MT6415CA: A 640×512-15µm CTIA ROIC for SWIR InGaAs Detector Arrays

Selim Eminoglu, Murat Isikhan, Nusret Bayhan, M. Ali Gulden, O. Samet Incedere, S. Tuncer Soyer, Serhat Kocak, Gokhan S. Yilmaz, and Tayfun Akin
Mikro-Tasarim Ltd., ODTU-Teknokent, Ankara, 06530, TURKEY

ABSTRACT

This paper reports the development of a new low-noise CTIA ROIC (MT6415CA) suitable for SWIR InGaAs detector arrays for low-light imaging applications. MT6415CA is the second product in the MT6400 series ROICs from Mikro-Tasarim Ltd., which is a fabless IC design house specialized in the development of monolithic imaging sensors and ROICs for hybrid imaging sensors. MT6415CA is a low-noise snapshot CTIA ROIC, has a format of 640 × 512 and pixel pitch of 15 µm, and has been developed with the system-on-chip architecture in mind, where all the timing and biasing for this ROIC are generated on-chip without requiring any external inputs. MT6415CA is a highly configurable ROIC, where many of its features can be programmed through a 3-wire serial interface allowing on-the-fly configuration of many ROIC features. It performs snapshot operation both using Integrate-Then-Read (ITR) and Integrate-While-Read (IWR) modes. The CTIA type pixel input circuitry has three gain modes with programmable full-well-capacity (FWC) values of 10.000 e-, 20.000 e-, and 350.000 e- in the very high gain (VHG), high-gain (HG), and low-gain (LG) modes, respectively. MT6415CA has an input referred noise level of less than 5 e- in the very high gain (VHG) mode, suitable for very low-noise SWIR imaging applications. MT6415CA has 8 analog video outputs that can be programmed in 8, 4, or 2-output modes with a selectable analog reference for pseudo-differential operation. The ROIC runs at 10 MHz and supports frame rate values up to 200 fps in the 8-output mode. The integration time can be programmed up to 1s in steps of 0.1 µs. The ROIC uses 3.3 V and 1.8V supply voltages and dissipates less than 150 mW in the 4-output mode. MT6415CA is fabricated using a modern mixed-signal CMOS process on 200 mm CMOS wafers, and tested parts are available at wafer or die levels with test reports and wafer maps. A compact USB 3.0 camera and imaging software have been developed to demonstrate the imaging performance of SWIR sensors built with MT6415CA ROIC

Keywords: MT6415CA, ROIC, CTIA, Snapshot, low-noise, low-power, SWIR, InGaAs

1. INTRODUCTION

Mikro-Tasarim Ltd. is a fabless IC design company, specialized in the development of monolithic CMOS imaging sensors for visible imaging applications as well as readout integrated circuits (ROICs) for hybrid imaging sensors working in the SWIR, MWIR, and LWIR optical bands [1]. Mikro-Tasarim performs both standard and custom ROIC developments, for various detector types, with wide range of input circuitry selections (SF: Source Follower, DI: Direct-Injection, and CTIA: Capacitive Trans-Impedance Amplifier) capable of operating from room temperature down to cryogenic temperatures. This paper reports the second standard product from Mikro-Tasarim, namely MT6415CA, which is a CTIA ROIC with snapshot operation having a 640×512 format and 15µm pixel pitch, which is developed mainly for the SWIR InGaAs detector arrays to allow very low-noise and fast imaging applications.

SWIR imaging sensors using InGaAs detector arrays gained considerable attention over the last years due to unique advantages of both SWIR optical band and mature InGaAs FPA technology [2-6]. It is relatively easier for the viewers to understand SWIR images as they look similar to the visible images, since both type of images are formed by capturing the reflected light from the ambient rather than radiated light common for MWIR and LWIR bands. In addition, SWIR light can pass through regular glass, allowing the use of lower cost optics [3]. Furthermore, the dark current values in the InGaAs FPAs have been decreased considerably over the last years, which allows building compact and low-power uncooled SWIR cameras [4]. Finally, due to shorter wavelengths involved in SWIR imaging, potentially much smaller pixels, and therefore, more compact and higher resolution SWIR imaging sensors can be built without being limited by the optical diffraction phenomena [7], at least for practical pixel sizes that can be hybridized with the flip-chip technique.

Infrared Technology and Applications XXXIX, edited by Bjørn F. Andresen, Gabor F. Fulop, Charles M. Hanson, Paul R. Norton, Proc. of SPIE Vol. 8704, 87042Z · © 2013 SPIE
CCC code: 0277-786X/13/$18 · doi: 10.1117/12.2019519