



US006543286B2

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

(10) **Patent No.:** US 6,543,286 B2
(45) **Date of Patent:** Apr. 8, 2003

(54) **HIGH FREQUENCY PULSE WIDTH MODULATION DRIVER, PARTICULARLY USEFUL FOR ELECTROSTATICALLY ACTUATED MEMS ARRAY**

(75) Inventors: **Steven L. Garverick**, Solon, OH (US);
Michael L. Nagy, Lawrenceville, GA (US)

(73) Assignee: **Movaz Networks, Inc.**, Norcross, GA (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.

(21) Appl. No.: **09/884,676**

(22) Filed: **Jun. 19, 2001**

(65) **Prior Publication Data**

US 2002/0101769 A1 Aug. 1, 2002

Related U.S. Application Data

(60) Provisional application No. 60/264,267, filed on Jan. 26, 2001, and provisional application No. 60/267,285, filed on Feb. 7, 2001.

(51) **Int. Cl.⁷** G01P 15/00; G01P 15/125

(52) **U.S. Cl.** 73/514.18; 73/514.32

(58) **Field of Search** 73/514.16, 514.18, 73/514.26, 514.32, 514.36; 361/271, 277; 310/309

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,082,197 A * 7/2000 Mizuno et al. 73/514.32
6,242,989 B1 * 6/2001 Barber et al. 361/271
6,333,584 B1 * 12/2001 Jerman et al. 310/309

* cited by examiner

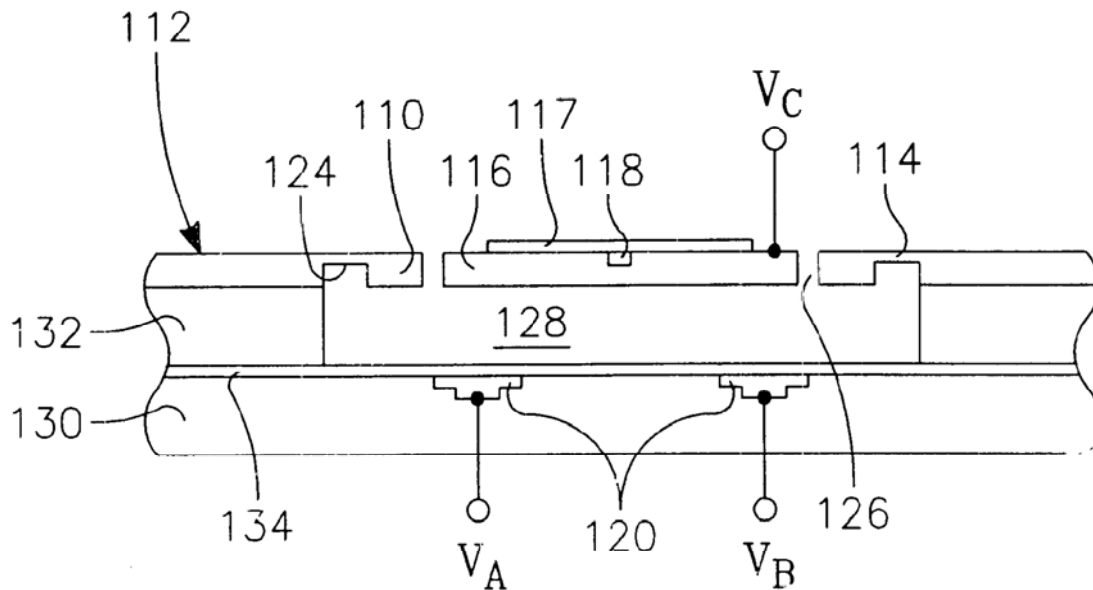
Primary Examiner—Trong Phan

(74) *Attorney, Agent, or Firm*—Charles Guenzer

(57) **ABSTRACT**

Pulse-width modulation (PWM) drive circuitry particularly applicable to an array of electrostatic actuators formed in a micro electromechanical system (MEMS), such as used for optical switching. A control cell associated with each actuator includes a register selectively stored with a desired pulse width. A clocked counter distributes its outputs to all control cells. When the counter matches the register, a polarity signal corresponding to a drive clock is latched and controls the voltage applied to the electrostatic cell. In a bipolar drive, one actuator electrode is driven by a drive clock; the other, by the latch. The MEMS element may be a tilttable plate supported in its middle by a torsion beam. Complementary binary signals may drive two capacitors formed across the axis of the beam. The register and comparison logic for each cell may be formed by a content addressable memory.

29 Claims, 14 Drawing Sheets



Capella 2017

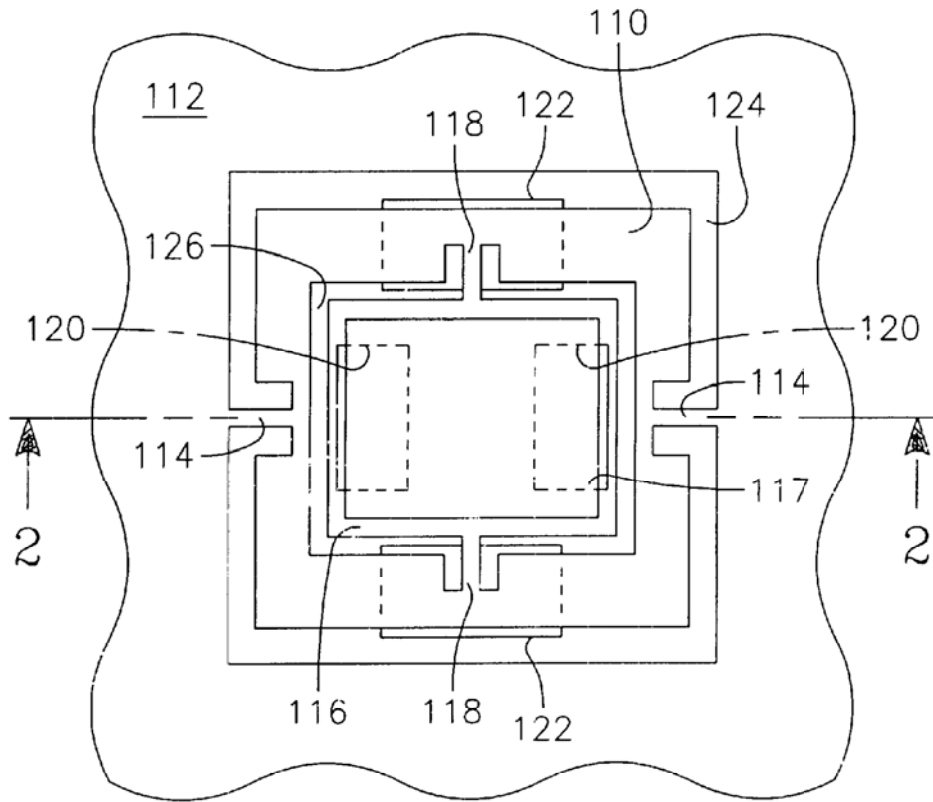


FIG. 1

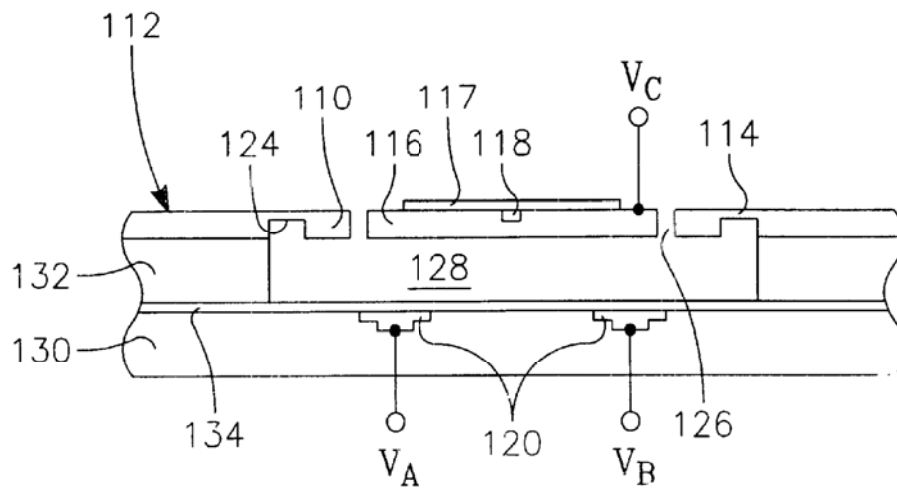


FIG. 2

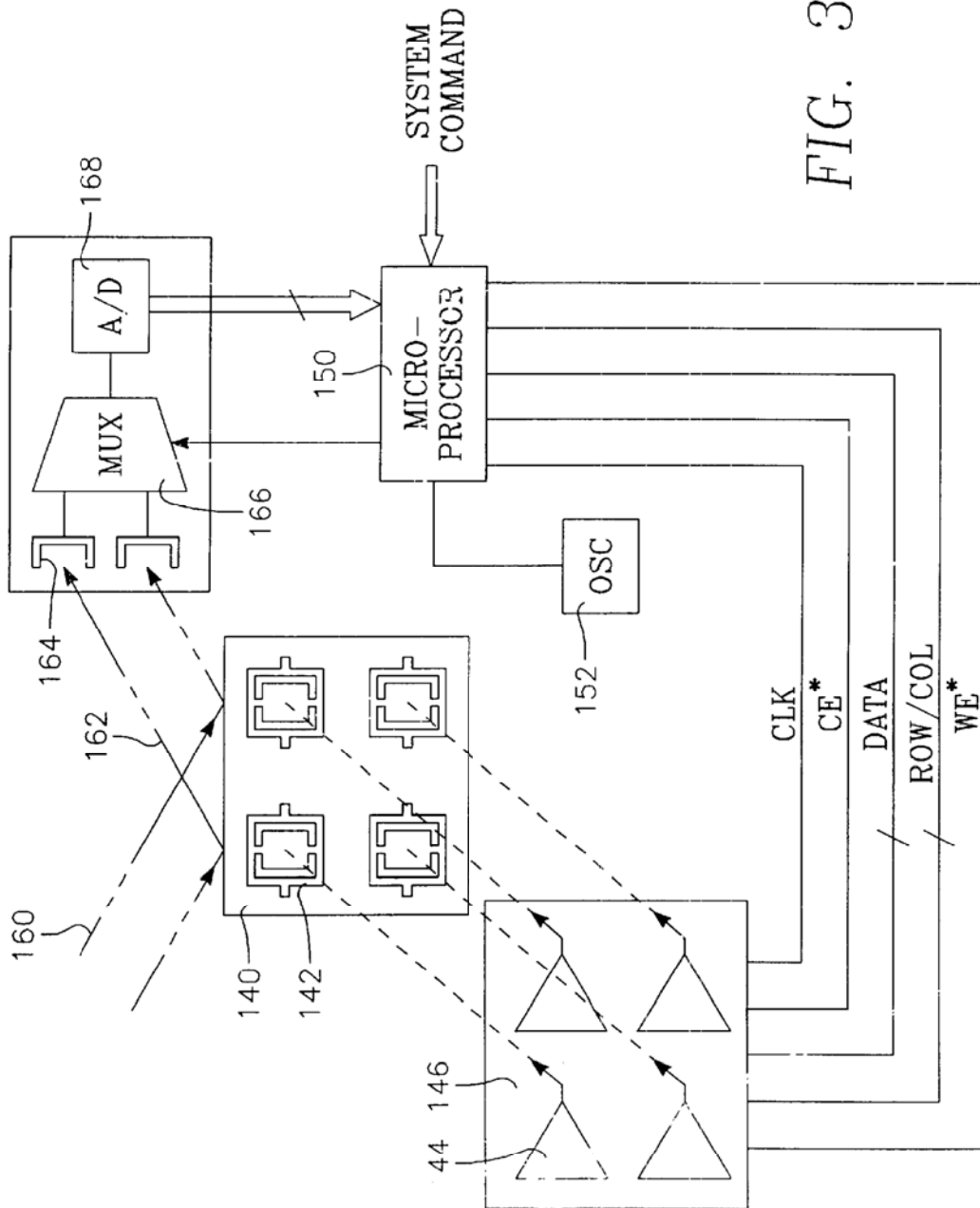


FIG. 3

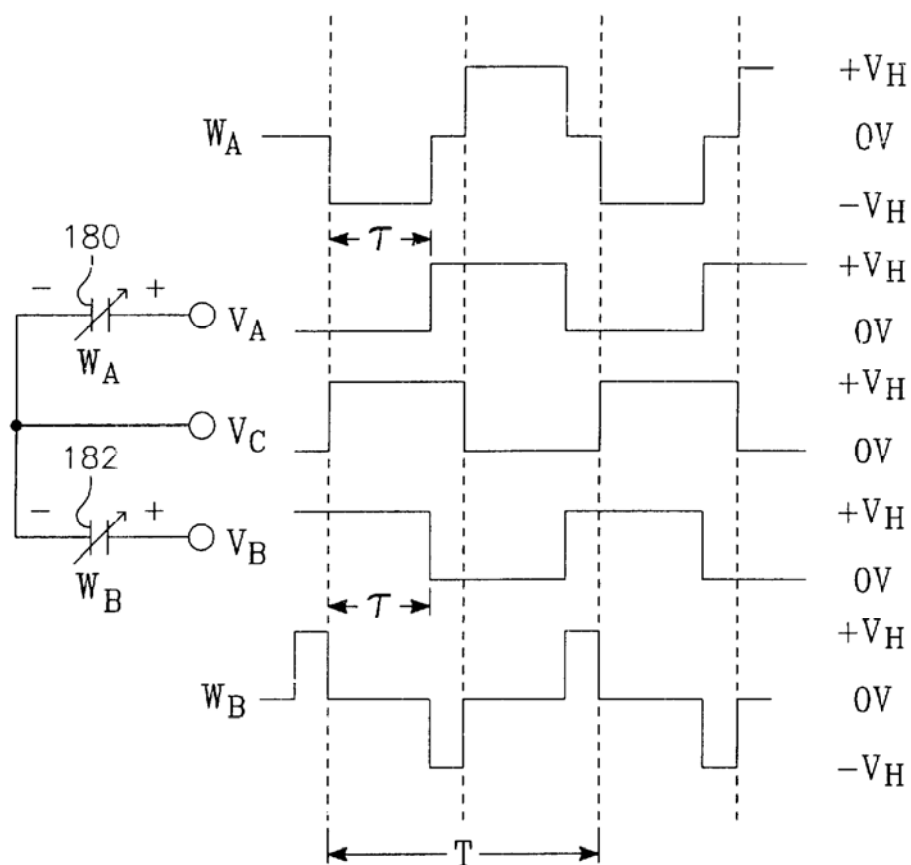


FIG. 4

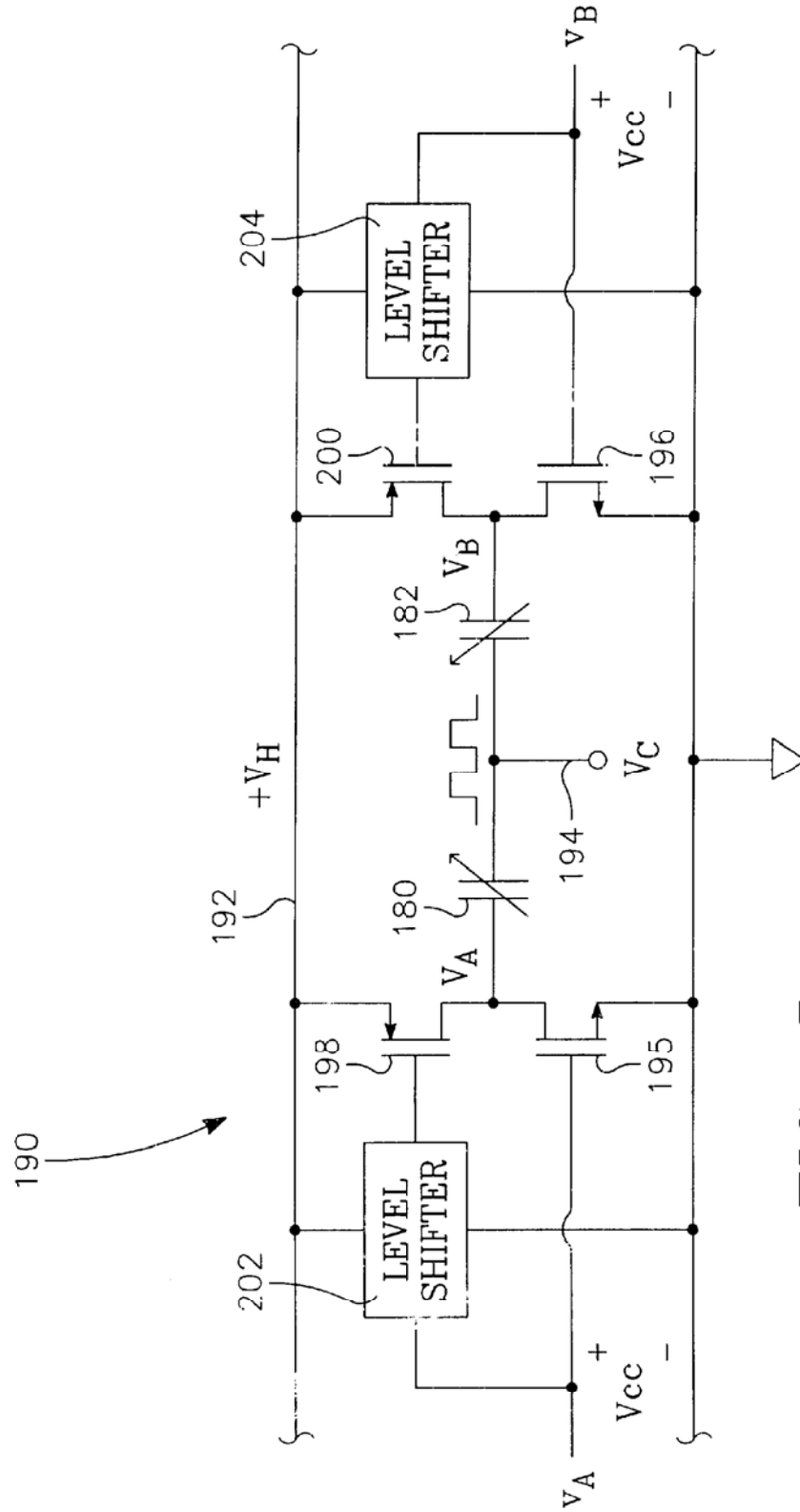


FIG. 5

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.