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

(10) Patent No.: **US 7,369,815 B2**
(45) **Date of Patent:** **May 6, 2008**

(54) **POWER COLLAPSE FOR A WIRELESS TERMINAL**

(75) Inventors: **Inyup Kang**, San Diego, CA (US); **Karthikeyan Ethirajan**, San Diego, CA (US)

(73) Assignee: **Qualcomm Incorporated**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 289 days.

(21) Appl. No.: **10/786,585**

(22) Filed: **Feb. 24, 2004**

(65) **Prior Publication Data**

US 2005/0064829 A1 Mar. 24, 2005

Related U.S. Application Data

(60) Provisional application No. 60/504,507, filed on Sep. 19, 2003.

(51) **Int. Cl.**
H04B 1/16 (2006.01)
H04M 1/00 (2006.01)

(52) **U.S. Cl.** **455/73**; 455/127.5; 455/343.1; 455/574

(58) **Field of Classification Search** 455/572–574, 455/343.1–343.4, 127.1, 127.5
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,615,162 A		3/1997	Houston	.... 365/226
5,745,860 A	*	4/1998	Kallin	.... 455/574
6,133,871 A	*	10/2000	Krasner	.... 342/357.06
6,151,681 A		11/2000	Roden et al.	.... 713/322
6,219,564 B1	*	4/2001	Grayson et al.	.... 455/574
6,442,407 B1	*	8/2002	Bauer et al.	.... 455/574
6,625,478 B1	*	9/2003	Nonogaki	.... 455/574
6,715,085 B2	*	3/2004	Foster et al.	.... 726/27
7,089,344 B1	*	8/2006	Rader et al.	.... 710/308
2002/0025839 A1		2/2002	Usui	.... 455/574
2002/0094840 A1	*	7/2002	Hattori et al.	.... 455/558
2003/0133337 A1	*	7/2003	Yamada et al.	.... 365/200

FOREIGN PATENT DOCUMENTS

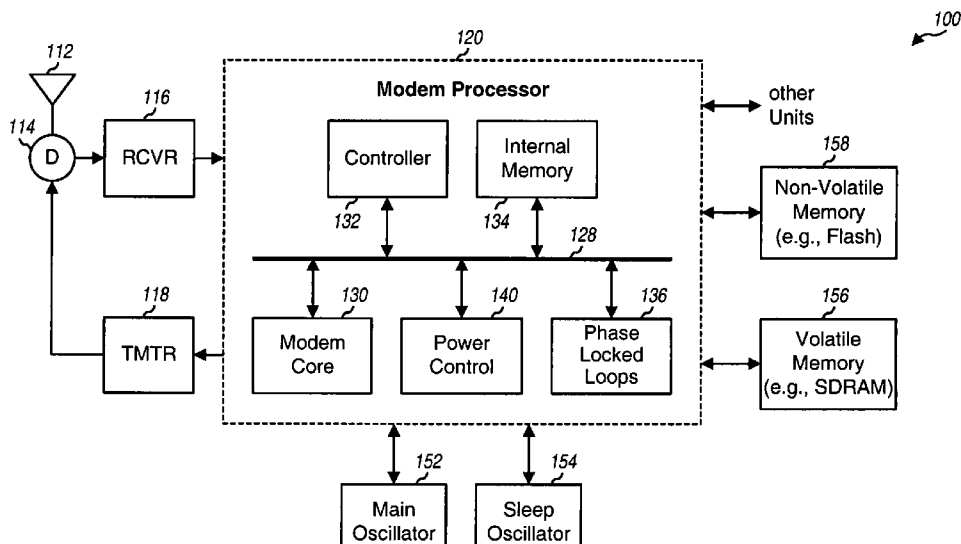|		
EP	1328066	7/2003

* cited by examiner

Primary Examiner—Simon Nguyen
(74) *Attorney, Agent, or Firm*—Howard Seo; Eric Ho; Thomas R. Rouse

(57) **ABSTRACT**

An integrated circuit for a modem processor includes processing units that are partitioned into "always-on" and "collapsible" power domains. An always-on power domain is powered on at all times. A collapsible power domain can be powered off if the processing units in the power domain are not needed. A power control unit within an always-on power domain powers down the collapsible power domains after going into sleep and powers up these domains after waking up from sleep. Tasks for powering down the collapsible power domains may include (1) saving pertinent hardware registers for these power domains, (2) freezing output pins of the IC to minimally disturb external units, (3) clamping input pins of the collapsed power domains, (4) powering down a main oscillator and disabling the oscillator clock, and so on. Complementary tasks are performed for powering up the collapsed power domains.
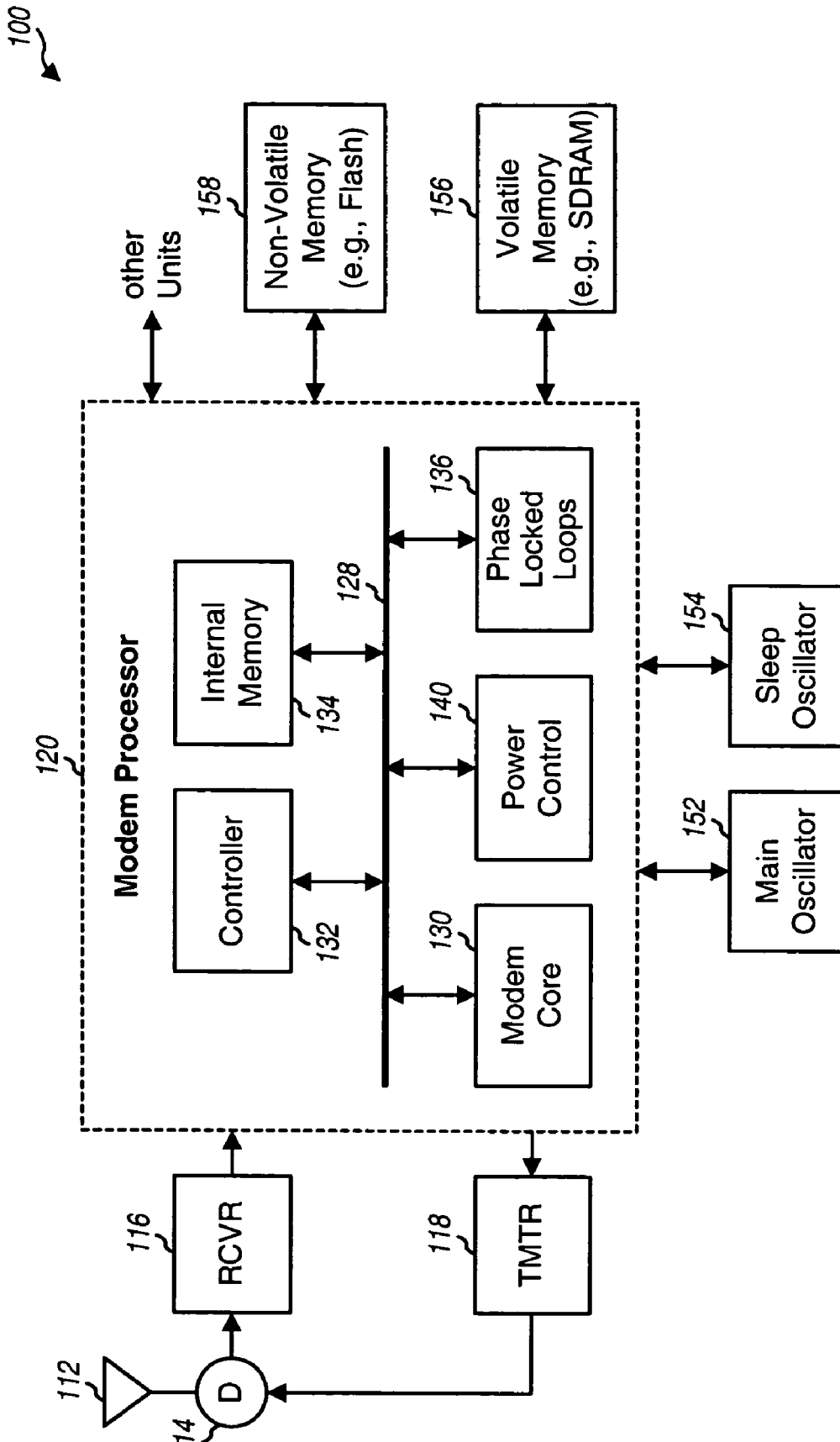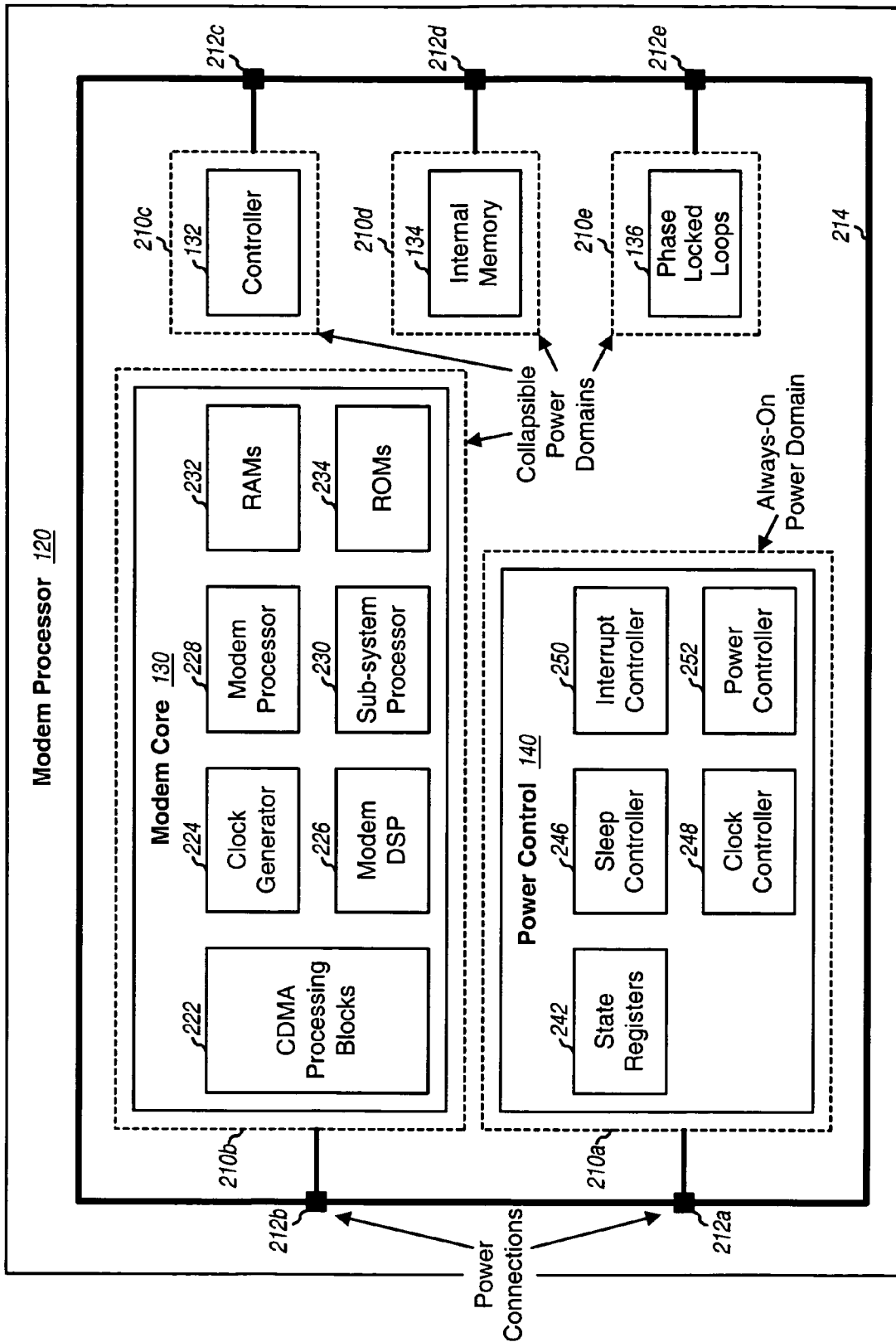
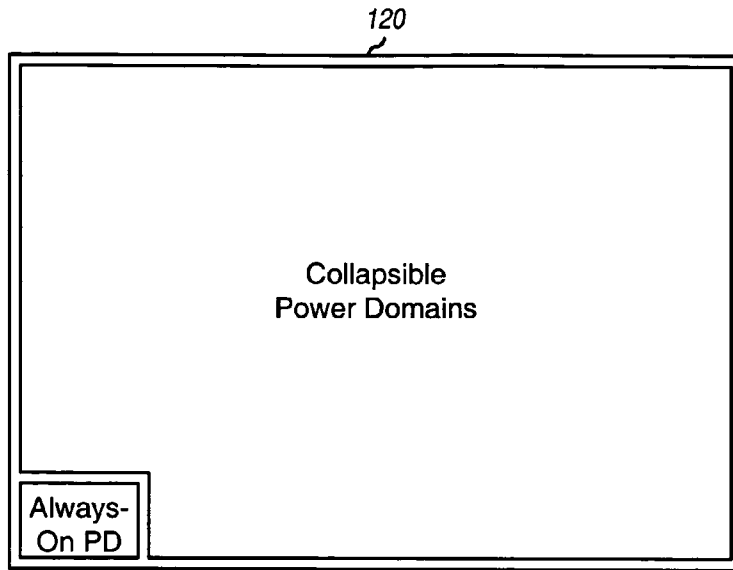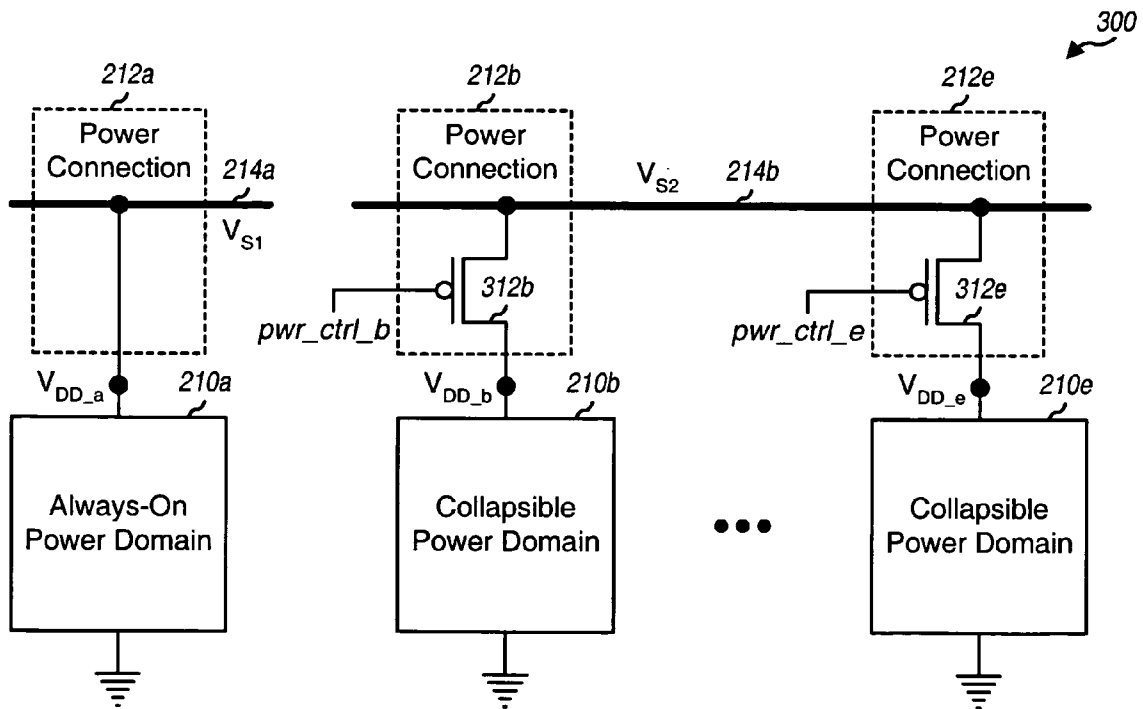**39 Claims, 6 Drawing Sheets**

FIG. 1

FIG. 2A

120

Collapsible
Power Domains

Always-
On PD

FIG. 2B

300

212a
Power
Connection
214a

V_{S1}

V_{DD_a} *210a*

Always-On
Power Domain

212b
Power
Connection

V_{S2} *214b*

312b

pwr_ctrl_b

V_{DD_b} *210b*

Collapsible
Power Domain

• • •

212e
Power
Connection

312e

pwr_ctrl_e

V_{DD_e} *210e*

Collapsible
Power Domain

FIG. 3

FIG. 4

Powering Down Sequence

FIG. 5A

Powering Up Sequence

FIG. 5B

DOCKET ALARM
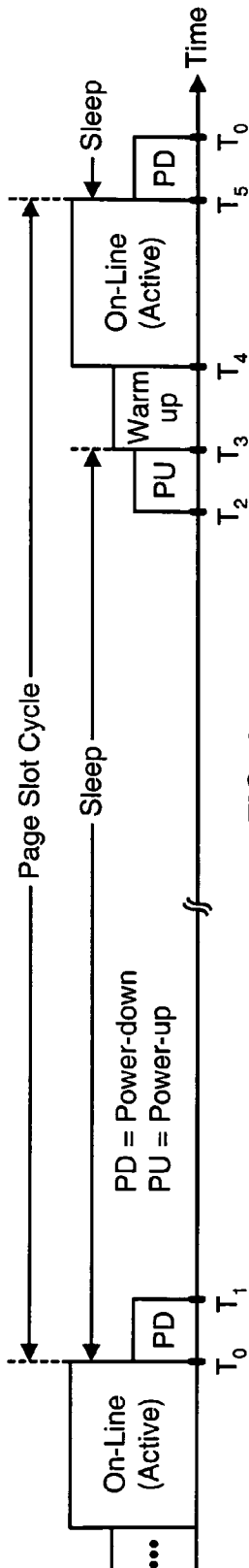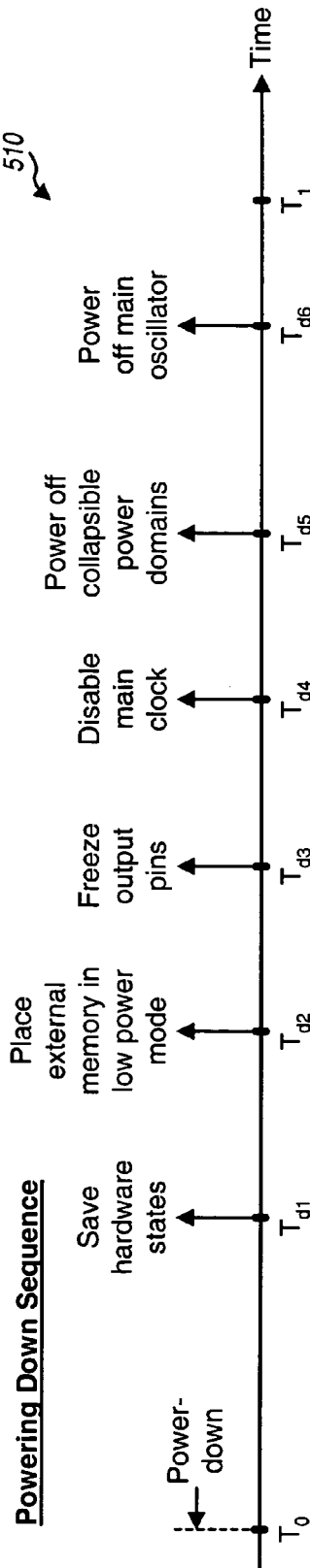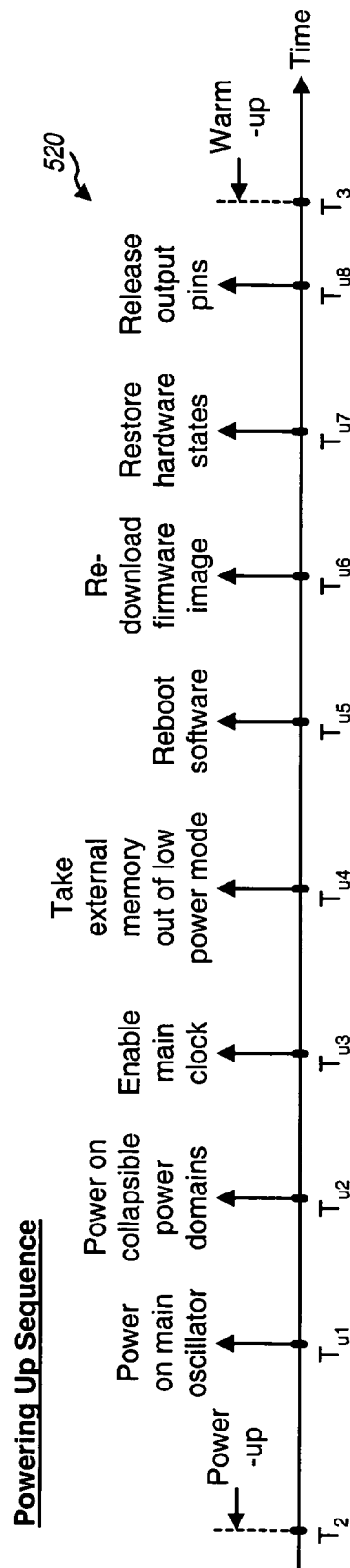
Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.