

EXHIBIT D

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

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 (45) **Date of Patent:** **Nov. 16, 2004**

(54) **MULTIMODE DATA BUFFER AND METHOD FOR CONTROLLING PROPAGATION DELAY TIME**

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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 77 days.

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(21) Appl. No.: **10/278,071**

(22) Filed: **Oct. 23, 2002**

(65) **Prior Publication Data**

US 2003/0210575 A1 Nov. 13, 2003

Related U.S. Application Data

(60) Provisional application No. 60/379,665, filed on May 10, 2002.

(51) **Int. Cl.**⁷ **G11C 7/00**

(52) **U.S. Cl.** **365/193**; 365/189.05; 365/191;
 365/194

(58) **Field of Search** 365/189.05, 191,
 365/193, 194

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U.S. PATENT DOCUMENTS

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(57) **ABSTRACT**

A data buffer, such as a data strobe input buffer or a data input buffer, which may operate in multiple modes, such as a single mode (SM) and a dual mode (DM) and where the mode is selected by providing a signal, such as an external signal such as an address signal or an external command signal. A data buffer which can be used for a SM/DM dual-use and can improve a data setup/hold margin. A semiconductor memory device including one or more of the data buffers described above. A method for controlling propagation delay times which can improve a data setup/hold margin in a SM/DM dual-use data buffer.

29 Claims, 13 Drawing Sheets

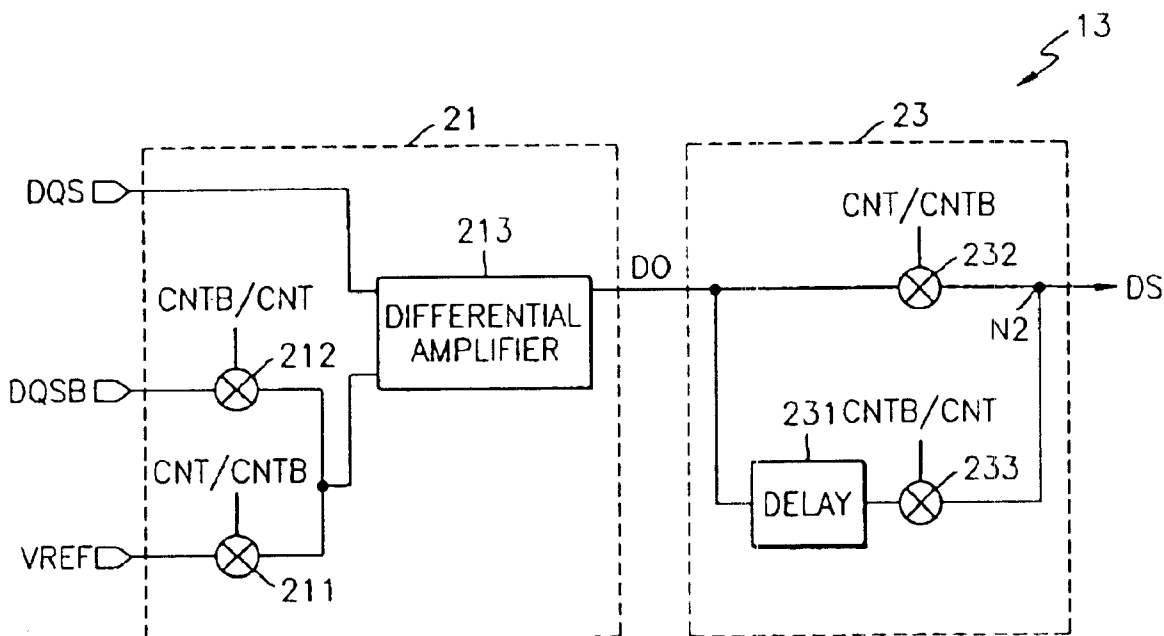


FIG. 1 Prior Art

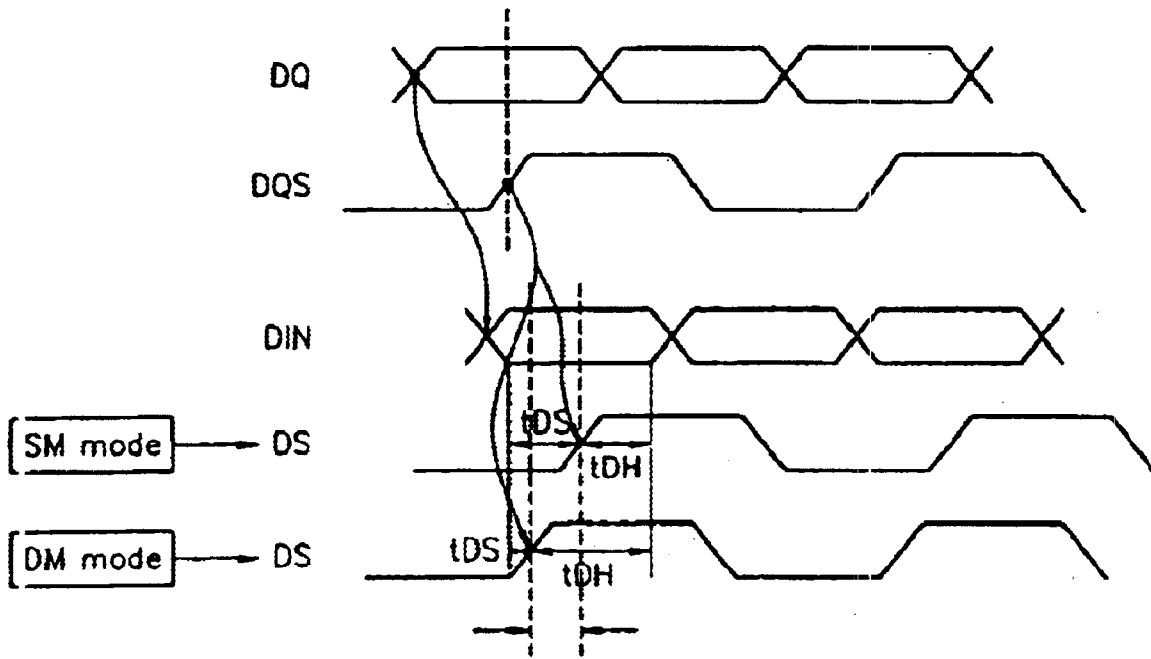


FIG. 2

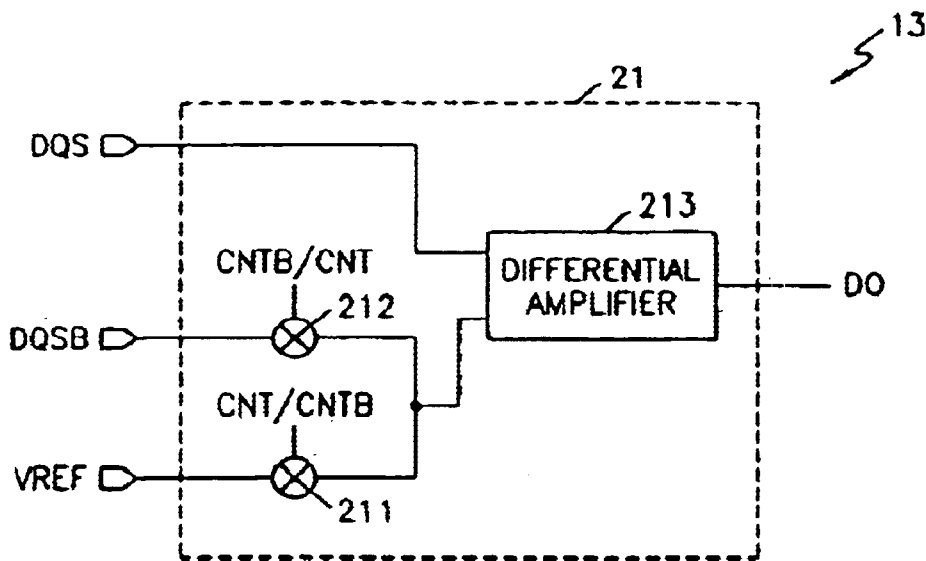


FIG. 3A

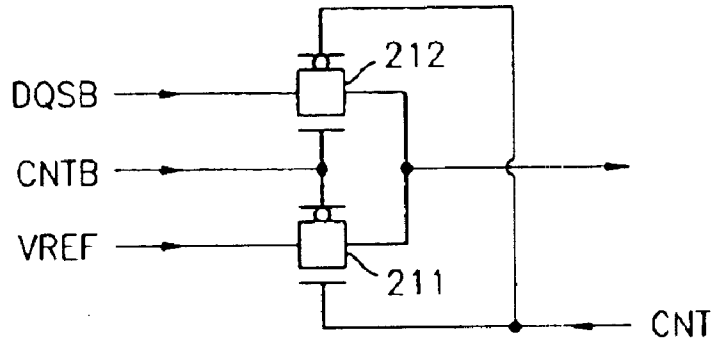


FIG. 3B

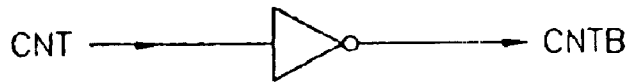


FIG. 4

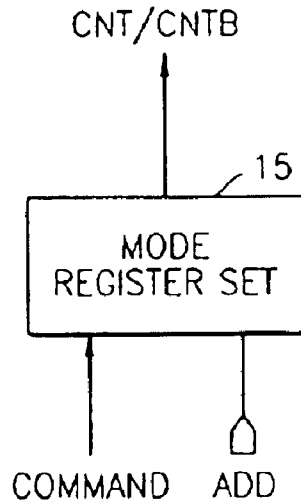


FIG. 5A

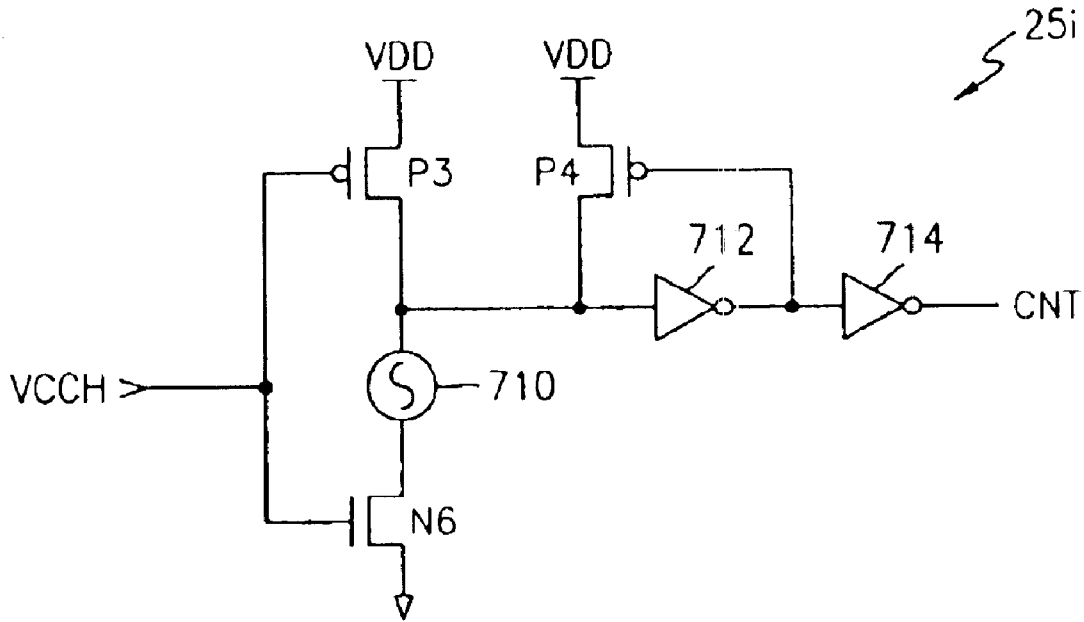
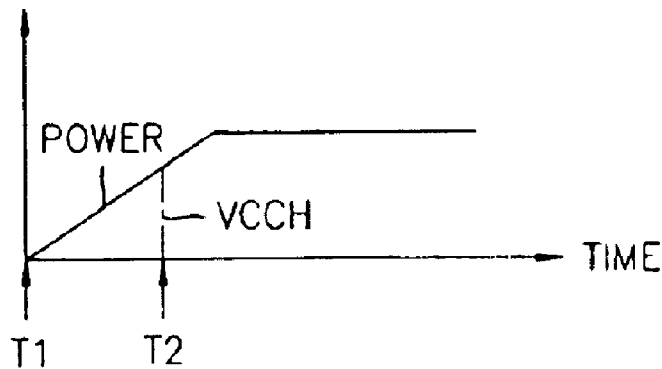


FIG. 5B

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