

具高動態範圍及溫度補償增益之
車用 CMOS 影像感測器

Wide Dynamic Range & Temperature Compensated Gain
CMOS Image Sensor in Automotive Applications

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中文摘要

影像感測器被廣泛的使用在日常生活中，其全面電子化的趨勢在近五年以內迅速地吞沒了原本屬於銀鹽底片以及傳統相機的世代。無論是以 CCD 製程抑或是 CMOS 製程所製作的產品，或是應用在數位相機、數位攝影機上，影像感測器必須要克服除了原本攝影上所遇到的問題，如高對比亮度限制、手震問題之外，亦要克服許多因為電子元件特性而導致畫質不良的因素，如強烈溫度變化對畫質之影響、定格雜訊等，均是被積極重視及研究的重要課題。基於上述問題，我們所改良開發的特殊應用影像感測器，則定位成須在亮度、溫度變化強烈的環境之下，亦又能維持一定程度的畫質，以提供清晰的影像給演算法做正確判斷，如車用電子之應用。本論文針對目前全球熱門的車用電子領域，考量車用影像感測器所必須面臨的高對比亮度、高溫度變化之惡劣室外環境，設計一個具有高動態範圍操作模式，且具有溫度補償增益之影像感測器。此晶片採用台積電 (Taiwan Semiconductor Manufacturing Company, TSMC) 0.35um 2P4M Mix-Signal CMOS 標準製程，並同時使用該公司提供之 cell base library 進行數位部份之電路合成；感光陣列為 256 像素 (16×16)，可視動態範圍為 80dB，溫度補償之放大器增益為 12 dB，操作頻率符合 VGA 解析度且維持 30 frames/sec 速度，供應電壓 3.3V，內建 1V 帶差參考電路 (Bandgap References)，不含類比-數位轉換器 (ADC)，總功率消耗 167.7uW，晶片面積 $2.826 \times 2.826 \text{ mm}^2$ 。

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Abstract

Image Sensor has been popularly used in our daily life. Whether digital camera or digital video camera in CCD or CMOS process implementation, the tendency toward fully electronic-image equipment engulf the old generation of silver film. Thus the original photography problems like limited of high contrast, vibration issue, there would be the other problems due to electronic devices' characteristic, such as thermal noise can strongly affect the quality of picture. These problems are still hot topics to be overcome, and lots of specialized image sensors have been implemented for different application. This paper thesis on automotive application, presented a high dynamic range and temperature compensated gain CMOS image sensor fabricated by Taiwan Semiconductor Manufacturing Company (TSMC) with 0.35um 2P4M Mix-Signal Standard CMOS process technology and it's cell base library. The chip has 256 pixels (16×16) sensor array, dynamic range extended as 80dB. The gain of temperature compensated differential difference amplifier is 12 dB. The chip operates at VGA resolution of 30 frames/sec. It also built in 1V bandgap reference circuit with 3.3V Supply voltage. Without Analog to Digital Converter (ADC), the total power consumption is 167.7uW, and area spent $2.826 \times 2.826 \text{ mm}^2$.

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