Eggleston et al.
6,600,450 B1* 7/2003 Efanov et al. 343/726

7,119,747 B2* 10/2006 Lin et al. 343/702
2004/0090376 A1 5/2004 Dai et al.
2004/0090377 A1 5/2004 Dai et al.
2004/0135729 A1 7/2004 Talvitie et al.
2004/0227665 A1 11/2004 Tai et al.
2004/0263396 A1* 12/2004 Sung 343/702
2007/0103371 A1* 5/2007 Kim et al. 343/702
2007/0132641 A1* 6/2007 Korva et al. 343/700 MS
2007/0139270 A1* 6/2007 Takei et al. 343/700 MS

FOREIGN PATENT DOCUMENTS

JP 08-204431 A 8/1996
JP 2002-043826 2/2002
WO WO 2004/097984 11/2004

OTHER PUBLICATIONS

EPO Search Report mailed Apr. 3, 2006.
Japanese Office Action issued Jun. 17, 2009 for corresponding Japa-
nese Application No. 2005-013005.

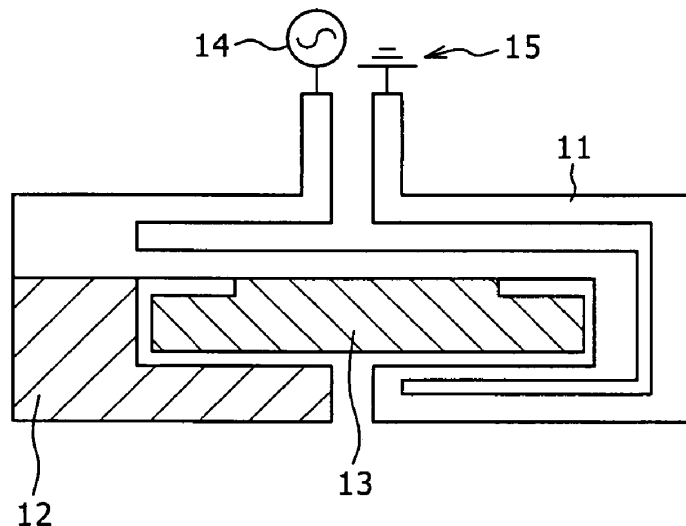
* cited by examiner

Primary Examiner—Hoang Anh T Le
(74) *Attorney, Agent, or Firm*—Rader, Fishman & Grauer
PLLC

(57) **ABSTRACT**

There is provided an antenna device which includes: a loop antenna connected at one end to a feed point and connected at the other end to ground, and provided to correspond to a first frequency band; and at least one stub antenna provided in the form of extending a part of the loop antenna and provided to correspond to a second frequency band overlapping with a partial frequency band of the first frequency band to which the loop antenna corresponds.

14 Claims, 5 Drawing Sheets





US007755548B2

(12) **United States Patent**
Lev

(10) **Patent No.:** **US 7,755,548 B2**
(45) **Date of Patent:** **Jul. 13, 2010**

(54) **CABLE TENSION MECHANISM FOR AN ANTENNA**

2002/0151328 A1 10/2002 Shin et al.
2003/0125070 A1 7/2003 Wagner et al.
2004/0140937 A1* 7/2004 Yang 343/702
2006/0082508 A1 4/2006 Doczy et al.

(75) Inventor: **Jeffrey A. Lev**, Cypress, TX (US)

FOREIGN PATENT DOCUMENTS

(73) Assignee: **Hewlett-Packard Development Company, L.P.**, Houston, TX (US)

KR 20020009130 A 2/2002
KR 20040103990 A 12/2004

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 595 days.

OTHER PUBLICATIONS

(21) Appl. No.: **11/745,297**

Kirby, Graham, "Integrating Bluetooth Technology into Mobile Products;" Intel Technology Journal Q2, 2000; 8 p.; Mobile Computing Group, Intel Corporation.
PCT International Search Report, mailed Oct. 28, 2008 (3 p.) for PCT/US2008/005636.
DE Office Action dated Mar. 17, 2010, pp. 3.

(22) Filed: **May 7, 2007**

* cited by examiner

(65) **Prior Publication Data**

US 2008/0278383 A1 Nov. 13, 2008

Primary Examiner—Shih-Chao Chen

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 3/02 (2006.01)

(57) **ABSTRACT**

(52) **U.S. Cl.** **343/702; 343/882**

A system comprises a hinged antenna adapted to reside within a slot, an electrical cable connected to the antenna, and a cable tension mechanism. The cable tension mechanism receives the electrical cable from the antenna and pulls on the cable when the hinged antenna is in the slot and also when the hinged antenna is rotated to a deployed position at least partially outside the slot.

(58) **Field of Classification Search** 343/702, 343/882, 900

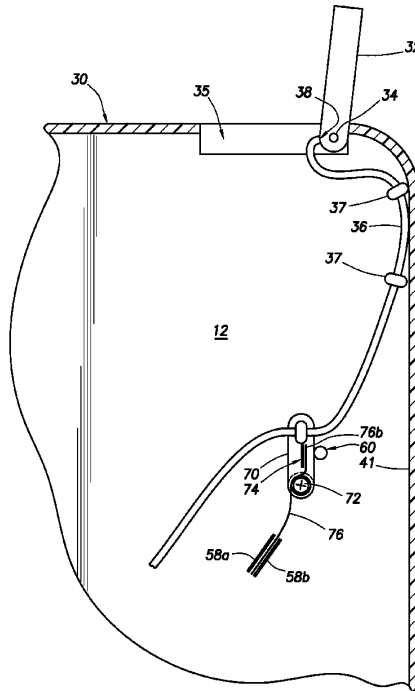
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,359,591 B1* 3/2002 Mou 343/702

20 Claims, 3 Drawing Sheets





US00775554B2

(12) **United States Patent**
Shih

(10) **Patent No.:** **US 7,755,554 B2**
(45) **Date of Patent:** **Jul. 13, 2010**

- (54) **ANTENNA**
- (75) Inventor: **Yen-Yi Shih**, Taipei Hsien (TW)
- (73) Assignee: **Hon Hai Precision Industry Co., Ltd.**,
Tu-Cheng, Taipei Hsien (TW)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 25 days.

3,852,760 A *	12/1974	Reggia	343/747
3,967,276 A *	6/1976	Goubau	343/752
4,242,685 A *	12/1980	Sanford	343/770
5,181,044 A *	1/1993	Matsumoto et al.	343/752
5,539,418 A *	7/1996	Egashira et al.	343/712
5,568,157 A *	10/1996	Anderson	343/713

FOREIGN PATENT DOCUMENTS

TW	1234901	6/2005
TW	200803053	1/2008

* cited by examiner

Primary Examiner—Michael C Wimer
(74) *Attorney, Agent, or Firm*—Frank R. Niranjan

- (21) Appl. No.: **12/164,129**
- (22) Filed: **Jun. 30, 2008**

- (65) **Prior Publication Data**
US 2009/0128418 A1 May 21, 2009

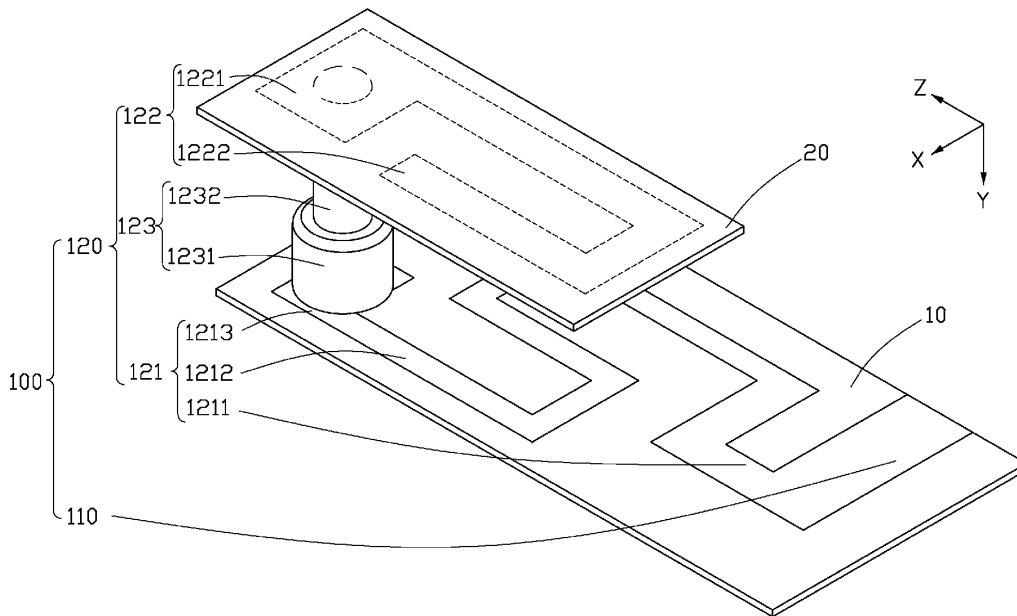
- (30) **Foreign Application Priority Data**
Nov. 16, 2007 (CN) 2007 1 0202575

- (51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
- (52) **U.S. Cl.** 343/729; 343/702; 343/828
- (58) **Field of Classification Search** 343/700 MS,
343/702, 725, 729, 828, 846
See application file for complete search history.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
3,838,429 A * 9/1974 Reggia 343/750

(57) **ABSTRACT**
An antenna (100) disposed on a first substrate (10) and a second substrate (20) includes a feeding portion (110) and a radiating portion (120). The feeding portion (110) is disposed on a first surface of the first substrate (10), for feeding electromagnetic signals. The radiating portion (120) connected to the feeding portion (110) for transceiving electromagnetic signals includes a first radiator (121), a second radiator (122) and a third radiator (123). The first radiator (121) is disposed on the first surface and connected to the feeding portion (110). The second radiator (122) is disposed on a second surface of the second substrate (20). The third radiator (123) includes a first cylinder portion (1231) and a second cylinder portion (1232) connected to the first cylinder portion (1231). The first cylinder portion (1231) and the second cylinder portion (1232) are connected to the first radiator (121) and the second radiator (122), respectively.

9 Claims, 5 Drawing Sheets





US00775559B2

(12) **United States Patent**
Pakosz et al.

(10) **Patent No.:** **US 7,755,559 B2**
(45) **Date of Patent:** **Jul. 13, 2010**

(54) **DUAL-BAND OMNIDIRECTIONAL ANTENNA**

(56) **References Cited**

(75) Inventors: **Daniel Pakosz**, Elgin, IL (US); **Randy Posluszny**, Brookfield, IL (US); **Clifford Raiman**, Roselle, IL (US)

U.S. PATENT DOCUMENTS

7,064,729 B2 6/2006 Olson
7,292,200 B2 11/2007 Posluszny et al.
7,369,094 B2 * 5/2008 Song et al. 343/816

(73) Assignee: **Mobile Mark, Inc.**, Schiller Park, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

* cited by examiner

Primary Examiner—Douglas W Owens

Assistant Examiner—Dieu Hien T Duong

(74) *Attorney, Agent, or Firm*—George H. Gerstman; Seyfarth Shaw LLP

(21) Appl. No.: **12/482,001**

(22) Filed: **Jun. 10, 2009**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2010/0141545 A1 Jun. 10, 2010

Related U.S. Application Data

(60) Provisional application No. 61/120,894, filed on Dec. 9, 2008.

A dual-band omnidirectional antenna is provided. The antenna comprises a vertically stacked antenna array, in the following order: a first dual-band dipole which resonates at a first frequency band and a second frequency band, a first single-band dipole which resonates only at the first frequency band, a second single-band dipole which resonates only at the first frequency band, and a second dual band dipole which resonates at the first frequency band and second frequency band. The first frequency band is of a higher frequency than the second frequency band.

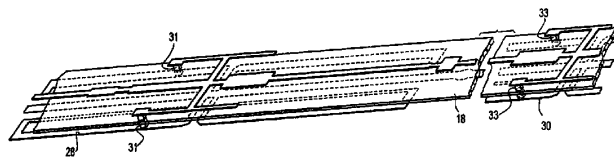
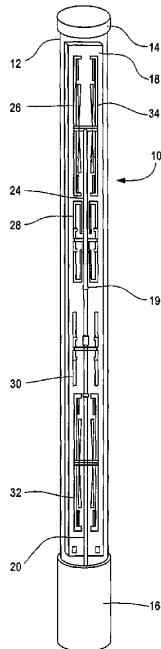
(51) **Int. Cl.**
H01Q 21/00 (2006.01)

(52) **U.S. Cl.** **343/810; 343/793; 343/700 MS**

(58) **Field of Classification Search** **343/810, 343/793, 700 MS**

See application file for complete search history.

12 Claims, 4 Drawing Sheets





US007755560B2

(12) **United States Patent**
Park et al.

(10) **Patent No.:** **US 7,755,560 B2**
(45) **Date of Patent:** **Jul. 13, 2010**

(54) **ANTENNA HAVING PARASITIC ELEMENT**

(56) **References Cited**

(75) Inventors: **Se-hyun Park**, Gyeonggi-do (KR);
Byung-tae Yoon, Gyeonggi-do (KR);
Young-min Moon, Seoul (KR);
Dong-jin Kim, Gyeonggi-do (KR)

U.S. PATENT DOCUMENTS

5,294,939 A *	3/1994	Sanford et al.	343/836
5,420,599 A *	5/1995	Erkocevic	343/828
6,476,773 B2 *	11/2002	Palmer et al.	343/795
6,876,331 B2 *	4/2005	Chiang et al.	343/702
2006/0044205 A1 *	3/2006	Lynch et al.	343/833

(73) Assignee: **Samsung Electronics Co., Ltd.**,
Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 8 days.

* cited by examiner

Primary Examiner—Tho G Phan
(74) *Attorney, Agent, or Firm*—NSIP Law

(21) Appl. No.: **12/099,739**

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(57) **ABSTRACT**

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(30) **Foreign Application Priority Data**

Sep. 7, 2007 (KR) 10-2007-0090820

(51) **Int. Cl.**
H01Q 19/10 (2006.01)

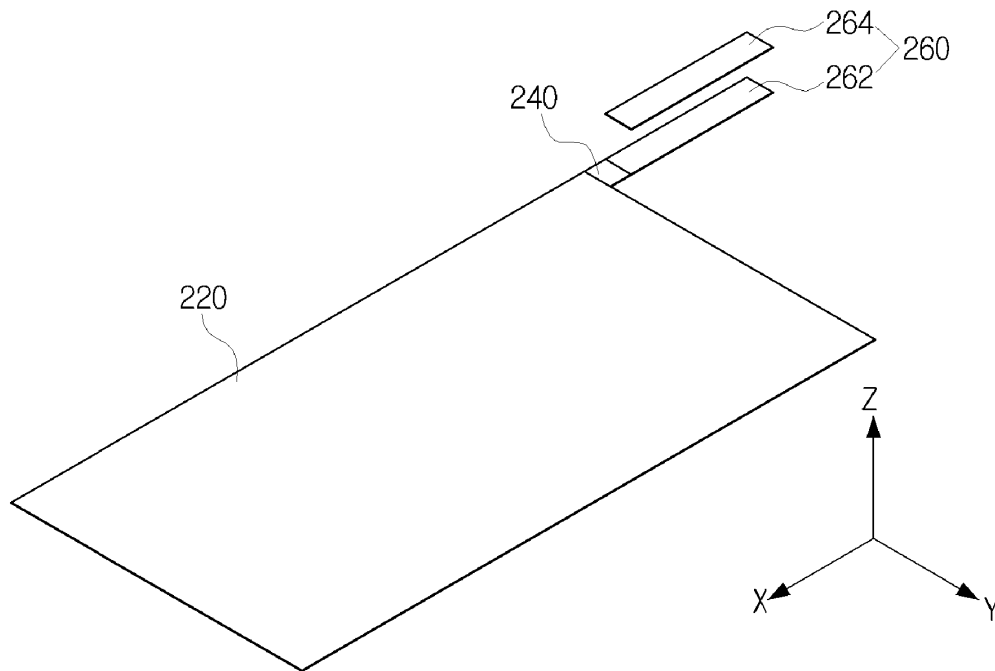
(52) **U.S. Cl.** **343/834**; 343/817; 343/833

(58) **Field of Classification Search** 343/816,
343/817, 833, 834

See application file for complete search history.

10 Claims, 9 Drawing Sheets

An antenna having a parasitic element is disclosed, the antenna including a ground, a radiation unit which is arranged on a different area of the same plane as the ground, and a parasitic element which is selectively connected to the ground, and operates as an antenna element. Where the antenna is in a first mode, electromagnetic waves resonate in the radiation unit, and where the antenna is in a second mode, electromagnetic waves resonate in the radiation unit and the parasitic element.





US007760140B2

(12) **United States Patent**
Kamgaing

(10) **Patent No.:** **US 7,760,140 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **MULTIBAND ANTENNA ARRAY USING ELECTROMAGNETIC BANDGAP STRUCTURES**

2006/0112898 A1* 6/2006 Fjelstad et al. 119/496
2006/0125713 A1* 6/2006 Thevenot et al. 343/909
2008/0258993 A1* 10/2008 Gummalla et al. 343/876

(75) Inventor: **Telesphor Kamgaing**, Chandler, AZ (US)

OTHER PUBLICATIONS

(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

International Search Report for corresponding matter P24200PCT dated Nov. 7, 2007.

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 727 days.

Fan Yang et al., Microstrip Antennas Integrated with Electromagnetic Band-Gap (EBG) Structures: A Low Mutual Coupling Design for Array Applications, *IEEE Transactions Antennas and Propagation*, vol. 51, Issue 10, Part 2, Oct. 2003, pp. 2936-2946.

(21) Appl. No.: **11/449,915**

Gardelli et al., EBG Superstrates for Dual Polarized Sparse Arrays, *Antennas and Propagation Society International Symposium*, 2005 IEEE vol. 2A, Jul. 3-8, 2005, pp. 586-589.

(22) Filed: **Jun. 9, 2006**

Kamgaing, T. et al; Electromagnetic band-gap structures for multiband mitigation of resonant modes in parallel-plate waveguides, *Antennas and Propagation Society International Symposium*, 2004 IEEE vol. 4, Jun. 20-25, 2004 pp. 3577-3580.

(65) **Prior Publication Data**

US 2007/0285336 A1 Dec. 13, 2007

U.S. Appl. No. 11/154,078, filed Jun. 15, 2006, Kamgaing.

U.S. Appl. No. 11/240,305, filed Sep. 29, 2005, Kamgaing.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 15/02 (2006.01)

Kamgaing, T. and Ramahi, O.M., "Electromagnetic Band-Gap Structures for Multiband Mitigation of Resonant Modes in Parallel-Plate Waveguides", *IEEE* 3577-3580, (2004).

International Preliminary Report on Patentability for corresponding matter P24200PCT, mailed Dec. 24, 2008.

(52) **U.S. Cl.** **343/700 MS**; 343/909; 343/829; 343/846; 343/893

* cited by examiner

(58) **Field of Classification Search** None
See application file for complete search history.

Primary Examiner—Trinh V Dinh

(74) *Attorney, Agent, or Firm*—David L. Guglielmi

(56) **References Cited**

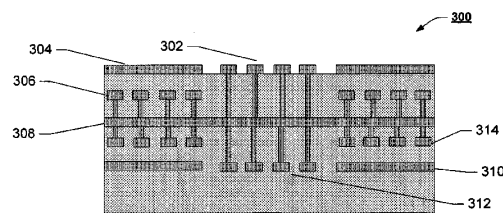
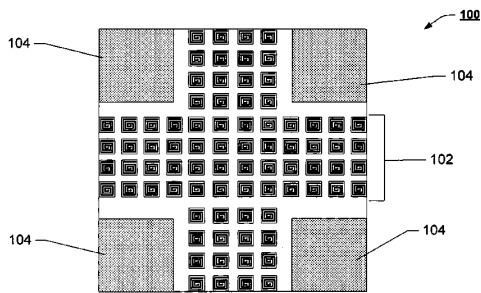
(57) **ABSTRACT**

U.S. PATENT DOCUMENTS

4,131,893	A *	12/1978	Munson et al.	343/700 MS
7,042,419	B2 *	5/2006	Werner et al.	
7,126,542	B2 *	10/2006	Mohamadi	343/700 MS
7,209,082	B2 *	4/2007	Waltho	343/700 MS
7,310,065	B2 *	12/2007	Anguera Pros et al.	343/700 MS
7,486,253	B2 *	2/2009	Kondo et al.	345/1.2
2002/0167457	A1 *	11/2002	McKinzie et al.	343/909
2003/0071763	A1 *	4/2003	McKinzie et al.	343/909
2005/0226468	A1 *	10/2005	Deshpande et al.	382/115

In some embodiments, a multiband antenna array using electromagnetic bandgap structures is presented. In this regard, an antenna array is introduced having two or more planar antennas situated substantially on a surface of a substrate, a first set of electromagnetic bandgap (EBG) cells situated substantially between and on plane with the antennas, and a second set of EBG cells situated within the substrate below the antennas. Other embodiments are also disclosed and claimed.

19 Claims, 2 Drawing Sheets





US007760142B2

(12) **United States Patent**
Sabet et al.

(10) **Patent No.:** **US 7,760,142 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **VERTICALLY INTEGRATED TRANSCEIVER ARRAY**

(75) Inventors: **Kazem F. Sabet**, Ann Arbor, MI (US);
Linda P. B. Katehi, Zionsville, IN (US);
Alexandros Margomenos, Ann Arbor, MI (US)

(73) Assignee: **EMAG Technologies, Inc.**, Ann Arbor, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 507 days.

(21) Appl. No.: **11/733,564**

(22) Filed: **Apr. 10, 2007**

(65) **Prior Publication Data**

US 2008/0252521 A1 Oct. 16, 2008

(51) **Int. Cl.**
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/700 MS**

(58) **Field of Classification Search** **343/700 MS**,
343/770, 702, 846, 848, 853; 342/368
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,421,013 B1 * 7/2002 Chung 343/700 MS

6,646,609 B2 * 11/2003 Yuasa et al. 343/700 MS
6,710,744 B2 * 3/2004 Morris et al. 343/700 MS
7,239,219 B2 * 7/2007 Brown et al. 333/156
7,460,060 B2 * 12/2008 Aoki 342/179
2005/0190101 A1 * 9/2005 Hiramatsu et al. 342/175
2006/0256018 A1 * 11/2006 Soler Castany et al. 343/700 MS

* cited by examiner

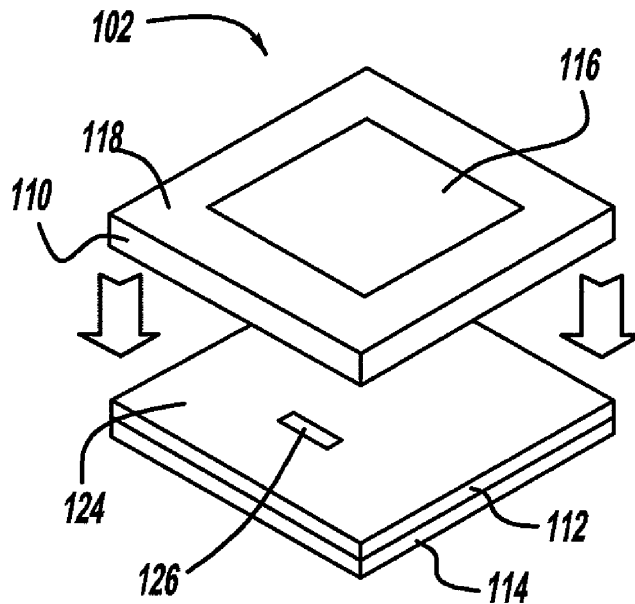
Primary Examiner—Huedung Mancuso

(74) *Attorney, Agent, or Firm*—John A. Miller; Miller IP Group, PLC

(57) **ABSTRACT**

A transceiver array that employs vertically integrated circuits in one or more wafers. The array includes a digital wafer having digital circuits. A plurality of RF cubes are formed to the digital wafer, where each RF cube includes an antenna wafer and at least one lower wafer, and where each RF cube represents a separate channel of the array. The antenna wafer includes a patch antenna and a resonating cavity. The at least one lower wafer includes high frequency RF integrated circuits and intermediate frequency RF integrated circuits. The array has application as a front-end for a digital beam-forming system.

31 Claims, 4 Drawing Sheets





US007760143B2

(12) **United States Patent**
Wei

(10) **Patent No.:** **US 7,760,143 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **MULTI-FREQUENCY ANTENNA AND AN ELECTRIC DEVICE THEREOF**

(75) Inventor: **Shen-Pin Wei**, Taipei Hsien (TW)

(73) Assignee: **Wistron NeWeb Corp.**, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 54 days.

(21) Appl. No.: **11/882,958**

(22) Filed: **Aug. 8, 2007**

(65) **Prior Publication Data**
US 2008/0231516 A1 Sep. 25, 2008

(30) **Foreign Application Priority Data**
Mar. 20, 2007 (TW) 96109590 A

(51) **Int. Cl.** *H01Q 1/38* (2006.01)
(52) **U.S. Cl.** 343/700 MS; 343/702
(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
7,034,754 B2* 4/2006 Hung et al. 343/700 MS

7,289,071 B2*	10/2007	Hung et al.	343/702
7,429,955 B2*	9/2008	Tai et al.	343/702
2005/0168384 A1*	8/2005	Wang et al.	343/700 MS
2005/0259024 A1*	11/2005	Hung et al.	343/770
2007/0018892 A1*	1/2007	Ku et al.	343/700 MS
2007/0030198 A1*	2/2007	Wei	343/700 MS
2007/0120753 A1*	5/2007	Hung et al.	343/702
2007/0146216 A1*	6/2007	Wang et al.	343/702
2007/0216582 A1*	9/2007	Cheng et al.	343/702
2008/0001839 A1*	1/2008	Wei et al.	343/848

FOREIGN PATENT DOCUMENTS

TW	562257	11/2003
TW	M299362	10/2006

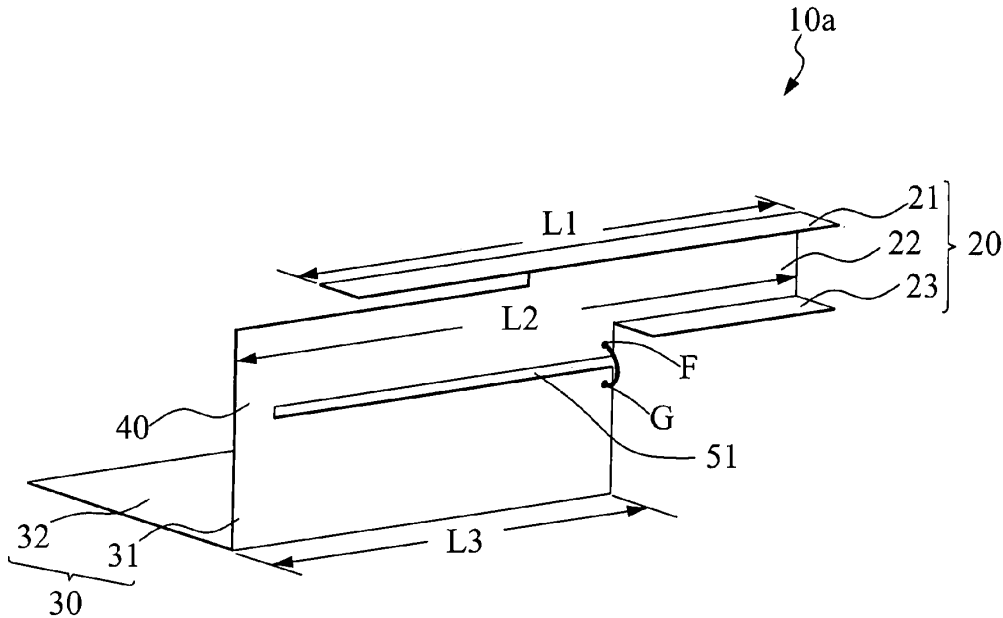
* cited by examiner

Primary Examiner—Trinh V Dinh
(74) *Attorney, Agent, or Firm*—Muncy, Geissler, Olds & Lowe, PLLC

(57) **ABSTRACT**

A multi-frequency antenna is disclosed. The multi-frequency antenna is positioned on an electric device for transmitting Wi-Fi and Wimax wireless signals. The multi-frequency antenna comprises a radiating element, a grounding element and a connecting element. The radiating element comprises a first radiating area and a second radiating area, which are perpendicular to each other. The connecting element is connected to the second radiating area of the radiating element and the grounding element.

14 Claims, 9 Drawing Sheets





US007760145B2

(12) **United States Patent**
Gold

(10) **Patent No.:** **US 7,760,145 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

- (54) **RAISING ANTENNA EFFICIENCY FOR A PORTABLE COMMUNICATION DEVICE**
- (75) Inventor: **Kristina Gold**, Uppsala (SE)
- (73) Assignee: **Sony Ericsson Mobile Communications AB**, Lund (SE)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 165 days.

- (21) Appl. No.: **10/593,997**
- (22) PCT Filed: **Feb. 17, 2005**
- (86) PCT No.: **PCT/EP2005/001582**
§ 371 (c)(1),
(2), (4) Date: **Jun. 18, 2007**
- (87) PCT Pub. No.: **WO2005/096438**
PCT Pub. Date: **Oct. 13, 2005**
- (65) **Prior Publication Data**
US 2007/0290945 A1 Dec. 20, 2007

Related U.S. Application Data

- (60) Provisional application No. 60/557,593, filed on Mar. 30, 2004.

Foreign Application Priority Data

- (30) Mar. 22, 2004 (EP) 04006810
 - (51) **Int. Cl.**
H01Q 1/24 (2006.01)
 - (52) **U.S. Cl.** **343/702; 343/700 MS**
 - (58) **Field of Classification Search** **343/702, 343/700 MS**
- See application file for complete search history.

- (56) **References Cited**
- U.S. PATENT DOCUMENTS

6,259,418	B1	7/2001	Jones et al.	343/846
6,262,364	B1 *	7/2001	Yoshikawa et al.	174/389
6,266,019	B1 *	7/2001	Stewart et al.	343/702
6,879,849	B2 *	4/2005	Begic	455/575.7
2002/0187758	A1	12/2002	Ylitalo et al.	455/575.1
2003/0068987	A1 *	4/2003	Dufosse et al.	455/90

FOREIGN PATENT DOCUMENTS

EP	1317116	6/2003
WO	WO 02/35810	5/2002

OTHER PUBLICATIONS

International Preliminary Examination Report for PCT/EP2005/001582.
Translation of Office Action in corresponding Chinese Application No. 20058009186.6, dated Oct. 16, 2009.

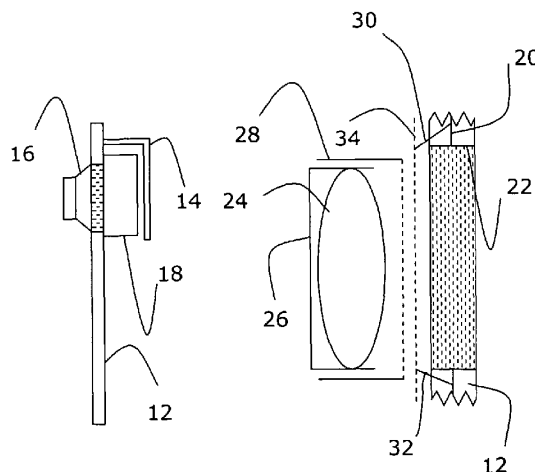
* cited by examiner

Primary Examiner—Douglas W Owens
Assistant Examiner—Dieu Hien T Duong
(74) *Attorney, Agent, or Firm*—Myers Bigel Sibley & Sajovec, PA

(57) **ABSTRACT**

Portable communication devices are provided that include a board for receiving electrical circuits and have a ground plane and at least one throughhole. The devices also include an antenna element on one side of the board and an acoustic element placed on the board and aligned with the throughhole. The devices further include a mesh of electrically conducting material positioned between a cover of the acoustic element and the board. The mesh can be connected to the ground plane of the board to enhance the efficiency of the antenna.

12 Claims, 1 Drawing Sheet





US007760146B2

(12) **United States Patent**
Ollikainen

(10) **Patent No.:** **US 7,760,146 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **INTERNAL DIGITAL TV ANTENNAS FOR HAND-HELD TELECOMMUNICATIONS DEVICE**

2005/0186931	A1 *	8/2005	Laiho et al.	455/280
2006/0099993	A1 *	5/2006	Leinonen et al.	455/562.1
2006/0135061	A1 *	6/2006	Ying	455/19
2006/0197538	A1 *	9/2006	Leinonen et al.	324/533

(75) Inventor: **Jani Ollikainen**, Helsinki (FI)

(73) Assignee: **Nokia Corporation**, Espoo (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 650 days.

(21) Appl. No.: **11/388,802**

(22) Filed: **Mar. 24, 2006**

(65) **Prior Publication Data**
US 2006/0214857 A1 Sep. 28, 2006

Related U.S. Application Data
(60) Provisional application No. 60/665,902, filed on Mar. 24, 2005.

(51) **Int. Cl.**
H01Q 1/24 (2006.01)
H01Q 1/50 (2006.01)
H01Q 3/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/860; 343/876**

(58) **Field of Classification Search** **343/702, 343/700 MS, 876, 850, 860, 895**
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
5,734,355 A * 3/1998 Watanabe 343/859

OTHER PUBLICATIONS

IEEE 0-7803-7954-3/03; J. Villanen et al.; "Compact Antenna Structures for Mobile Handsets"; pp. 40-44; 2003.

* cited by examiner

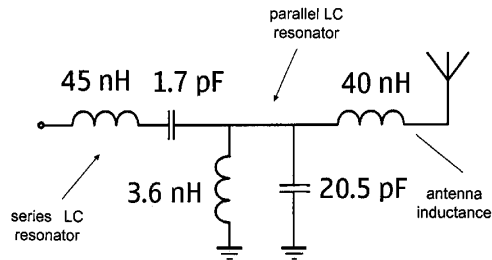
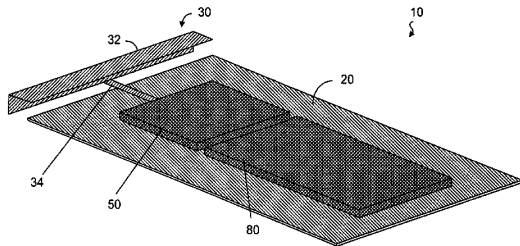
Primary Examiner—Shih-Chao Chen

(74) *Attorney, Agent, or Firm*—Ware, Fressola, Van Der Sluys & Adolphson LLP

(57) **ABSTRACT**

An antenna structure comprises an unbalanced antenna for receiving digital video broadcasting signals. The antenna is dimensioned to fit within an electronic device, such as a mobile phone. The unbalanced antenna has a radiative element and a feed line connected to a matching circuit so as to achieve two or more resonances within a DVB-H frequency range, such as 470 to 702 MHz. The physical length of the radiative element is always smaller than $\lambda/4$ at the frequencies of interest (470-702 MHz), but the electrical length can be smaller or substantially equal to $\lambda/4$. The matching circuit can comprise one or more LC resonators depending on the number of resonances. The resonators can be series or parallel connected between the feed line and RF circuitry for processing the broadcasting signals. The antenna can be tuned to other bands above the DVB-H frequencies for use as a diversity or MIMO antenna.

21 Claims, 11 Drawing Sheets





US007760147B2

(12) **United States Patent**
Nam

(10) **Patent No.:** **US 7,760,147 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **ANTENNA AND MOBILE COMMUNICATION
TERMINAL COMPRISING THE SAME**

(75) Inventor: **Soo Hyun Nam**, Seoul (KR)

(73) Assignee: **LG Electronics, Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 15 days.

(21) Appl. No.: **11/944,297**

(22) Filed: **Nov. 21, 2007**

(65) **Prior Publication Data**
US 2008/0111749 A1 May 15, 2008

(30) **Foreign Application Priority Data**
Nov. 23, 2006 (KR) 10-2006-0116280

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702; 343/700 MS;**
343/841; 343/895

(58) **Field of Classification Search** 343/702,
343/700 MS, 841-848, 793, 797, 810-820,
343/850, 778, 864, 872, 860, 895

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,936,584 A * 8/1999 Lawrence et al. 343/702
6,867,746 B2 * 3/2005 Mendolia et al. 343/841
7,411,556 B2 * 8/2008 Sanz et al. 343/702
7,605,765 B2 * 10/2009 Ku 343/702

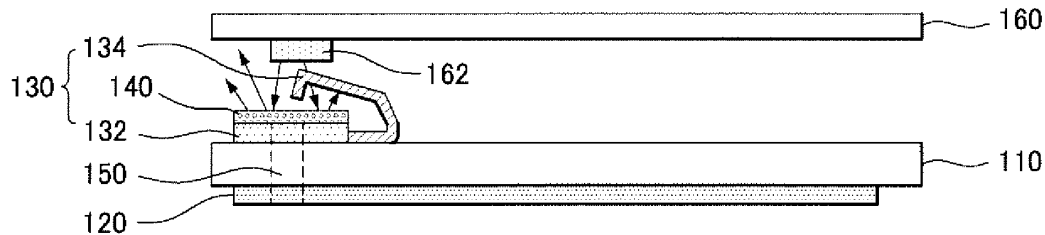
* cited by examiner

Primary Examiner—James H. Cho
Assistant Examiner—Christopher Lo
(74) *Attorney, Agent, or Firm*—Lee, Hong, Degerman,
Kang & Waimey

(57) **ABSTRACT**

A mobile terminal and antenna including a case configured to include a circuit board and an antenna disposed inside the case. The antenna including an antenna pattern formed on a substrate, a feed unit having a first end connected to the antenna pattern and a second end connected to the circuit board. The feed unit is configured to supply an electrical signal to the antenna pattern, and an Electromagnetic Interference (EMI) attenuation unit is disposed in a location corresponding to the feed unit and configured to attenuate the EMI generated by the feed unit.

19 Claims, 11 Drawing Sheets





US007760149B2

(12) **United States Patent**
Höök

(10) **Patent No.:** **US 7,760,149 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **HULL OR FUSELAGE INTEGRATED ANTENNA**

FOREIGN PATENT DOCUMENTS

(75) Inventor: **Anders Höök**, Hindås (SE)

WO WO-2005/069442 A1 7/2005

(73) Assignee: **SAAB AB**, Linköping (SE)

WO WO-2006/091162 A1 8/2006

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 55 days.

OTHER PUBLICATIONS

(21) Appl. No.: **12/073,116**

J. L. Volakis et al.; Broadband RCS Reduction of Rectangular Patch by Using Distributed Loading; Electronics Letters; Dec. 3, 1992, vol. 28, No. 25; pp. 2322-2323.

(22) Filed: **Feb. 29, 2008**

* cited by examiner

(65) **Prior Publication Data**

Primary Examiner—Michael C Wimer
(74) *Attorney, Agent, or Firm*—Venable LLP; Eric J. Franklin

US 2008/0316124 A1 Dec. 25, 2008

(57) **ABSTRACT**

(30) **Foreign Application Priority Data**

Mar. 2, 2007 (EP) 07446003

An antenna structure integrated in a hull or fuselage. The hull or fuselage can be the outer surface of an aircraft, artillery shell, missile or ship. The antenna structure includes an array antenna. The array antenna includes a number of antenna elements. Each antenna element includes a radiator and an RF feed. The antenna elements are arranged in a lattice within an antenna area including a central antenna area and a transition region outside the central antenna area wherein a number of the antenna radiators as well as resistive sheets are arranged in substantially the same plane as a surrounding outer surface of the hull or fuselage.

(51) **Int. Cl.**
H01Q 1/28 (2006.01)

(52) **U.S. Cl.** **343/708**; 343/770

(58) **Field of Classification Search** 343/705, 343/708, 700 MS, 853, 770, 795

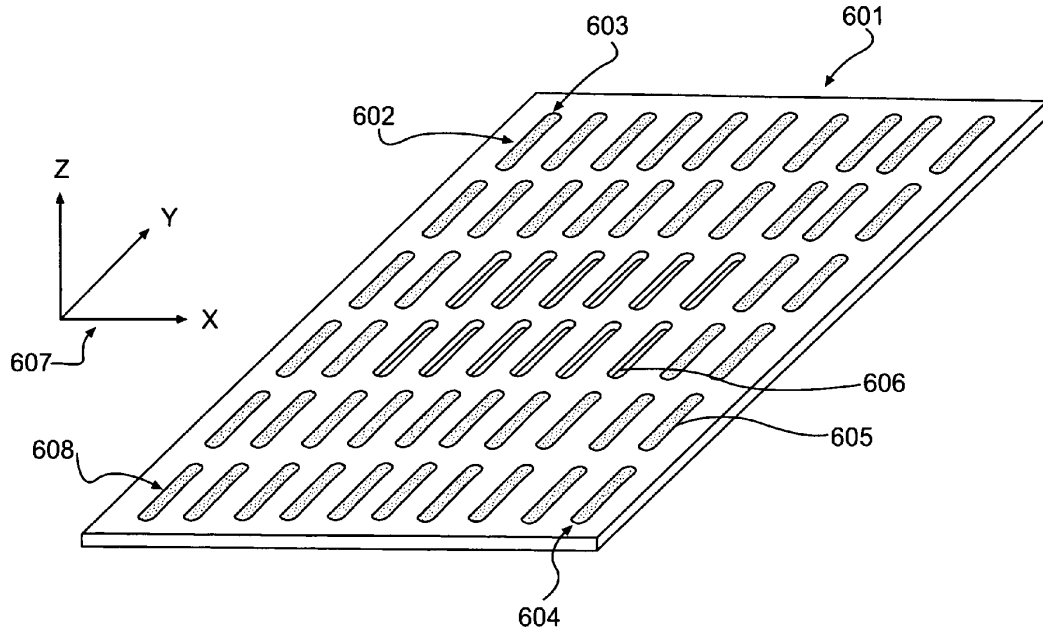
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,409,891 A 11/1968 Lode
4,684,952 A * 8/1987 Munson et al. 343/700 MS

31 Claims, 10 Drawing Sheets





US007760150B2

(12) **United States Patent**
Sato

(10) **Patent No.:** **US 7,760,150 B2**
(45) **Date of Patent:** **Jul. 20, 2010**

(54) **ANTENNA ASSEMBLY AND WIRELESS UNIT EMPLOYING IT**

(75) Inventor: **Junji Sato**, Tokyo (JP)
(73) Assignee: **Panasonic Corporation**, Osaka (JP)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 429 days.

(21) Appl. No.: **11/568,985**
(22) PCT Filed: **Apr. 14, 2005**
(86) PCT No.: **PCT/JP2005/007244**
§ 371 (c)(1),
(2), (4) Date: **Nov. 13, 2006**
(87) PCT Pub. No.: **WO2005/112194**
PCT Pub. Date: **Nov. 24, 2005**

(65) **Prior Publication Data**
US 2008/0231526 A1 Sep. 25, 2008

(30) **Foreign Application Priority Data**
May 18, 2004 (JP) 2004-147267
Feb. 18, 2005 (JP) 2005-042572

(51) **Int. Cl.**
H01Q 1/00 (2006.01)
H01Q 21/00 (2006.01)
H01Q 19/10 (2006.01)
H01Q 19/00 (2006.01)

(52) **U.S. Cl.** **343/724; 343/722; 343/726; 343/729; 343/730; 343/818; 343/833**

(58) **Field of Classification Search** **343/722, 343/724, 726, 729, 730, 741, 748, 818, 833, 343/866, 868, 702**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS
6,947,007 B1 * 9/2005 Rohde et al. 343/804
2004/0070548 A1 * 4/2004 Cake 343/803

FOREIGN PATENT DOCUMENTS
JP 54127616 A * 10/1979

(Continued)

OTHER PUBLICATIONS

Takahashi, English translation of JP 54-127616.*

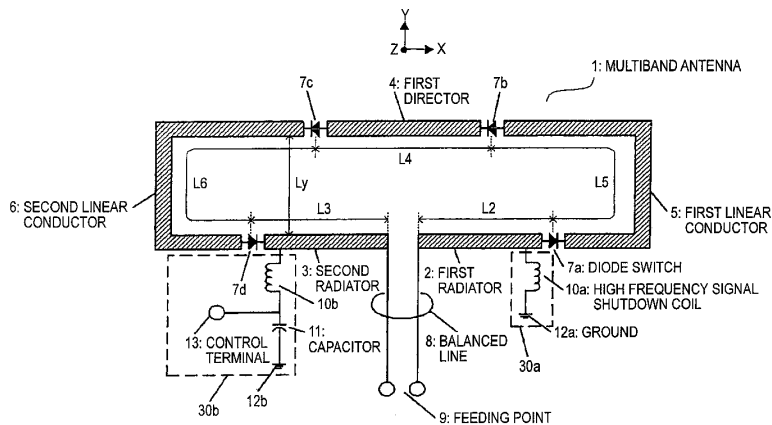
Primary Examiner—Douglas W Owens
Assistant Examiner—Jennifer F Hu
(74) *Attorney, Agent, or Firm*—Pearne & Gordon LLP

(57) **ABSTRACT**

An object of the invention is to provide an antenna apparatus whose directional characteristic can be switched 90 degrees conforming to the communication mode at the same time as the frequency band can be switched in response to the communication mode for application to a multiband radio for covering different communication modes such as voice communications and data communications, and a radio using the antenna apparatus.

An antenna apparatus 1 of the invention includes linear radiator 2, 3; a first linear director 4; and first and second linear conductors 5 and 6 connected at one end to the radiator 2, 3 and at an opposite end to the first director 4 through switches 7. The first and second conductors 5 and 6 are disposed symmetrically with respect to an orthogonal plane in the length direction of the radiator, and the radiator 2, 3, the first director 4, the first conductor 5, and the second conductor 6 are switched between a loop state in which they are connected like a loop and a separate state in which they are separate by switching the switches 7.

23 Claims, 12 Drawing Sheets





US007764233B2

(12) **United States Patent**
Wu

(10) **Patent No.:** **US 7,764,233 B2**

(45) **Date of Patent:** **Jul. 27, 2010**

(54) **SYMMETRICAL UNI-PLATED ANTENNA
AND WIRELESS NETWORK DEVICE
HAVING THE SAME**

(75) Inventor: **Jung Tai Wu**, Taipei (TW)

(73) Assignee: **Cameo Communications Inc.** (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/790,303**

(22) Filed: **Apr. 24, 2007**

(65) **Prior Publication Data**

US 2008/0266180 A1 Oct. 30, 2008

(51) **Int. Cl.**
H01Q 1/38 (2006.01)

(52) **U.S. Cl.** **343/700 MS; 343/702; 343/767; 343/846**

(58) **Field of Classification Search** **343/700 MS, 343/702, 767, 770, 846**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,295,030	B1 *	9/2001	Kozakai et al.	343/700	MS
6,549,169	B1 *	4/2003	Matsuyoshi et al.	343/702	
7,193,571	B2 *	3/2007	Inatsugu et al.	343/702	
7,339,536	B2 *	3/2008	Hung et al.	343/702	

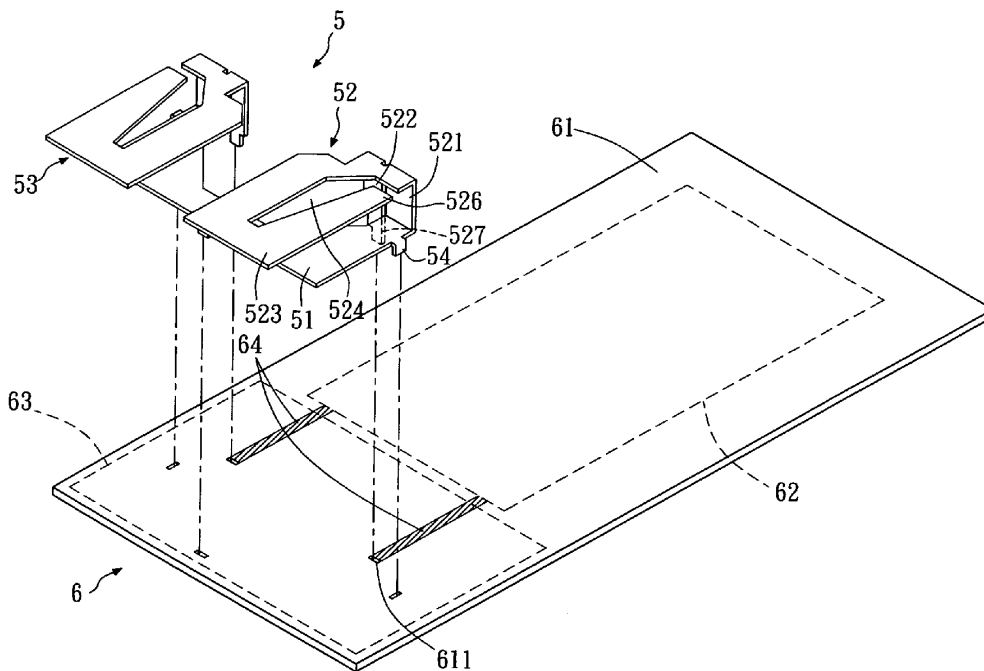
* cited by examiner

Primary Examiner—Hoang V Nguyen

(57) **ABSTRACT**

The present invention discloses an antenna adapted for use in a wireless network device. The antenna includes a base and two antenna portions. Each antenna portion includes a radiation section and a ground section. The ground sections of the two antenna portions are connected with the same base and substantially perpendicular to the base. The radiation section is connected with the ground section and substantially parallel to the base with a difference in height formed between the radiation section and the base. The antenna is a single component integrally formed by stamping an electrically conductive thin metal plate, which not only facilitates fabrication thereof, but also the assembly of the antenna to a substrate of the wireless network device, thereby increasing the gain of the wireless network device along a vertical direction.

12 Claims, 8 Drawing Sheets





US007764234B2

(12) **United States Patent**
Tsai et al.

(10) **Patent No.:** **US 7,764,234 B2**
(45) **Date of Patent:** **Jul. 27, 2010**

(54) **ANTENNA STRUCTURE**
(75) Inventors: **Tony Tsai**, Taipei (TW); **Ryan Chang**,
Shanghai (CN); **Yanping Gao**, Shanghai
(CN); **Jie Zhou**, Shanghai (CN)
(73) Assignee: **Inventec Appliances Corp.**, Taipei (TW)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 417 days.

7,400,300 B2* 7/2008 Qi et al. 343/700 MS
7,403,164 B2* 7/2008 Sanz et al. 343/702
7,405,703 B2* 7/2008 Qi et al. 343/702
7,423,592 B2* 9/2008 Pros et al. 343/700 MS
7,466,273 B2* 12/2008 Lee et al. 343/702

(21) Appl. No.: **11/819,177**

* cited by examiner
Primary Examiner—Douglas W Owens
Assistant Examiner—Chuc D Tran
(74) *Attorney, Agent, or Firm*—Wang Law Firm; Li K. Wang

(22) Filed: **Jun. 26, 2007**

(57) **ABSTRACT**

(65) **Prior Publication Data**
US 2008/0111744 A1 May 15, 2008

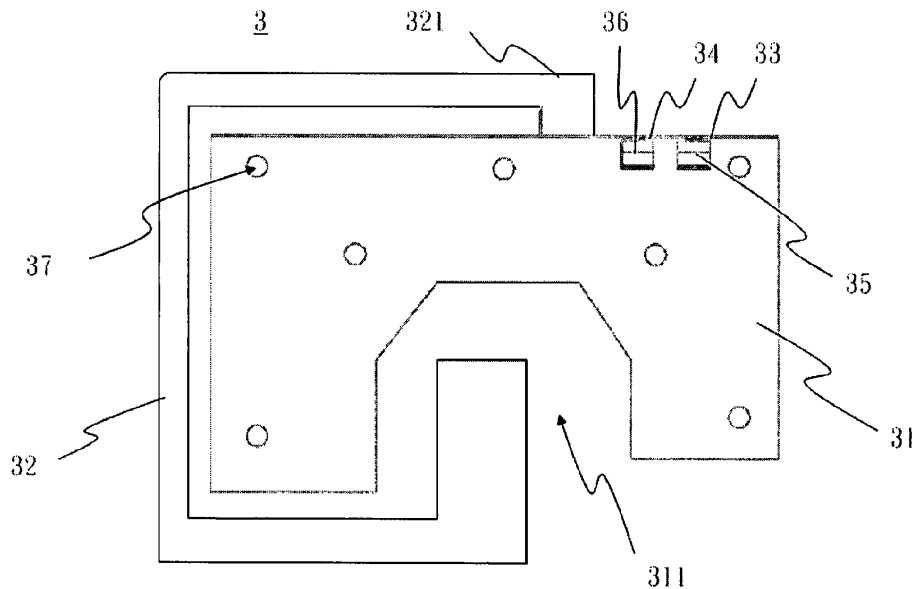
An antenna structure is disposed on a substrate. The antenna structure includes a Γ -shaped radiation body and a first radiation body, and both share a feeding end and a grounding end. The feeding end and the grounding end are disposed to a side edge of the Γ -shaped radiation body. The positions of the feeding end and the grounding end allow the Γ -shaped radiation body to form the operation of two frequency bands. Moreover, the first radiation body is vertically extended from the side edge near the feeding end disposed to the Γ -shaped radiation body, and continuously extended from an end to keep a spacing between periphery of the Γ -shaped radiation body and the first radiation body, and extended to a front of an opening of the Γ -shaped radiation body, thereby vertically extending toward the opening. Therefore, the first radiation body could provide the operation of another frequency band.

(30) **Foreign Application Priority Data**
Nov. 13, 2006 (TW) 95219974 U

(51) **Int. Cl.**
H01Q 9/04 (2006.01)
(52) **U.S. Cl.** **343/700 MS; 343/702;**
343/745; 343/748; 343/828; 343/895
(58) **Field of Classification Search** **343/700 MS,**
343/702, 745, 748, 828, 895
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
6,408,190 B1* 6/2002 Ying 455/553.1

11 Claims, 6 Drawing Sheets





US007764238B2

(12) **United States Patent**
Hotta et al.

(10) **Patent No.:** **US 7,764,238 B2**
(45) **Date of Patent:** **Jul. 27, 2010**

(54) **ANTENNA DEVICE AND ELECTRONIC EQUIPMENT**

2009/0009401 A1* 1/2009 Suzuki et al. 343/700 MS

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Hiroyuki Hotta**, Hamura (JP); **Masao Teshima**, Kunitachi (JP); **Koichi Sato**, Tachikawa (JP)

JP	2003-124742	4/2003
JP	2003-158419	5/2003
JP	2003-168916	6/2003
JP	2003-218623	7/2003
JP	2004-201278	7/2004
JP	2005-094501	4/2005
JP	2005-252480	9/2005
JP	2007-028255	2/2007
JP	3959396 B2	8/2007
JP	2008-028734	2/2008
JP	2008-066779	3/2008
JP	2008-092311	4/2008
JP	2008-167467	7/2008

(73) Assignee: **Kabushiki Kaisha Toshiba**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/415,513**

(22) Filed: **Mar. 31, 2009**

(65) **Prior Publication Data**

US 2010/0026602 A1 Feb. 4, 2010

(30) **Foreign Application Priority Data**

Jul. 29, 2008 (JP) 2008-195529

(51) **Int. Cl.**
H01Q 1/24 (2006.01)

(52) **U.S. Cl.** **343/702**; 343/700 MS; 343/846

(58) **Field of Classification Search** 343/700 MS, 343/702, 829, 843, 846
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,434,579	A *	7/1995	Kagoshima et al.	343/700 MS
6,297,776	B1 *	10/2001	Pankinaho	343/700 MS
6,686,886	B2 *	2/2004	Flint et al.	343/702
7,026,999	B2	4/2006	Umehara et al.	
7,425,924	B2 *	9/2008	Chung et al.	343/702
2005/0110692	A1 *	5/2005	Andersson	343/702

* cited by examiner

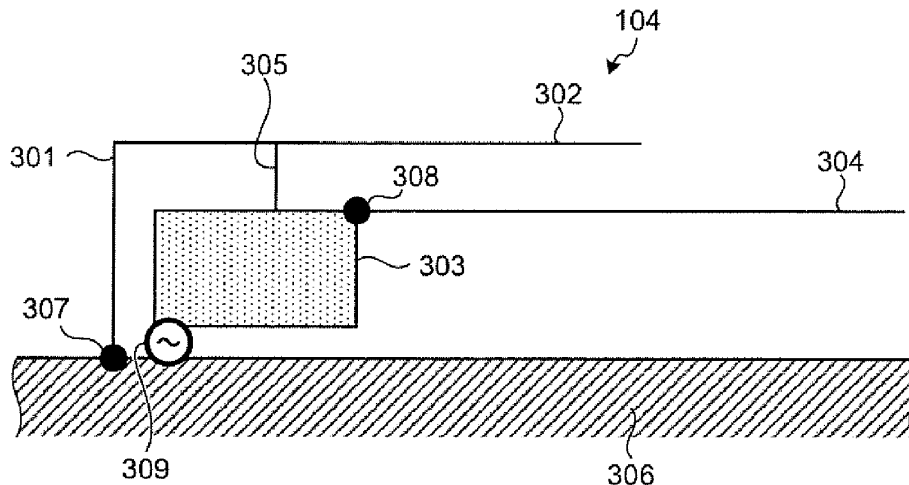
Primary Examiner—Tho G Phan

(74) *Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman LLP

(57) **ABSTRACT**

According to one embodiment, an antenna device includes a short circuit path, a first open-ended element, a feed side element, a second open-ended element, and a short circuit element. One end of the short circuit path is connected to a ground point near a feed point. The first open-ended element extends from another end of the short circuit path. The feed side element extends from near the feed point in a direction in which the first open-ended element extends with an edge close to ground. The second open-ended element extends from near an end of the feed side element in the direction in which the first open-ended element extends. The short circuit element connects between an end of the first open-ended element and a point on an edge of the feed side element opposite the edge close to the ground or a point on the second open-ended element.

10 Claims, 23 Drawing Sheets





US007764242B2

(12) **United States Patent**
Milyakh

(10) **Patent No.:** **US 7,764,242 B2**
(45) **Date of Patent:** **Jul. 27, 2010**

- (54) **BROADBAND ANTENNA SYSTEM**
- (75) Inventor: **Yaroslav Milyakh**, Suwon-si (KR)
- (73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 31 days.

6,208,306	B1 *	3/2001	McLean et al.	343/747
6,906,677	B2	6/2005	Yamamoto et al.	
6,950,066	B2 *	9/2005	Hendler et al.	343/700 MS
7,046,199	B2 *	5/2006	Montgomery et al. .	343/700 MS
2002/0149527	A1	10/2002	Wen et al.	
2004/0066338	A1	4/2004	Chen et al.	

- (21) Appl. No.: **12/186,171**
- (22) Filed: **Aug. 5, 2008**

FOREIGN PATENT DOCUMENTS

EP	1441415	A1	7/2004
JP	08-250916	A	9/1996
JP	09-055620	A	2/1997
JP	2003-188633	A	7/2003
JP	2004-023637	A	1/2004
WO	03/075404	A1	9/2003

- (65) **Prior Publication Data**
US 2009/0033559 A1 Feb. 5, 2009

OTHER PUBLICATIONS

S. Lim, et al.: "Electrically small antenna for maximizing transmissio into HF ground waves"—Electronics Letters, IEE Stevenage, GB, vol. 40, No. 22, Oct. 28, 2004, pp. 1388-1389, ISSN: 0013-5194.

- Related U.S. Application Data**
- (62) Division of application No. 11/319,426, filed on Dec. 29, 2005, now Pat. No. 7,425,921.

* cited by examiner

Primary Examiner—Shih-Chao Chen
(74) *Attorney, Agent, or Firm*—Sughrue Mion, PLLC

- (30) **Foreign Application Priority Data**
Jun. 13, 2005 (KR) 10-2005-0050516

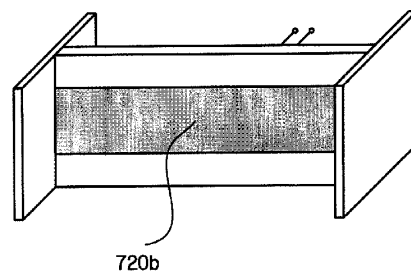
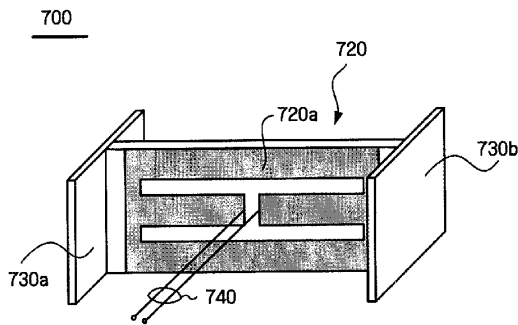
(57) **ABSTRACT**

- (51) **Int. Cl.**
H01Q 9/00 (2006.01)
H01Q 9/28 (2006.01)
 - (52) **U.S. Cl.** **343/752**; 343/795
 - (58) **Field of Classification Search** 343/752, 343/793, 795, 830
- See application file for complete search history.

A broadband antenna system includes a ground plane, a metal plate parallel to the ground plane, and constituting a capacitance load against the ground plane, and a radiation structure connected perpendicularly to the ground plane and the metal plate. The radiation structure includes a feed conductor to supply an electric signal, a short-circuit stub to transfer the supplied electric signal to the ground plane, a conducting bridge to interconnect the feed conductor and the short-circuit stub, which is separated from the metal plate, and a radiating conductor connected to the ground plane the metal plate, and coupled to the supplied electric signal to thereby radiate electromagnetic waves.

- (56) **References Cited**
U.S. PATENT DOCUMENTS
3,967,276 A 6/1976 Goubau
5,181,044 A * 1/1993 Matsumoto et al. 343/752

4 Claims, 12 Drawing Sheets





US007764245B2

(12) **United States Patent**
Loyet

(10) **Patent No.:** **US 7,764,245 B2**
(45) **Date of Patent:** **Jul. 27, 2010**

(54) **MULTI-BAND ANTENNA**
(75) Inventor: **Lowell Lee Loyet**, Woodinville, WA (US)
(73) Assignee: **Cingular Wireless II, LLC**, Atlanta, GA (US)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 628 days.

7,394,437 B1 * 7/2008 Loyet 343/795
2001/0012788 A1 8/2001 Gammon
2002/0075906 A1 6/2002 Cole et al.
2004/0266485 A1 12/2004 Paramesh et al.
2005/0073456 A1 4/2005 Sievenpiper et al.
2005/0073465 A1 * 4/2005 Olson 343/795
(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 809 319 A 11/1997
(Continued)

OTHER PUBLICATIONS

International Search Report dated Dec. 7, 2007 for PCT Application Serial No. PCT/US07/71413, 8 Pages.
(Continued)

Primary Examiner—Trinh V Dinh

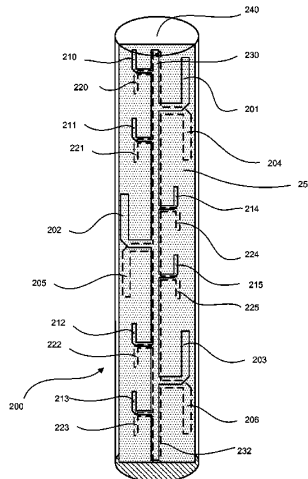
(21) Appl. No.: **11/424,614**
(22) Filed: **Jun. 16, 2006**
(65) **Prior Publication Data**
US 2007/0290938 A1 Dec. 20, 2007
(51) **Int. Cl.**
H01Q 9/28 (2006.01)
H01Q 1/38 (2006.01)
(52) **U.S. Cl.** **343/795; 343/700 MS**
(58) **Field of Classification Search** None
See application file for complete search history.

(57) **ABSTRACT**

A multi-band antenna for use in a wireless communications network provides frequency support for different wireless technologies in a single structure. This substantially reduces installation costs and can be the only solution in limited space installation sites. In one instance, the multi-band antenna has two serial feedlines carrying respective anode and cathode components of RF signals. Each, comprising serial feedline is coupled to two or more different length dipole elements. Each dipole element of a given length attached to the first serial feedline has a corresponding dipole element of approximately equal length attached to the second serial feedline and oriented, with respect to the first dipole element so as to form a dipole. Thus, at least two dipoles of differing lengths are formed, enabling performance in two different bands by the antenna. The gain of the antenna for any particular band is determined by the number of dipoles corresponding to that band contained within the antenna.

(56) **References Cited**
U.S. PATENT DOCUMENTS
3,016,536 A 1/1962 Fubini
5,592,185 A 1/1997 Itabashi et al.
5,949,382 A 9/1999 Quan
6,469,677 B1 10/2002 Schaffner
6,529,170 B1 3/2003 Nishizawa et al.
6,658,263 B1 12/2003 Ke et al.
6,734,828 B2 5/2004 Shor
6,747,605 B2 * 6/2004 Lebaric et al. 343/795
6,859,176 B2 2/2005 Choi
6,965,353 B2 11/2005 Shirosaka et al.
6,992,632 B1 1/2006 Mohuchy
7,181,175 B2 2/2007 Nimmo-Smith et al.
7,277,062 B1 10/2007 Loyet

16 Claims, 9 Drawing Sheets





US007764246B2

(12) **United States Patent**
Yu et al.

(10) **Patent No.:** **US 7,764,246 B2**
(45) **Date of Patent:** **Jul. 27, 2010**

(54) **WIRELESS DEVICE AND METHOD FOR IMPROVING ANTENNA CHARACTERISTIC OF THE WIRELESS DEVICE**

(75) Inventors: **Chao-Hui Yu**, Taipei Hsien (TW);
Hung-Jen Chen, Taipei Hsien (TW);
Yu-Yuan Wu, Taipei Hsien (TW)

(73) Assignee: **Cheng Uei Precision Industry Co., Ltd.**, Taipei Hsien (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 481 days.

(21) Appl. No.: **11/864,969**

(22) Filed: **Sep. 29, 2007**

(65) **Prior Publication Data**
US 2009/0085822 A1 Apr. 2, 2009

(51) **Int. Cl.**
H01Q 1/52 (2006.01)

(52) **U.S. Cl.** **343/841; 343/702; 343/872**

(58) **Field of Classification Search** **343/841, 343/702, 872**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,394,160	A *	2/1995	Iwasaki et al.	343/702
5,596,487	A *	1/1997	Castaneda et al.	361/814
5,874,920	A *	2/1999	Araki et al.	343/702

* cited by examiner

Primary Examiner—Douglas W Owens

Assistant Examiner—Dieu Hien T Duong

(74) *Attorney, Agent, or Firm*—WPAT, P.C.; Anthony King

(57) **ABSTRACT**

A wireless device includes a housing having a shielding case and a dielectric case. The housing receives a printed circuit board and an antenna element. The printed circuit board has a feeding pad, a first ground pad and a second ground pad. The antenna has a feeding portion electronically coupled with the feeding pad of the printed circuit board and a ground portion electronically coupled with the shielding case for increasing ground dimension to improve antenna characteristic. The first and second ground pads of the printed circuit board electronically coupled with the shielding case for reducing coupling effect to improve antenna characteristic.

9 Claims, 5 Drawing Sheets

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