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(54) **Title:** MEMORY COMPONENTS AND CONTROLLERS THAT CALIBRATE MULTIPHASE SYNCHRONOUS TIMING REFERENCES

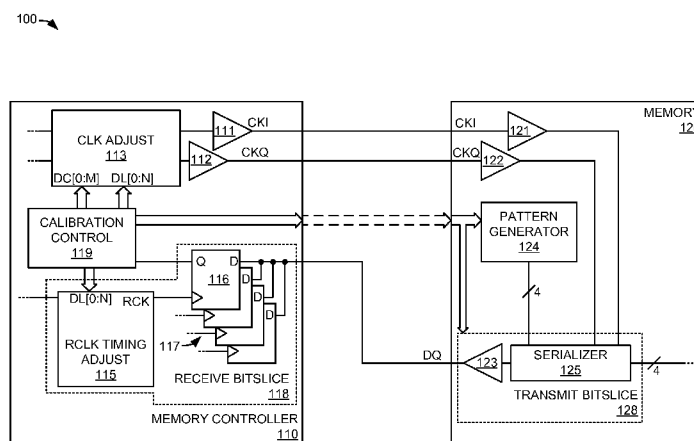


FIGURE 1

(57) **Abstract:** A first timing reference signal and a second timing reference signal are sent to a memory device. The second timing reference signal has approximately a quadrature phase relationship with respect to the first timing reference signal. A plurality of serial data patterns are received from the memory device. The transitions of the first timing reference and the second timing reference determining when transitions occur between the bits of the plurality of data patterns. Timing indicators associated with when received transitions occur between the bits of the plurality of data patterns are received from the memory device. The timing indicators are each measured using a single sampler. Based on the timing indicators, a first duty cycle adjustment for the first timing reference signal, a second duty cycle adjustment for the second timing reference signal, and a quadrature phase adjustment are determined and applied.

A. CLASSIFICATION OF SUBJECT MATTER*G11C 7/22(2006.01)i, G11C 7/10(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G11C 7/22; H03L 7/00; H04L 7/00; G11C 7/00; G06F 12/00; G06F 1/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: reference, signal, quadrature, phase, sample, calibration, bit, pattern, strobe

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0271092 A1 (ZERBE et al.) 28 October 2010 See abstract, paragraph [0004] and claim 19.	1-105
A	US 2007-0217559 A1 (STOTT et al.) 20 September 2007 See abstract, paragraphs [0077]-[0079] and figure 14.	1-105
A	US 2009-0138747 A1 (HAMPEL et al.) 28 May 2009 See abstract, paragraphs [0144]-[0149] and figure 13.	1-105
A	US 7586800 B1 (KORNACHUK) 08 September 2009 See abstract, paragraphs [0144]-[0149] and figure 13.	1-105



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010-0271092 A1	28.10.2010	EP 2223227 A2 WO 2009-055103 A2 WO 2009-055103 A3 WO 2009-055103 A4	01.09.2010 30.04.2009 30.04.2009 06.08.2009
US 2007-0217559 A1	20.09.2007	US 8121237 B2 WO 2007-106766 A2 WO 2007-106766 A3	21.02.2012 20.09.2007 20.09.2007
US 2009-0138747 A1	28.05.2009	EP 1446910 A1 EP 1446910 B1 EP 1865648 A2 EP 1865648 A3 US 2003-0117864 A1 US 2011-0248761 A1 US 7668276 B2 US 7965567 B2 WO 03-036445 A1 WO 03-036850 A1	18.08.2004 11.08.2010 12.12.2007 30.04.2008 26.06.2003 13.10.2011 23.02.2010 21.06.2011 01.05.2003 01.05.2003
US 7586800 B1	08.09.2009	US 7577049 B1	18.08.2009