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Chen et al.

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(54) **LOW-POWER LCD DATA DRIVER FOR STEPWISELY CHARGING**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 211 days.

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(51) **Int. Cl.**⁷ **G09G 5/00**

(52) **U.S. Cl.** **345/211; 345/98**

(58) **Field of Search** 345/204, 208-215,
345/690-693, 87, 94-96, 98-100

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Primary Examiner—Kent Chang

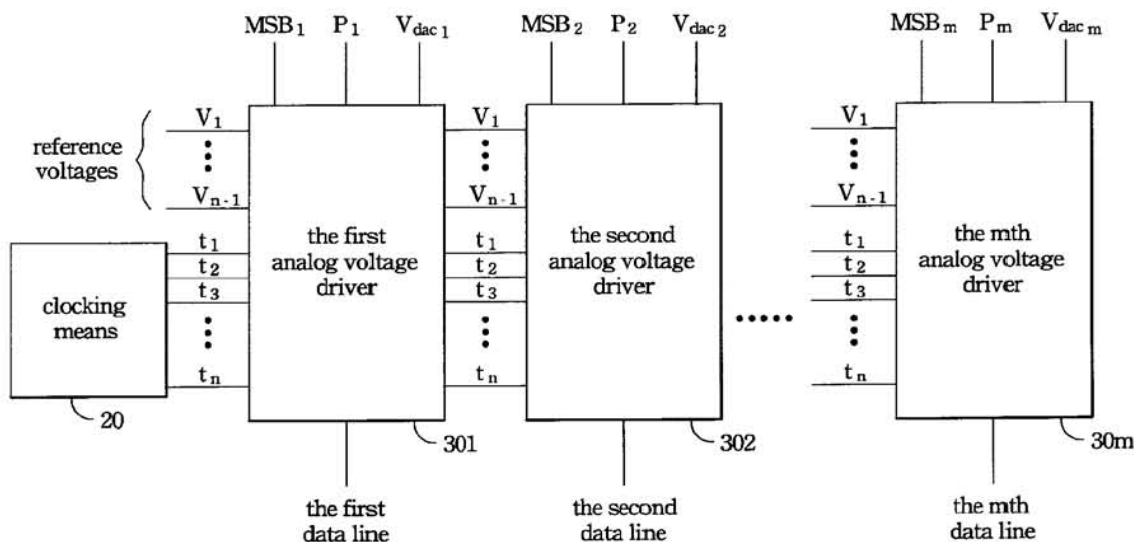
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(57) **ABSTRACT**

A power-saving data driver for stepwisely applying alternating driving voltages with a predetermined number of steps to a plurality of data lines in a liquid crystal display is disclosed. The data driver is comprised of a clocking means, a plurality of reference voltages, and a plurality of analog voltage driver. The clocking means is used for providing clock signals for stepwisely charging and discharging. The plurality of reference voltages work as steps of said stepwisely charging and discharging. The reference voltages are distributed between the system voltage and the ground. Each of the analog voltage driver corresponds to one of the data lines. A given pixel is stepwisely driven from a driving voltage of the last pixel as a beginning voltage to a driving voltage of the given pixel as a target voltage. The reference voltages between the beginning voltage and the target voltage are turned-on in order according to the clock signals generated by the clocking means.

30 Claims, 4 Drawing Sheets



SHARP EXHIBIT 1013

Sharp Corp. et al. v. Surpass Tech. Innovation, LLC

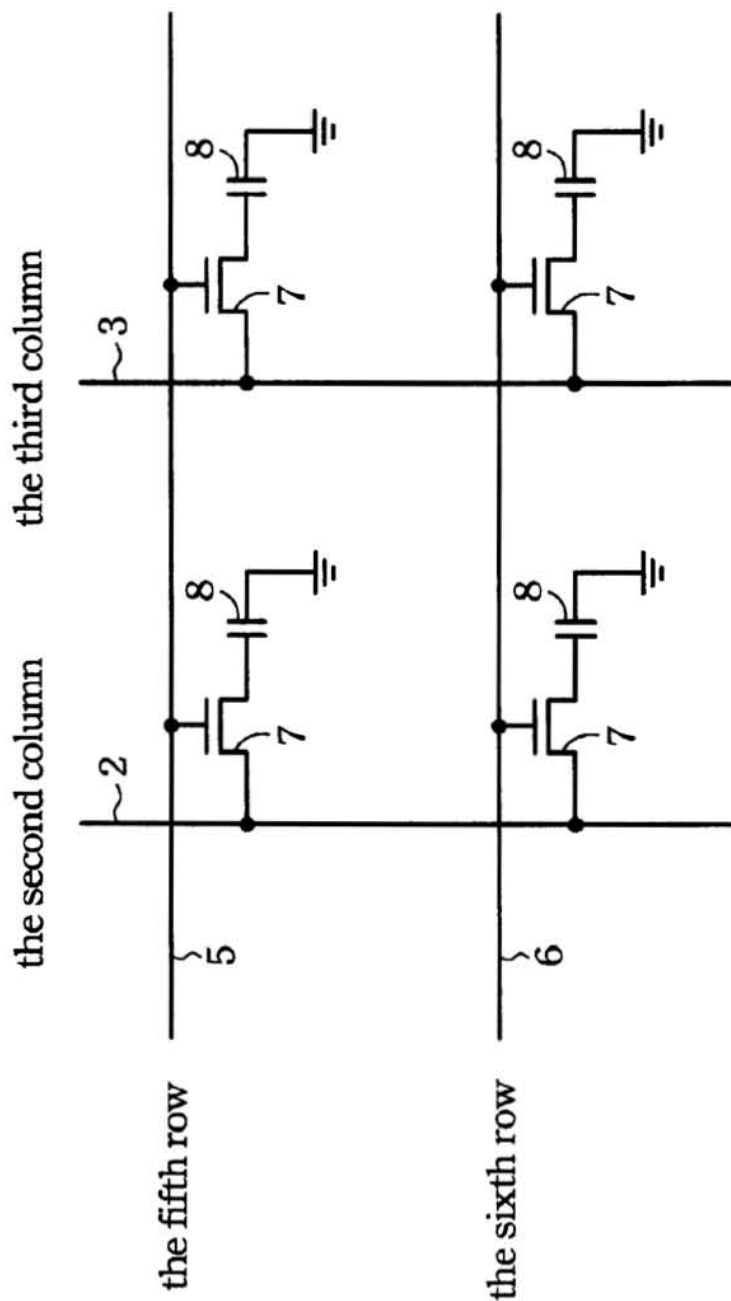


Fig. 1
(Prior Art)

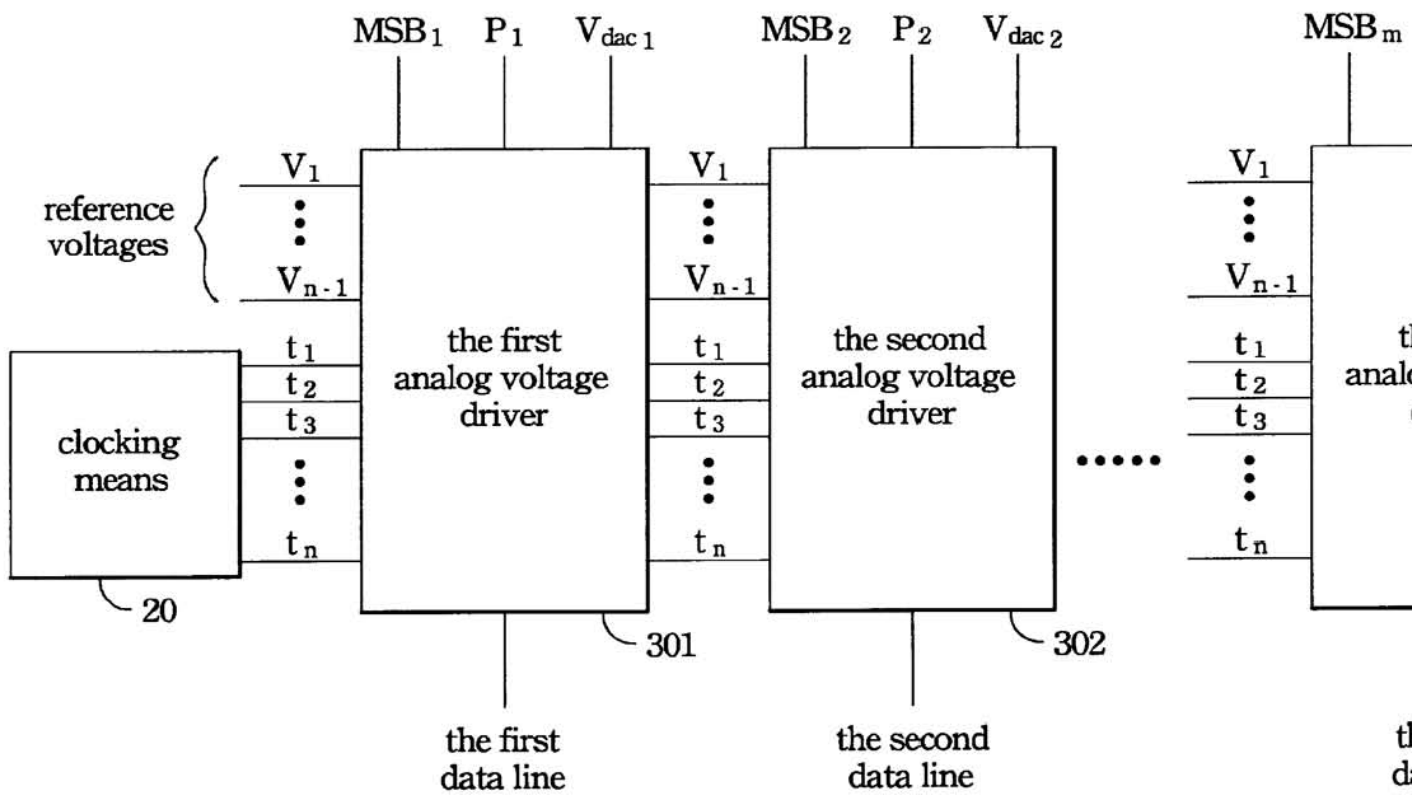


Fig. 2

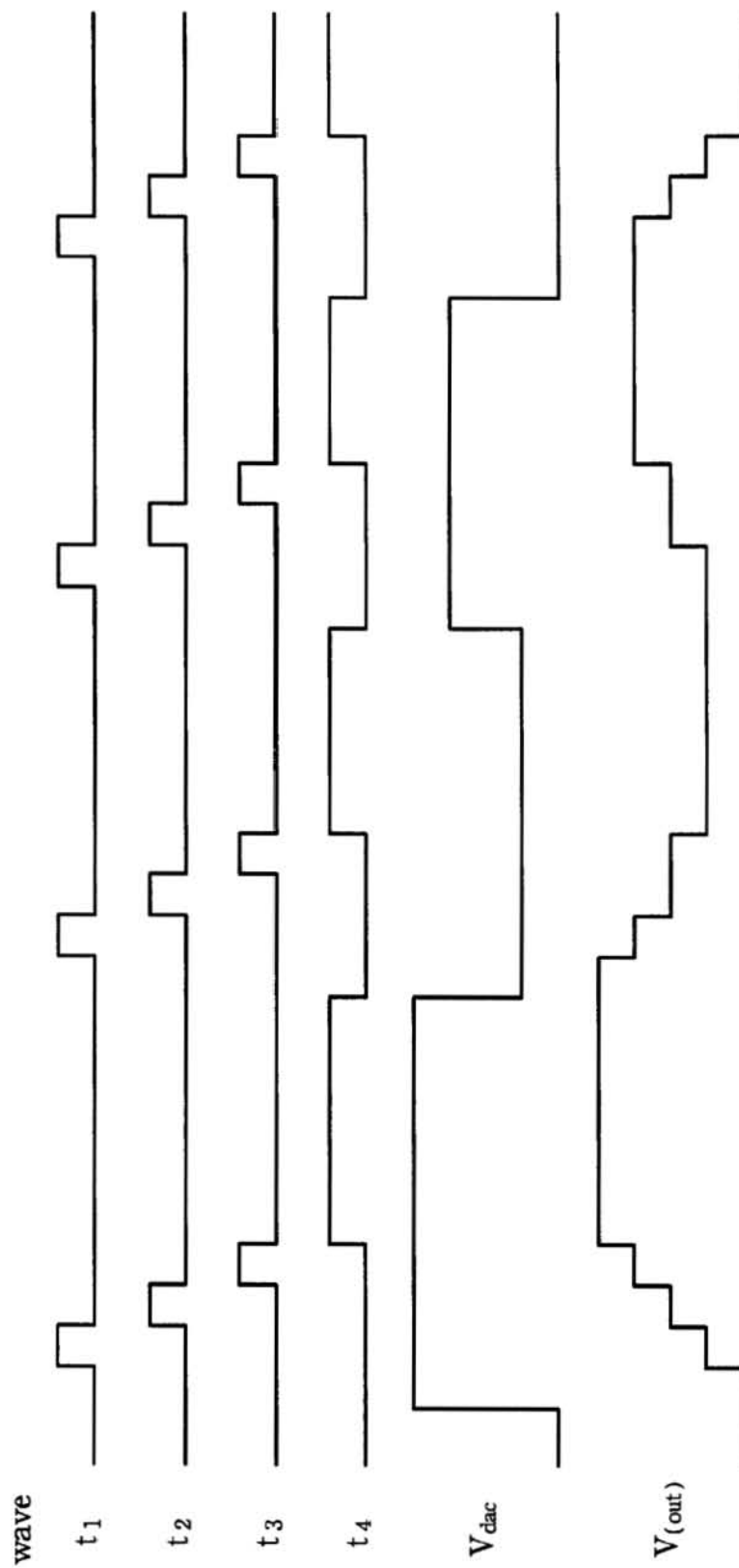


Fig. 3

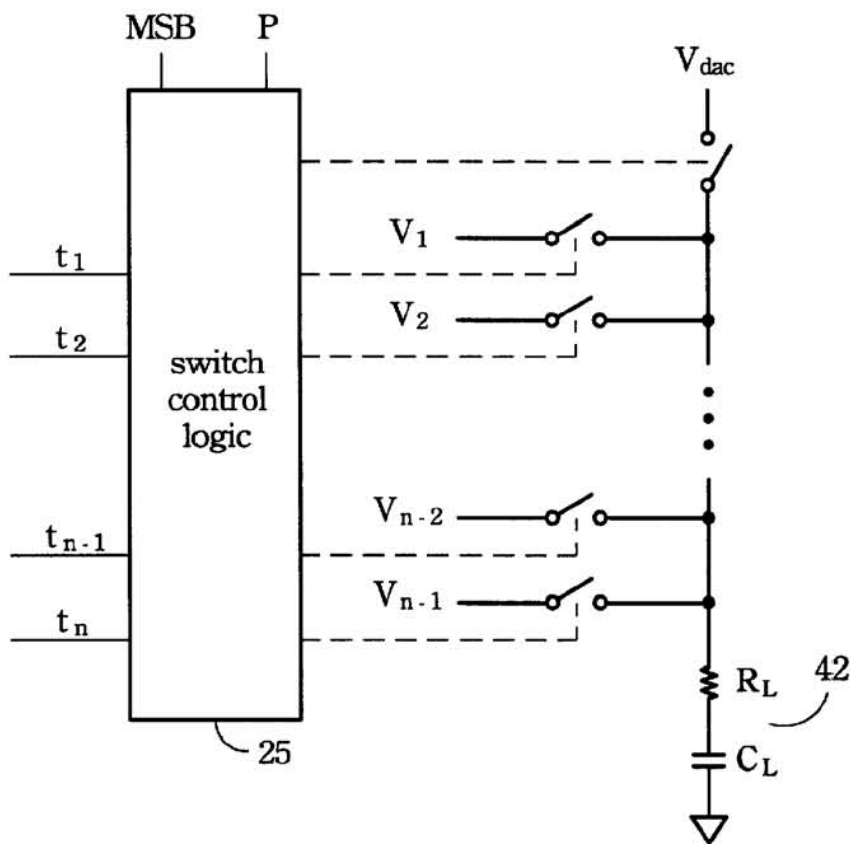


Fig. 4

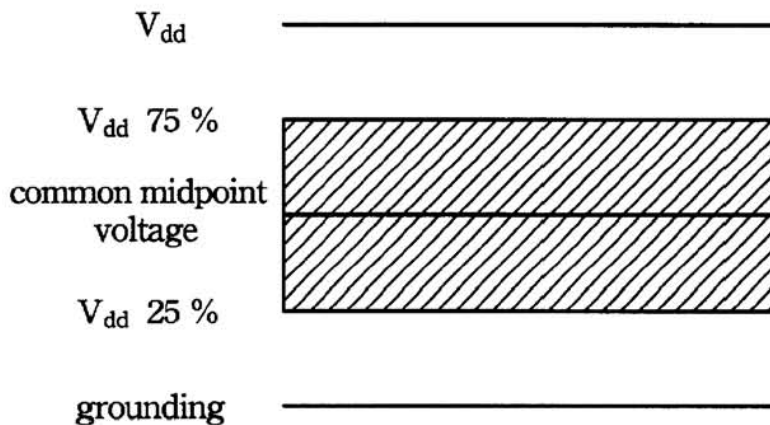


Fig. 5

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