Active Matrix Driving and Circuit Simulation

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1. Introduction

This chapter explains the principle of active matrix driving which is the most popular driving method used in current liquid crystal displays (LCDs). It then discusses issues that designers must overcome to avoid the malfunctioning and introduces a liquid crystal model for conducting circuit simulations to optimize the circuit parameters efficiently.

1.1 Equivalent circuit of a pixel in LCDs

The equivalent circuit of a pixel operated by active matrix driving is shown in Fig. 1.
Data lines are connected to a data driver for generating the signal pulses for the picture data. Scan lines are connected to a scan driver for generating the scan pulses which enable the addressing driving. Vsig and Vg are applied to the data lines and scan lines, respectively. The thin film transistor (TFT) has three terminals of MOS transistors, and each terminal gate, drain, and source is connected to a scan line, a data line, and a pixel electrode, respectively. Cgs means the parasitic capacitance between the gate and source terminal in the TFT. Liquid crystal is injected into the gap between the pixel electrode and the counter backplane electrode, and it forms a liquid crystal cell capacitance (Clc). Clc is a variable capacitor that changes value according to the applied voltage between the pixel electrode and a counter backplane electrode. The voltage of the pixel electrode and counter backplane electrode are denoted by Vpix and Vcom, respectively. The storage capacitor is denoted Csc, and it is connected in parallel to Clc. Its function is to hold charges on a pixel electrode while the TFT is switched off.

1.2 Timing chart for each signal pulse

Fig. 2 shows the wave forms applied to each bus line and electrode. The period during which the pixel electrode voltage (Vpix) is higher than the counter electrode voltage (Vcom) is called the "plus frame" (Fig.2 (a)), whereas the period during which Vpix is lower than Vcom is called the "minus frame" (Fig.2 (b)). The plus and minus frames are switched every frame period (Tf).
When the voltage of the gate terminal connecting to the scan line rise to a high level, the resistance between the drain and source terminals becomes very low (Ron). As a result, electrical charges flow into the pixel electrode from the data line till the voltage of the pixel electrode achieves the voltage of the data line during the writing time (Tw). This process is called the "Charge Process". When the voltage of the scan line starts to drop, the pixel electrode voltage shows a negative shift ΔVfd because of the coupling with the gate terminal

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Design, Simulation and Construction of Field Effect Transistors Dhanasekaran Vikraman,Hyun-Seok Kim,2018-07-18 In recent years research on microelectronics has been specifically focused on the proposition of efficient alternative methodologies and materials to fabricate feasible integrated circuits This book provides a general background of thin film transistors and their simulations and constructions The contents of the book are broadly classified into two topics design and simulation of FETs and construction of FETs All the authors anticipate that the provided chapters will act as a single source of reference for the design simulation and construction of FETs This edited book will help microelectronics researchers with their endeavors and would be a great addition to the realm of semiconductor physics **Smart Cities** Anuar Mohamed Kassim,Lutfi Al-Sharif,2021-10-13 The development of smart cities is important and beneficial to a government and its citizens With the advent of the smartphone rapid and reliable communication between and among individuals and governments has become ubiquitous Everything can be connected and accessed easily with the touch of a finger Changes in mobile internet telecommunication systems allow for the advance of new urbanization using smart city development methods The evolution of technology in Industry 4 0 such as the advancement of cutting edge sensors utilizing the Internet of things IoT concept has wide applications in developing various smart systems This publication analyzes the interconnected cyber physical systems inherent in smart cities and the development methods and applications thereof **Applied Science & Technology Index** ,1996 **Human Digital Twins for Medical and Product Engineering** Jörg Miehling,Anne D. Koelewijn ,Julie Choisne,2024-10-25 The current trend towards digitalization of human centred engineering processes in conjunction with advances in bio mechanistic modelling high performance computing artificial intelligence AI and sensor technology leads to unprecedented transformation potentials in medical product and human factors engineering for the enhancement of human technology interaction as well as medical treatment outcomes Biomechanical simulations hold high potential by revealing the processes and inner strain conditions of the human body For reliable simulation results a model suitable for the application and a way to measure estimate predict the human motion behaviour and the interaction with the environment and or interacting technology are necessary In this context we refer to a human digital twin as an extension and connection of participant person specific biomechanical human models with data streams from clinical observation operational use of technology or daily life Each human digital twin is an instance digitally representing a specific person in healthy or pathological state suitable for the specified application **Predicasts F & S Index United States** ,1993 A comprehensive index to company and industry information in business journals **F & S Index United States Annual** ,1994 *Accelerated Circuit Simulation Via Faber Series and Hierarchical Matrix Techniques* Ying-chi Li (M. Phil.),2013

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