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(54) **APPARATUS AND METHOD FOR WIRELESS COMMUNICATIONS**

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Related U.S. Application Data

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(51) Int. Cl.[7] **H04B 1/30**; H04L 27/18
(52) U.S. Cl. **375/322**; 375/133; 375/222; 375/281; 375/345; 329/304
(58) Field of Search 375/132, 133, 375/136, 219, 222, 259, 279, 281, 316, 326, 327, 329, 332, 345; 329/304, 306, 307, 308; 455/234.1, 257, 276.1

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,144,308 A 9/1992 Norsworthy 341/131

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

JP 6053422 A 2/1994 .... H01I/27/06

(List continued on next page.)

OTHER PUBLICATIONS

Bluetooth Special Interest Group website http://www.bluetooth.com; "Bluetooth—Document Page", including "Technology Overview", "Radio", "Baseband", "Link Management", "Software Framework", "PC General", "Telephone", "Others"; Date Unknown; pp. 1–10.

(List continued on next page.)

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(57) **ABSTRACT**

An apparatus for receiving signals includes a low noise amplifier (LNA) configured to receive a radio frequency (RF) signal. An I/Q direct down converter is coupled to the LNA. The I/Q direct down converter is configured to split the RF signal into real and imaginary components and to down convert the real and imaginary components directly to baseband signals. A local oscillator (LO) is coupled to the I/Q direct down converter and is configured to drive the I/Q direct down converter. First and second filters are coupled to the I/Q direct down converter. The first and second filters are configured to filter the down converted real and imaginary components, respectively. First and second analog-to-digital converters (ADCs) are coupled to the first and second filters, respectively. The first and second ADCs are configured to convert the real and imaginary components into digital signals. The first and second ADCs have a dynamic range that is wide enough to convert the filtered, down converted real and imaginary components to digital signals without using variable gain on the filtered and down converted real and imaginary components. An apparatus for use in wireless communications includes a radio, a modem and a controller integrated onto a single integrated circuit (IC). The radio includes a receiver for receiving data and a transmitter for transmitting data. The modem is coupled to the radio and is configured to demodulate received data and modulate data for transmission. The controller is coupled to the modem and includes a digital interface for external communications through which received data and data for transmission is sent, a connection state machine configured to accept commands through the digital interface and to respond to the commands by initiating a sequence, and a receive/transmit state machine configured to perform state control of the radio in response to the initiated sequence.

38 Claims, 45 Drawing Sheets-
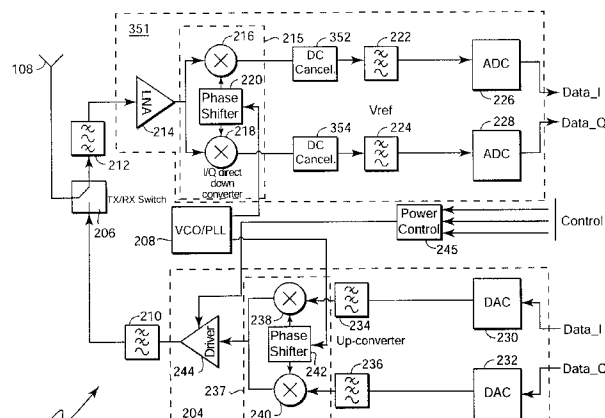
U.S. PATENT DOCUMENTS

5,279,978	A	1/1994	See et al. 437/34
5,294,823	A	3/1994	Eklund et al. 257/370
5,339,040	A	8/1994	Loper 329/358
5,424,739	A	6/1995	Norsworthy et al. 341/143
5,430,317	A	7/1995	Onai et al. 257/347
5,449,953	A	9/1995	Nathanson et al. 257/728
5,498,885	A	3/1996	Deen et al. 257/139
5,578,970	A	11/1996	Nguyen et al. 331/75
5,619,069	A	4/1997	Ohta et al. 257/692
5,643,805	A	7/1997	Ohta et al. 437/31
5,661,329	A	8/1997	Hiramoto et al. 257/510
5,684,482	A	11/1997	Galton 341/144
5,708,971	A	* 1/1998	Dent 455/38.3
5,724,653	A	* 3/1998	Baker et al. 455/296
5,745,061	A	4/1998	Norsworthy et al. 341/131
5,757,921	A	5/1998	Okanobu et al. 380/38
5,773,340	A	6/1998	Kumauchi et al. 438/234
5,799,010	A	* 8/1998	Lomp et al. 370/335
5,825,887	A	* 10/1998	Lennen 380/34
5,930,286	A	* 7/1999	Walley 375/140

FOREIGN PATENT DOCUMENTS

JP	8241999	9/1996	.... H01L/29/786
WO	WO 9625790	8/1996	
WO	WO 97/02602	1/1997	.... H01L/27/12
WO	WO 98/49779	11/1998	.... H04B/1/38

OTHER PUBLICATIONS

Durec, Jeff, "An Integrated Silicon Bipolar Receiver Subsystem for 900–Mhz ISM Band Applications" *IEEE Journal of Solid State Circuits* 33(9):1352–1372 (Sep. 1998).

Hashimoto et al., "A 6–μ m^2 biplolar transistor using 0.25–μ m process technology for high–speed applications" *IEEE Proceedings of the Bipolar BiCMOS Circuits and Technology Meeting*: 152–155 (Sep. 1998).

IEEE Personal Communications, "Figure 3. A Wireless–enhanced scenario for PCCAs", Dec. 1998, p. 1.

Kikuchi et al., "A 0.35μm ECL–CMOS Process Technology on SOI for Ins Mega–bits SRAM's with 40ps Gate Array" *International Electronic Devices Meeting Technical Digest* 95:923–926 (Dec. 1995).

Sze, S.M., *Semiconductor Devices, Physics and Technology*, New Jersey, John Wiley & Sons, 1985., p. 468–472. ISBN 0–471–87424–8.
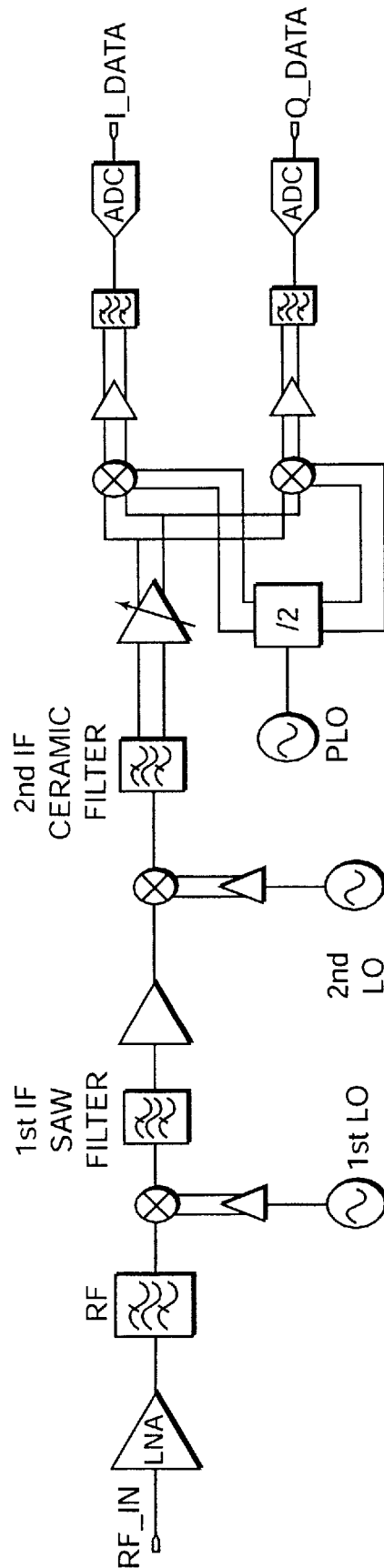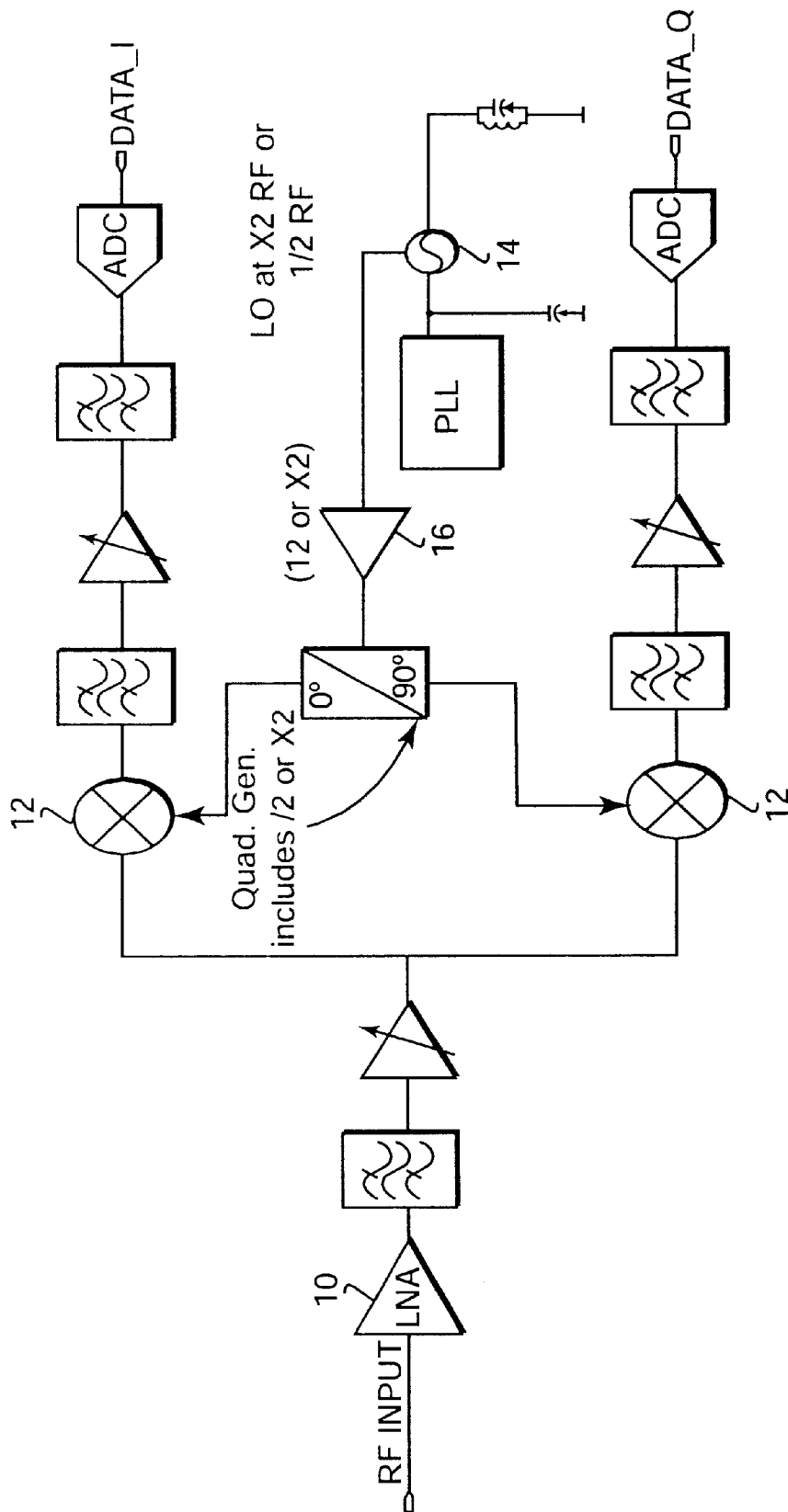
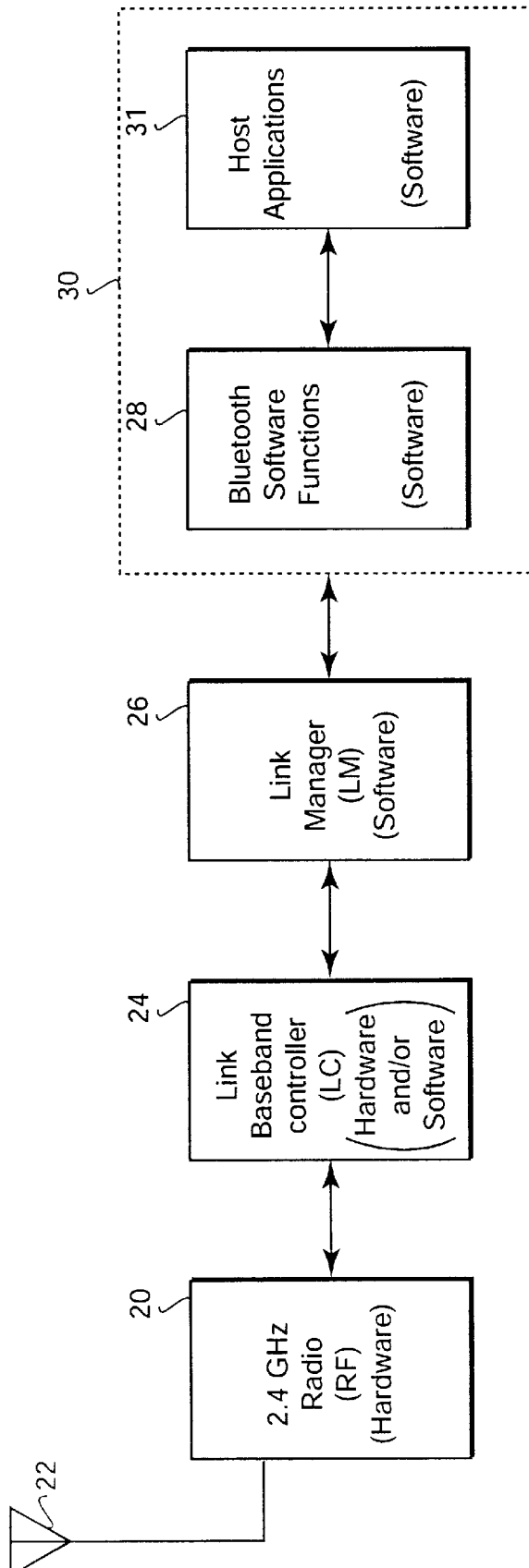* cited by examiner

FIG. 1
(PRIOR ART)

FIG. 2
(PRIOR ART)

FIG. 3
(PRIOR ART)

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