SunASIC
Fingerprint Technologies

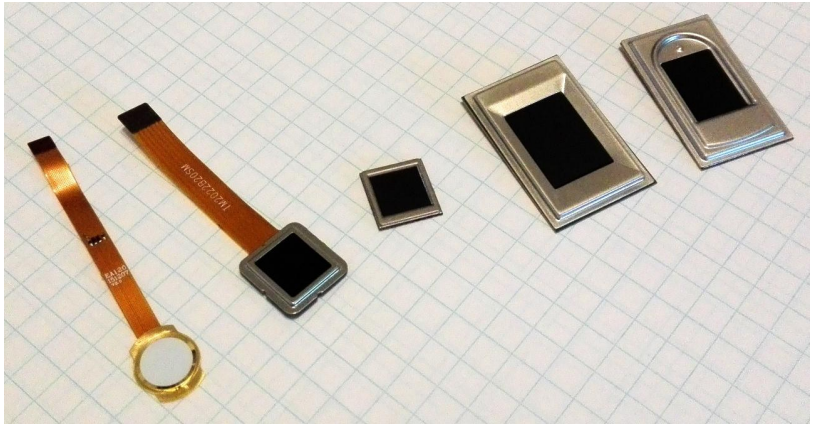
February 2022

About SunASIC Technologies, Inc.

- Established in April 2007, Taipei, initially as a consulting company.
- Specialized in imaging algorithms, system architecture, embedded software, ASIC and sensor design
- Starting 2013, we started to ship fingerprint sensor wafer to customers.
- Customers include
  - JPsensor (2013~, first fingerprint sensor)
  - Biosec Co. Shanghai (2015~)
  - Zteway Co. Beijing (2015~)
  - Suprema Inc. and other Korean customers (2018~)
- Website

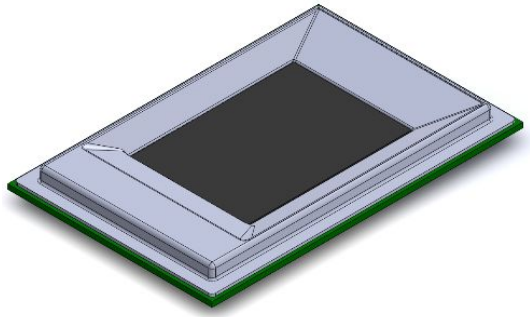
SunASIC Product lines

Imaging array	Active area (mm^2)
112x88	5.6x4.4
120x120	6x6
160x160	8x8
176x176	8.8x8.8
192x192	9.6x9.6
208x288	10.4x14.4
256x360	12.8x18



Basic features of A365MRC

- Active sensing area: 18x12.8mm (FAP 10)
- Resolution: 508 DPI
- Sample rate: 4Mpix/sec
- Supply power: 2.7~3.3V, 1.8mA
- Interface: SPI
- ESD: +/- 15KV
- Operating temperature:-30~80°C
- RoHS compliance
- PIV certified



Additional feature/facts

- RCA（abbrassive test）enhanced to 700
- Low power finger detection
- Low resolution finger tracking
- On-chip 256 bit OTP memory with unique ID
- Image data encryption with 64-bit key from OTP
- Patented method to eliminate noise caused by scratch and residue
- Fabricated with UMC 0.35um mixed mode process
- We keep the test record and raw image data for every chip shipped to customer

Qualification / approvals

- IP67
- RoHS
- PIV (FAP 10 for A365MRC/MQ)
- GA

CERTIFICATION OF COMPLIANCE

for

SUNASIC TECHNOLOGIES, INC

***A365MRC* or *A365MQ* single finger plainscan capture device at 508 ppi.**

The FBI certifies that the equipment described above is in compliance with the following FBI CJIS Division's Next Generation Identification System Image Quality Specifications (IQS):

Personal Identity Verification (PIV) Single Finger Capture Device Specifications

This certification process does not constitute an endorsement, but only attests that the product meets FBI standards. Continued acceptance of the images created by an installed system, for retention in the FBI Master Fingerprint files, is contingent on the ability of the product to meet the IQS over time. As equipment can degrade, the FBI recommends that your company assist customers in the establishment of quality assurance programs and appropriate maintenance schedules for your products.

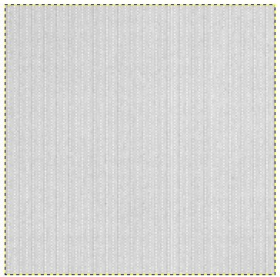
This certification process is not intended to endorse one entity or implementation over another, but merely to certify that the implementation meets FBI standards. The authenticity of this certificate can be confirmed by checking the online registry at <https://www.fbibiospecs.cjis.gov/>.

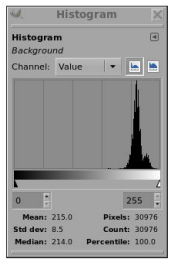
Date: August 9, 2018

Patent granted - US 09836636

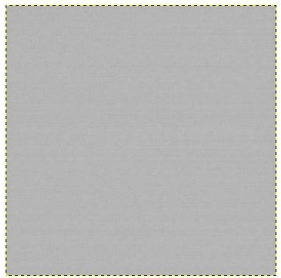
- A white A-series fingerprint sensor image quality, a white paper

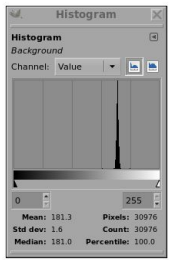
Raw image

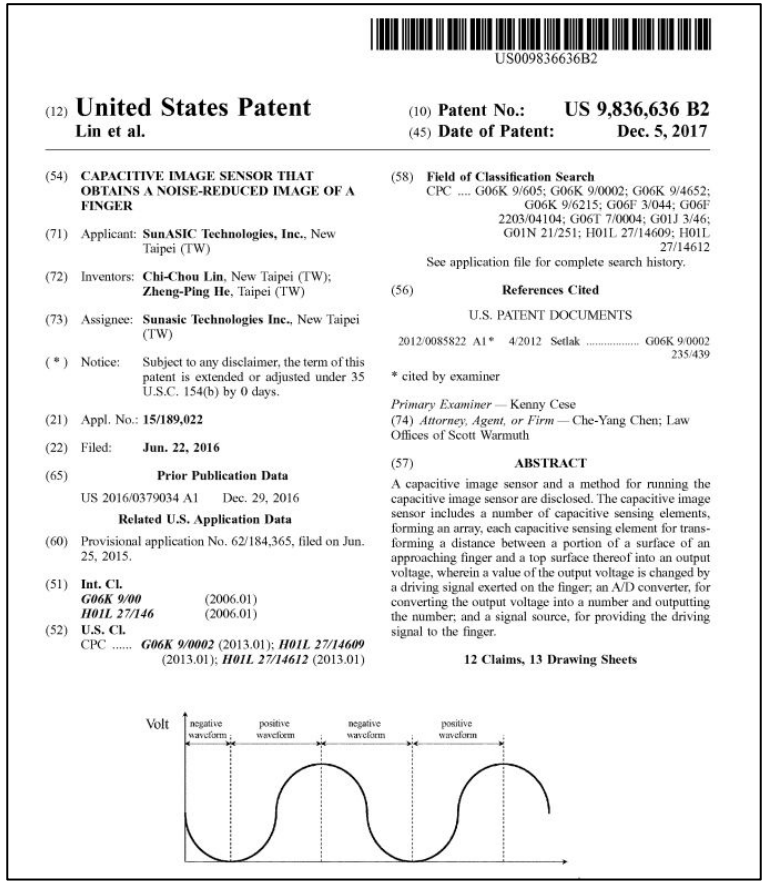




With noise reduction







US009836636B2

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

(10) **Patent No.: US 9,836,636 B2**
(45) **Date of Patent: Dec. 5, 2017**

(54) **CAPACITIVE IMAGE SENSOR THAT OBTAINS A NOISE-REDUCED IMAGE OF A FINGER**

(71) Applicant: **SunASIC Technologies, Inc.**, New Taipei (TW)

(72) Inventors: **Chi-Chou Lin**, New Taipei (TW); **Zheng-Ping He**, Taipei (TW)

(73) Assignee: **Sunasic Technologies Inc.**, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/189,022**

(22) Filed: **Jun. 22, 2016**

(65) **Prior Publication Data**

US 2016/0379034 A1 Dec. 29, 2016

Related U.S. Application Data

(60) Provisional application No. 62/184,365, filed on Jun. 25, 2015.

(51) **Int. Cl.**
G06K 9/00 (2006.01)
H01L 27/146 (2006.01)

(52) **U.S. Cl.**
CPC ***G06K 9/0002*** (2013.01); ***H01L 27/14609*** (2013.01); ***H01L 27/14612*** (2013.01)

(58) **Field of Classification Search**
CPC G06K 9/605; G06K 9/0002; G06K 9/4652; G06K 9/6215; G06F 3/044; G06F 2203/04104; G06T 7/0004; G01J 3/46; G01N 21/251; H01L 27/14609; H01L 27/14612
See application file for complete search history.

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* cited by examiner

Primary Examiner — Kenny Cese
(74) *Attorney, Agent, or Firm* — Che-Yang Chen; Law Offices of Scott Warmuth

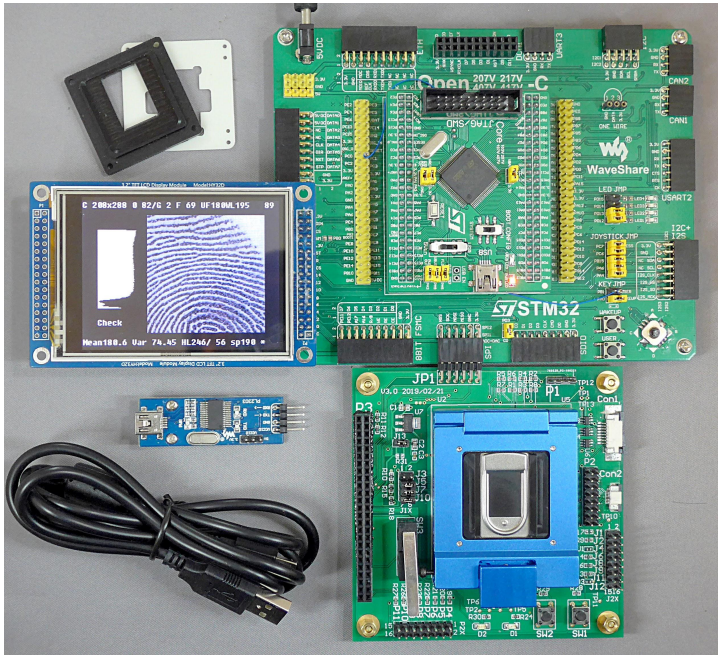
(57) **ABSTRACT**

A capacitive image sensor and a method for running the capacitive image sensor are disclosed. The capacitive image sensor includes a number of capacitive sensing elements, forming an array, each capacitive sensing element for transforming a distance between a portion of a surface of an approaching finger and a top surface thereof into an output voltage, wherein a value of the output voltage is changed by a driving signal exerted on the finger; an A/D converter, for converting the output voltage into a number and outputting the number; and a signal source, for providing the driving signal to the finger.

12 Claims, 13 Drawing Sheets

Quality assurance and test tools

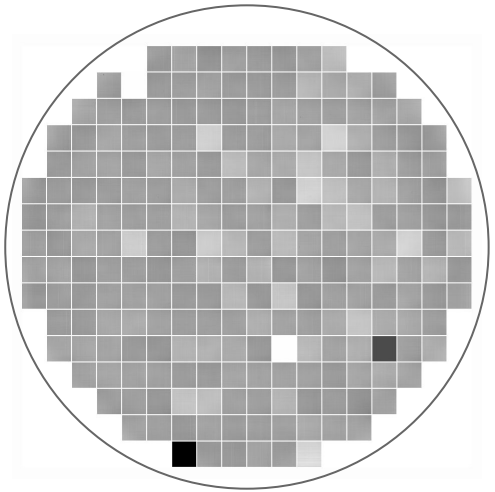
- Efficient field test tool
- Production report
- Yield analysis
- Electrical qualification
- Image quality check
- Record keeping and RMA tracking



Wafer test reports

Records have been kept for every wafer shipped.

Complete image map



Numerical data

Wafer 20140816 TURFE12

N	X	Y	info	registers	idle_d(A)	idle_a(A)	act_d(A)	act_a(A)	mean	variance	bad col	bad row	weak col	weak row	row variation	col variation	bad pixel	error code
0	6	16	20140816TURFE12001	x1300225A122FFF01	-0.000005	0.00162	0.000818	0.002474	155.0	6.1	0	0	2	0	13.0	17.0	3	1
1	7	16	20140816TURFE12002	x1300225A122FFF01	-0.000005	0.001925	0.000674	0.002643	164.0	5.0	0	0	1	0	10.0	18.0	0	1
2	8	16	20140816TURFE12003	x1300225A122FFF01	-0.000004	0.002269	0.000756	0.002825	147.0	5.5	0	0	0	0	16.0	18.0	0	0
3	9	16	20140816TURFE12004	x1300225A122FFF01	-0.000004	0.003138	0.000659	0.003653	160.0	5.1	0	0	0	0	15.0	16.0	0	0
4	10	16	20140816TURFE12005	x1300225A122FFF01	-0.000007	0.002808	0.00068	0.003198	154.0	5.1	0	0	0	0	13.0	23.0	0	0
5	11	16	20140816TURFE12006	x1300225A122FFF01	-0.000007	0.003748	0.000751	0.004007	152.0	4.5	0	0	0	0	11.0	14.0	0	0
6	12	16	20140816TURFE12007	x1300225A122FFF01	-0.000002	0.002024	0.000722	0.002476	161.0	4.2	0	0	0	0	9.0	14.0	0	0
7	13	16	20140816TURFE12008	x1300225A122FFF01	-0.000007	0.002299	0.000653	0.002794	188.0	5.0	0	0	0	0	13.0	12.0	1	0
8	15	15	20140816TURFE12009	x1300225A122FFF01	-0.000005	0.004317	0.000689	0.004597	160.0	5.8	0	0	0	0	17.0	21.0	0	0
9	14	15	20140816TURFE12010	x1300225A122FFF01	-0.000005	0.003488	0.000706	0.004001	173.0	4.8	0	0	0	0	10.0	18.0	0	0
10	13	15	20140816TURFE12011	x1300225A122FFF01	-0.000007	0.002106	0.0007	0.002583	189.0	4.7	0	0	0	0	12.0	19.0	0	0
11	12	15	20140816TURFE12012	x1300225A122FFF01	-0.000009	0.003859	0.000673	0.004122	182.0	4.9	0	0	0	0	13.0	13.0	1	0
12	11	15	20140816TURFE12013	x1300225A122FFF01	-0.000006	0.003306	0.00075	0.004077	156.0	4.8	0	0	1	0	12.0	10.0	0	1
13	10	15	20140816TURFE12014	x1300225A122FFF01	-0.000006	0.002361	0.000644	0.002883	155.0	4.6	0	0	0	0	11.0	22.0	0	0
14	9	15	20140816TURFE12015	x1300225A122FFF01	-0.000006	0.003363	0.00082	0.003726	155.0	4.6	0	0	0	0	15.0	13.0	0	0
15	8	15	20140816TURFE12016	x1300225A122FFF01	-0.000009	0.003375	0.000678	0.004201	162.0	4.7	0	0	0	0	13.0	16.0	0	0
16	7	15	20140816TURFE12017	x1300225A122FFF01	-0.000005	0.003825	0.000721	0.004382	157.0	4.5	0	0	0	0	14.0	15.0	0	0
17	6	15	20140816TURFE12018	x1300225A122FFF01	-0.000002	0.003322	0.000641	0.003746	154.0	4.9	0	0	0	0	13.0	14.0	0	0
18	5	15	20140816TURFE12019	x1300225A122FFF01	-0.000007	0.002689	0.010014	0.003151	254.0	0.0	0	0	0	0	0.0	0.0	0	0
19	4	15	20140816TURFE12020	x1300225A122FFF01	-0.000003	0.002206	0.000701	0.002806	160.0	7.2	0	0	1	0	0.0	0.0	0	0
20	3	14	20140816TURFE12021	x1300225A122FFF01	-0.000007	0.001962	0.000797	0.00252	168.0	5.9	0	0	0	0	0.0	0.0	0	0
21	4	14	20140816TURFE12022	x1300225A122FFF01	-0.000008	0.002107	0.000646	0.002642	198.0	5.2	0	0	0	0	0.0	0.0	0	0
22	5	14	20140816TURFE12023	x1300225A122FFF01	-0.000005	0.002923	0.000734	0.003444	155.0	5.6	0	0	0	0	0.0	0.0	0	0
23	6	14	20140816TURFE12024	x1300225A122FFF01	-0.000008	0.003067	0.000811	0.003502	158.0	4.5	0	0	0	0	0.0	0.0	0	0
24	7	14	20140816TURFE12025	x1300225A122FFF01	-0.000009	0.00338	0.000736	0.003983	154.0	5.0	0	0	0	0	0.0	0.0	0	0
25	8	14	20140816TURFE12026	x1300225A122FFF01	-0.000005	0.003715	0.00098	0.003982	154.0	4.9	0	0	0	0	0.0	0.0	0	0
26	9	14	20140816TURFE12027	x1300225A122FFF01	-0.000007	0.003627	0.000782	0.003836	152.0	4.5	0	0	0	0	0.0	0.0	0	0
27	10	14	20140816TURFE12028	x1300225A122FFF01	-0.000003	0.002572	0.000676	0.002935	157.0	5.7	1	0	0	0	0.0	0.0	0	0
28	11	14	20140816TURFE12029	x1300225A122FFF01	-0.000005	0.003514	0.000709	0.003456	166.0	4.5	0	0	0	0	0.0	0.0	0	0
29	12	14	20140816TURFE12030	x1300225A122FFF01	-0.000003	0.003219	0.000652	0.004368	161.0	5.3	0	0	0	0	0.0	0.0	0	0
30	13	14	20140816TURFE12031	x1300225A122FFF01	-0.000005	0.002791	0.000704	0.003854	159.0	4.5	0	0	0	0	0.0	0.0	0	0
31	14	14	20140816TURFE12032	x1300225A122FFF01	-0.000006	0.003153	0.000688	0.003442	161.0	5.7	0	0	0	0	0.0	0.0	0	0
32	15	14	20140816TURFE12033	x1300225A122FFF01	-0.000007	0.003904	0.000656	0.003992	162.0	5.3	0	0	0	0	0.0	0.0	0	0
33	16	14	20140816TURFE12034	x1300225A122FFF01	-0.000005	0.002071	0.000658	0.002494	170.0	5.0	0	0	0	0	0.0	0.0	0	0

Report for packaging

```
DEVICE:  FP210
WAFERID  TURFE_21_20140816
X:18
Y:16
REFDIE:
-----11000000.....
---1500000010000...
--.000000030000000..
.0000000000000001.
.0000000000000001.
0000000010001000000
0000000001000000000
1001000100001000001
0000000101000000000
0100000000000000000
.1001000000000100.
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--.00000000000000.--
---.000000000000.---
----.00100100000.----
------.901000.------
FLAT ZONE : BOTTOM
```
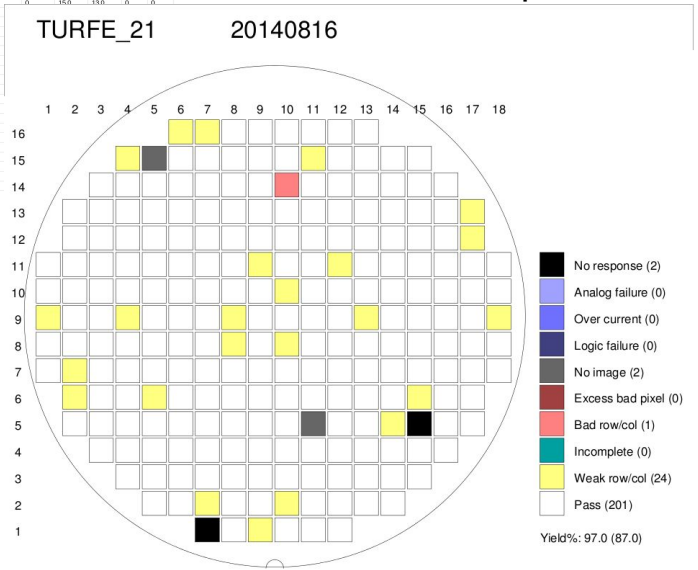
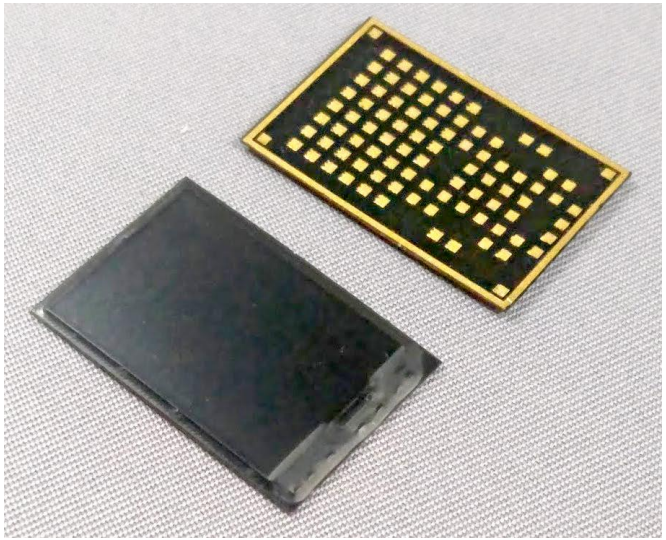
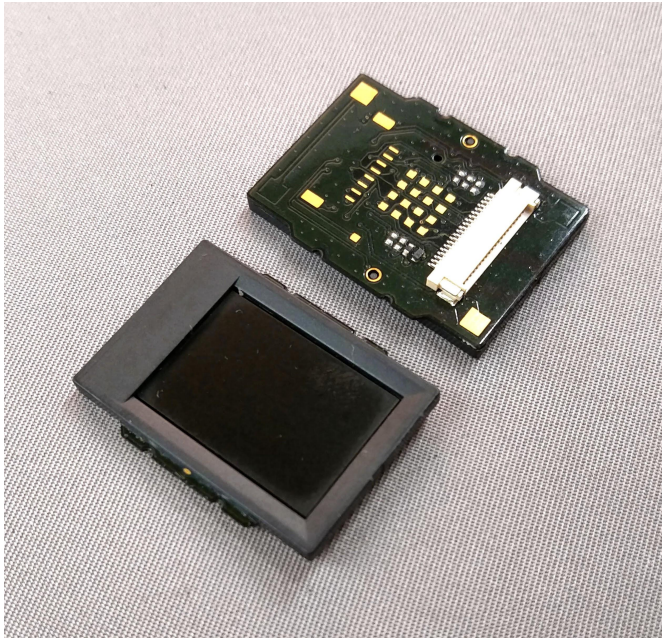

Yield report



A365MQ - An alternative packaging

Allowing custom designed bezel and substrate.





Main supplier to Korean door lock manufacturers

Our patents

- US 9,305,202 - Portable device having fingerprint recognition function
- US 9,690,916 - Multi-function identification system and operation method thereof
- US 9,818,248 - Compound and securable key
- US 9,907,178 - Printed circuit board having electronic component embedded
- US 9,836,636 - Capacitive image sensor that obtains a noise-reduced image of a finger
- US 10,042,947- Read-only method and system for operating portable devices
- Other SunASIC patents - As of Dec 2021, 30 US patents have been granted, with more pending applications in the areas of packaging technology, sensor design, security device and and trusted execution environment.

Business model

Current

- ASIC/Sensor design service (NRE/Royalty based)
- Fingerprint sensor wafers
- Fingerprint sensor packaging

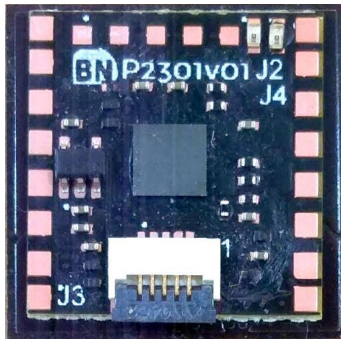
In development

- Fingerprint modules (card, USB dongle, etc.)
- Patent/IP licensing

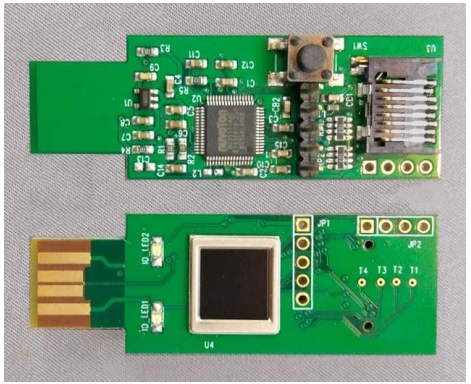
New product lines for personal security

- Announced in Embedded World 2019
- Standard product lines
  - Fingerprint sensors
  - FC-series fingerprint ”buttons“
  - UL-series fingerprint protected USB devices
- Customization services
  - Product development and prototyping
  - Circuit board/housing design and manufacturing

FC1701

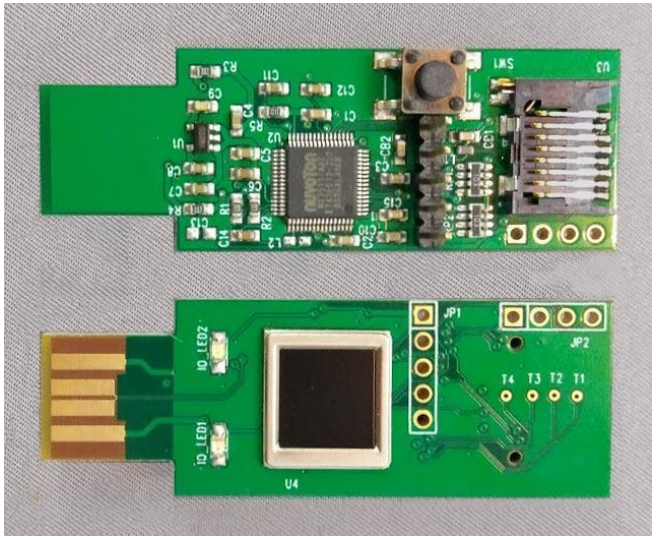


UL1701

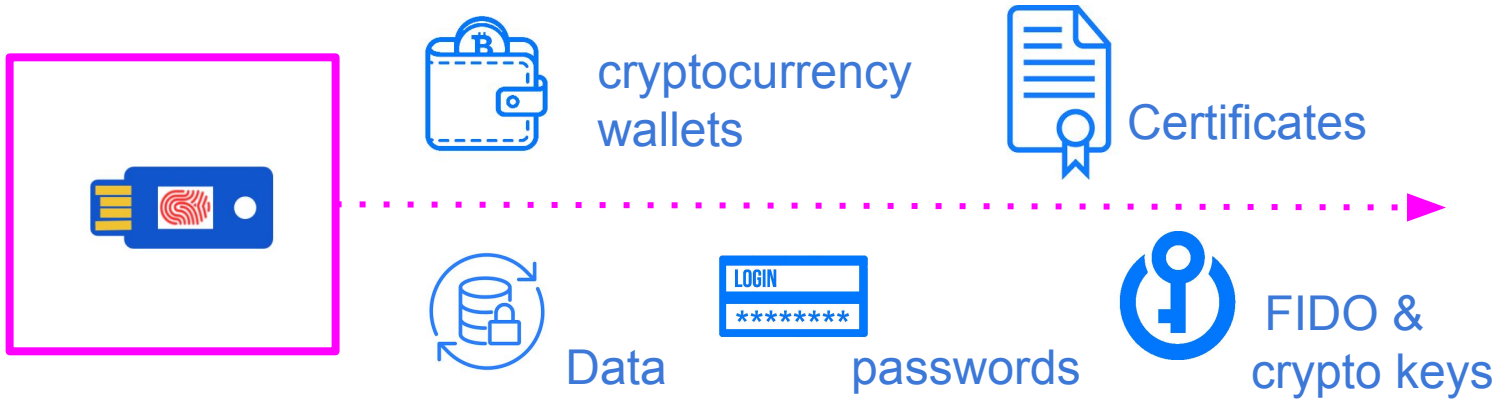


UL-series USB fingerprint dongle

- 96Mhz Cortex-M23 processor with “TrustZone”, 512KB Flash, 96KB SRAM
- hardware crypto accelerator supporting AES/DES/3DES/SHA/ECC/TRND
- SunASIC A172 fingerprint sensor
- Fingerprint matching library
- Javacard runtime library (option)
- SD card slot for extended storage
- FIDO and FIDO2 ready

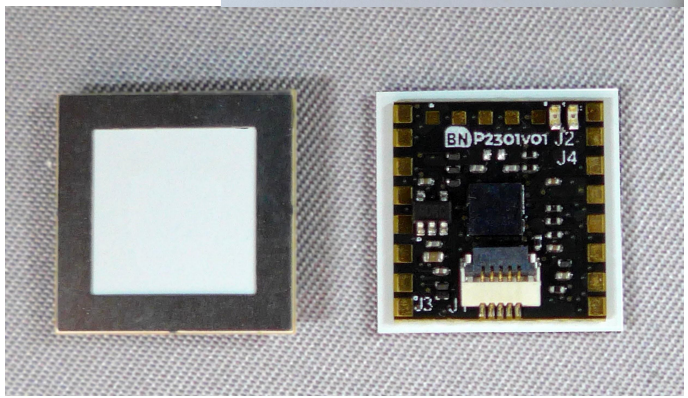


UL-Series USB fingerprint module

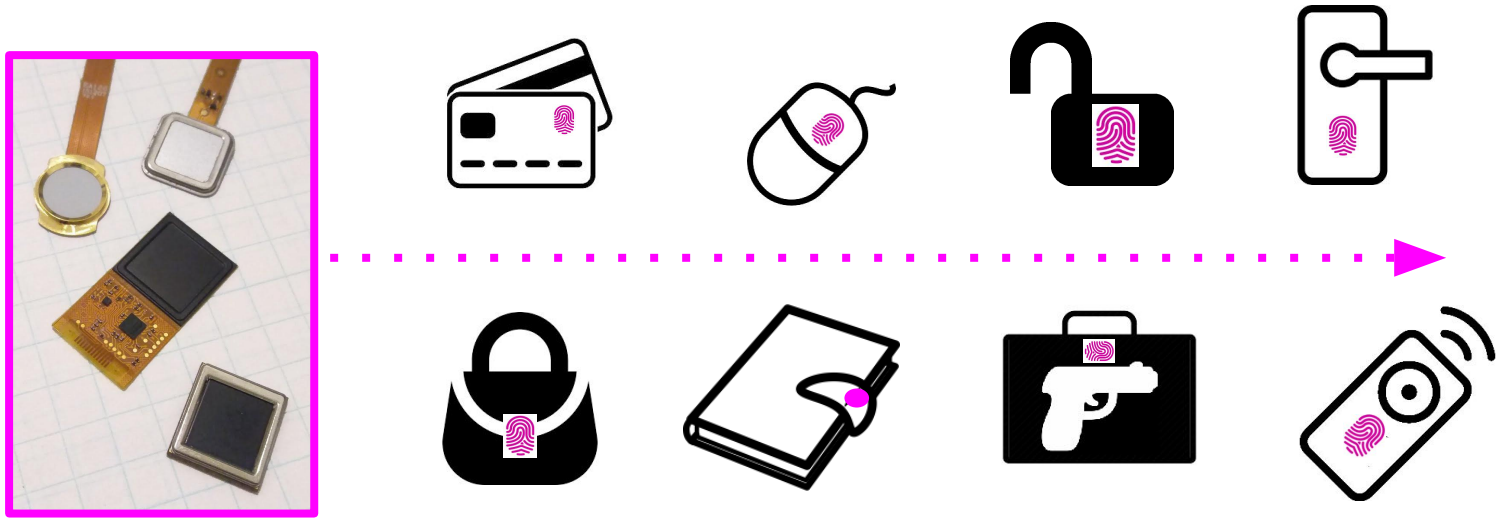


FC-series fingerprint “buttons”

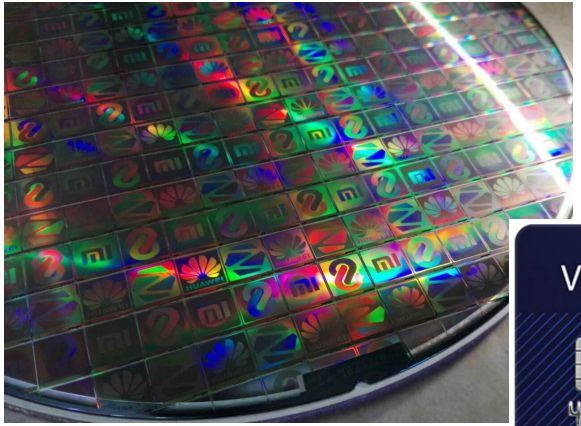
- Cortex-M23 processor with “TrustZone”
- Customizable, innovative packaging (patent pending)
- Wake-up by touch sensing
- Battery charge control
- SunASIC A172 fingerprint sensor
- Fingerprint matching library
- Javacard runtime library (option)

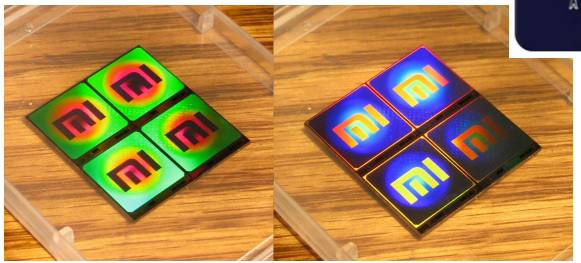


FC-Series fingerprint “buttons”



Wafers having colored top side





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

(10) **Patent No.: US 10,168,450 B2**
(45) **Date of Patent: Jan. 1, 2019**

(54) **SILICON WAFER HAVING COLORED TOP SIDE**

(71) Applicant: **SunASIC Technologies, Inc.**, New Taipei (TW)

(72) Inventors: **Chi-Chou Lin**, New Taipei (TW); **Zheng-Ping He**, New Taipei (TW)

signee: **Sunasic Technologies, Inc.**, New Taipei (TW)

tice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 101 days.

pl. No.: **14/141,717**

ed: **Dec. 27, 2013**

Prior Publication Data

2015/0185378 A1 Jul. 2, 2015

. Cl.

IL 23/544	(2006.01)
IL 21/76	(2006.01)
2B 1/00	(2006.01)
G02B 5/18	(2006.01)
G02B 5/20	(2006.01)

(52) **U.S. Cl.**
CPC ***G02B 1/005*** (2013.01); ***G02B 5/1842*** (2013.01); ***G02B 5/203*** (2013.01); *H01L 2933/0083* (2013.01)

(58) **Field of Classification Search**
CPC B82Y 20/00; G02B 5/18; G02B 5/1866; G02B 5/3083; H01L 23/544
USPC 359/576; 427/162; 216/24; 438/479
See application file for complete search history.

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(57) **ABSTRACT**

A silicon wafer having colored top side is disclosed in the present invention. The silicon wafer includes: a wafer; a first semi-conductor layer, formed on at least a portion of a top side of the wafer, having periodical structures to form a grating pattern, and a second semi-conductor layer, formed on the first semi-conductor layer with a bottom side substantially fully contacted with the periodical structures. The first semi-conductor layer and the second semi-conductor layer form a photonic crystal layer and work to reflect a predetermined wavelength range of incident visible light beams. The present invention provides a silicon wafer which can reflect specified color(s) from the surface facing external light beams. Therefore, dies from cutting the silicon wafer with functions to interact with external environment rather than packaged can have advantages to show some specified logo or trademark.

18 Claims, 12 Drawing Sheets

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