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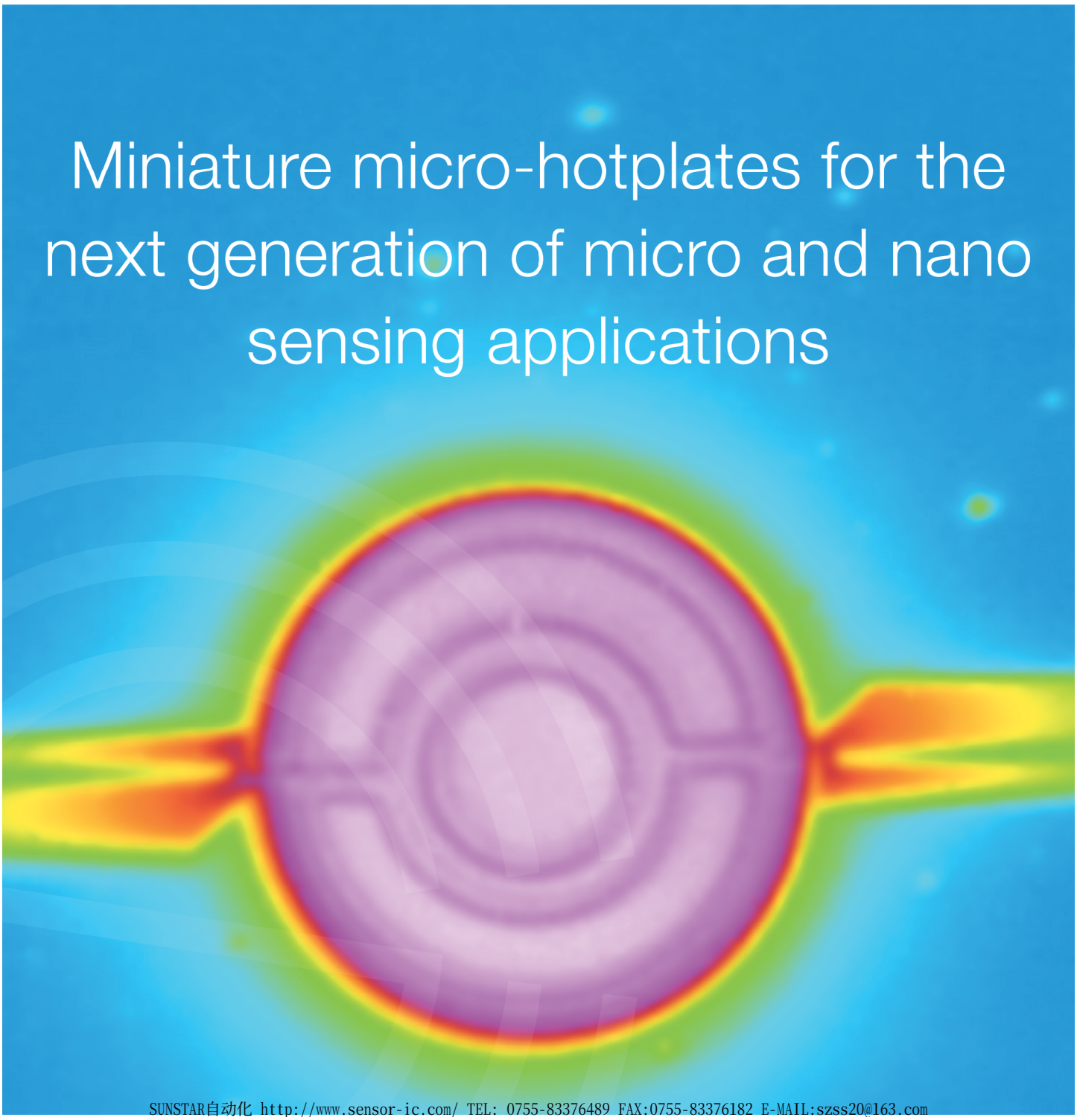
CMOS MEMS MICRO-HOTPLATES

CAMBRIDGE CMOS SENSORS

Miniature micro-hotplates for the next generation of micro and nano sensing applications



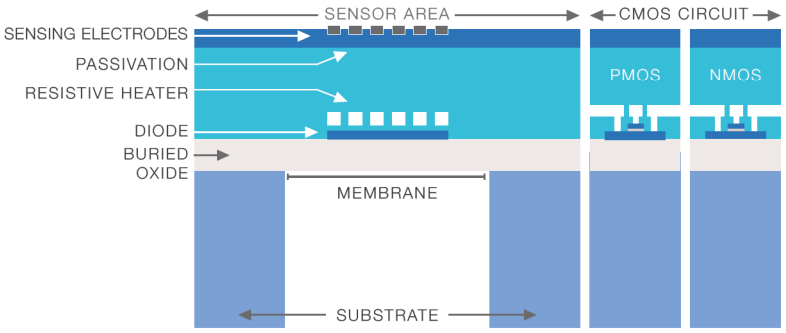
TECHNOLOGY OVERVIEW

Cambridge CMOS Sensors (CCMOSS) micro-hotplate technology offers a radical step change in heater technology for resistive and catalytic sensor products, and other applications. Based on advanced CMOS Silicon on Insulator (SOI) technology, the micro-hotplate is formed from a circular dielectric membrane, supported on silicon pillars, with a central Tungsten heater, produced by a Deep Reactive Ion Etch (DRIE) MEMS process. The inherently low thermal mass allows for very high speed operation (from ambient to high temperature >500°C), enabling pulsed mode operation at high frequencies, thereby improving sensor accuracy, and significantly reducing power consumption. The technology uses standard CMOS processes, making it ideal for high volume consumer applications, in scalability and cost.

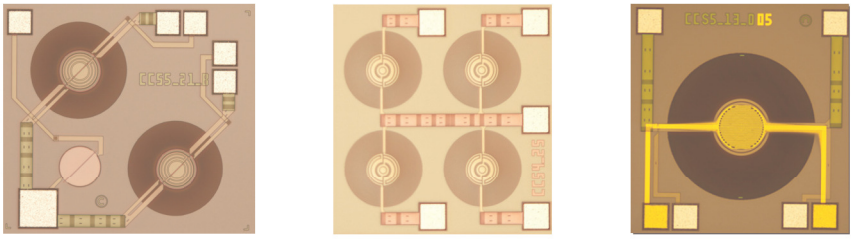
Micro-hotplates with Inter-digitated Electrodes (IDE) are available to customers for post-processing with metal oxide materials for resistive gas sensing applications. They are available in a range of packaging options, as well as bare die and custom-made array solutions for miniature multi-sensing applications. In addition, our devices come with integrated FET drivers, where the heater temperature can be controlled by appropriately adjusting the gate or the supply voltage, therefore eliminating the need for a separate off-chip FET device. An integrated sensing diode also provides the benefit of accurately and independently monitoring the temperature of the heater, further improving sensor accuracy and lifetime stability.

APPLICATIONS

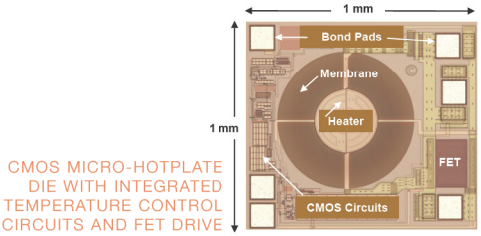
- Micro-heating elements
- Catalytic and resistive gas sensing
- Infrared source
- NDIR gas sensing
- FTIR spectroscopy
- Temperature sensing
- Flow sensing
- Smart sensing



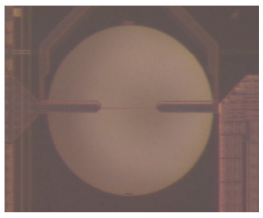
CROSS-SECTION OF MICRO-HOTPLATE WITH INTEGRATED FET DRIVER & TEMPERATURE SENSOR



DUAL & QUAD ARRAYS AND GOLD INTERDIGITATED ELECTRODES



CMOS MICRO-HOTPLATE DIE WITH INTEGRATED TEMPERATURE CONTROL CIRCUITS AND FET DRIVE

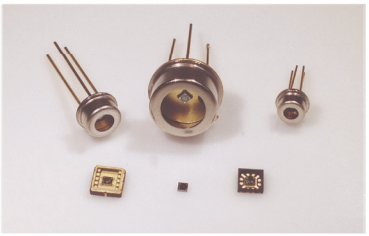


FLOW SENSOR

GENERIC PRODUCT CODE	TEMP RANGE	DIE SIZE (mm x mm)	HEATER DIAMETER SENSING AREA (µm)	DC INPUT POWER (mW)	GOLD ELECT-RODE	TEMP SENSOR	FET	APPLICATION	
								RESISTIVE	CALORI-METRIC
CCSMHX09X	600*	~1 X 1	250	72	Y	Y	Y	Y	Y
CCSMHX61X	500*	~1 X 1	600	160	N	N	N	N	Y
CCSMHX79X	450*	~1.6 X 1.6	800	140	Y	Y	Y	Y	Y
CCSMHX88X (DUAL)	500*	~1.6 X 1.6	300 (EACH)	55 (EACH)	N	Y	N	N	Y

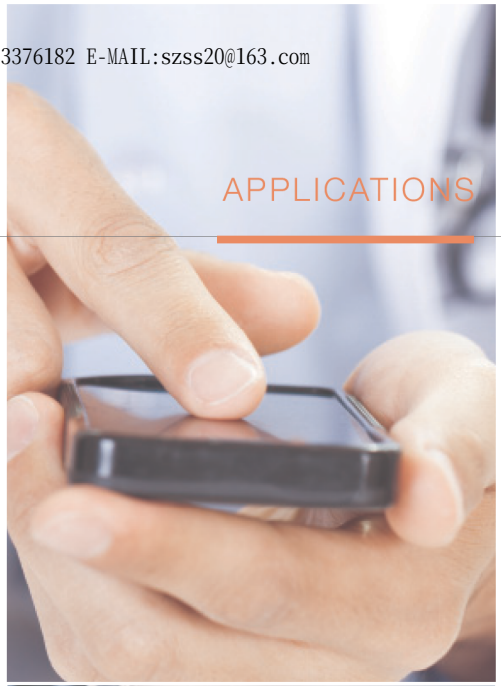
*Can be operated at higher temperature for thermal recycling. Continuous operation at elevated temperature may affect lifetime.

APPLICATIONS

PARAMETER	CCSMHX09X	CCSMHX61X	CCSMHX79X	CCSMHX88X
POWER CONSUMPTION (DC)	72mW ± 5mW	160mW ± 15mW	140mW ± 15mW	150mW ± 20mW
THERMAL RISE TIME ($T_{10-90\%}$)	15ms ± 5ms	20ms ± 5ms	40ms ± 5ms	20ms ± 5ms
THERMAL FALL TIME ($T_{90-10\%}$)	30ms ± 5ms	45ms ± 5ms	60ms ± 5ms	50ms ± 5ms
OPERATING TEMPERATURE	600°C	500°C	450°C	500°C
AMBIENT RESISTANCE (R_0)	40Ω ± 10Ω	17.5Ω ± 3.5Ω	11Ω ± 2.5Ω	40Ω ± 8Ω
HEATER RESISTANCE (R)	80Ω ± 20Ω	33Ω ± 8Ω	21Ω ± 5Ω	73Ω ± 15Ω
HEATER VOLTAGE (V_H)	2.4V + 0.3V	2.3V + 0.2V	1.7V + 0.2V	2.0V + 0.2V
HEATER CURRENT (I_H)	30mA ± 4mA	70mA ± 15mA	80mA ± 10mA	28mA ± 3mA
GATE VOLTAGE (V_G)	3V (5V MAX)	-	NOTE 1	NOTE 1
SUPPLY VOLTAGE (V_{DD})	2.7V (3V MAX)	-	NOTE 1	NOTE 1
DIODE TEMP COEFFICIENT (D)	1.3 X 10^{-3} V/K	-	NOTE 1	NOTE 1
LIFE TIME (MTTF) NOTE 2	~100K HOURS	>50K HOURS	>50K HOURS	>50K HOURS
PACKAGE OPTIONS			BARE DIE, WAFER, TO39, SMD, ARRAY OPTIONS AVAILABLE FOR ALL PRODUCT RANGE	
INTERDIGITATED ELECTRODES	CHOICE OF ELECTRODE ASPECT RATIO, SEPARATION AND THICKNESS OPTIONS AVAILABLE			

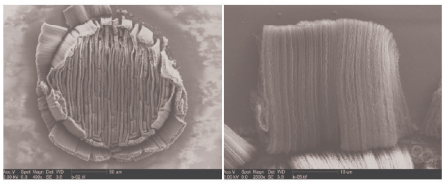
NOTE 1: On-chip integrated FET and heater temperature sensor options available on packaged parts.

NOTE 2: Life time is subject to change and depends on the sensing material placed on the sensor area.



HIGH TEMPERATURE HEATING ELEMENTS

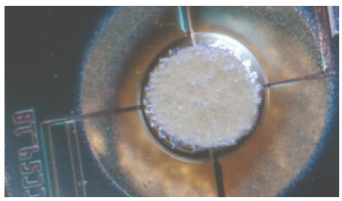
- Nano-material processing/annealing
- Localised Carbon Nano-tube (CNT) growth by Chemical Vapour Deposition (CVD)



WAFER-LEVEL CNT GROWTH ON MICRO-HOTPLATE AT 700°C

CATALYTIC & RESISTIVE GAS SENSING

- Micro-pellistors for combustible gas sensing
- Resistive Metal Oxide (MOX) gas sensing



MOX MATERIAL DROP-COATED AND CURED ON MICRO-HOTPLATE AT 500°C

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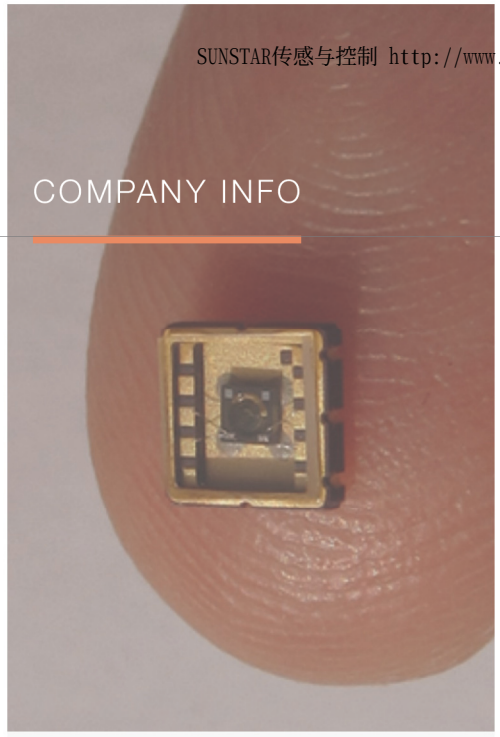
COMPANY INFO



CAMBRIDGE CMOS SENSORS

Cambridge CMOS Sensors are a leading supplier of CMOS MEMS Micro-Hotplates and Infrared Sources, designed specifically for high performance, high stability gas and materials sensing, as well as other applications. Our micro-hotplates provide the key technology platform for chemical resistive, and catalytic gas sensors. The Infrared Sources are used in a range of applications, including Non-Dispersive Infrared (NDIR) optical sensors for gas sensing and spectroscopy applications, and Attenuated Total Reflectance (ATR) sensors for analysis of liquids and solids.

The unique CMOS MEMS technology, which forms the basis of all our products, enables a new generation of miniature sensors and applications, in emerging sensor markets such as Consumer and Home Healthcare, as well as offering unique differentiation in established markets such as Automotive, Industrial and Domestic.

BENEFITS & FEATURES

- High-stability
- Lifetime >10 years
- High temperature – up to 700°C
- Ultra-low power consumption
- On-chip integrated FET driver
- Miniaturisation
- Fast thermal transient response <10ms
- High reliability
- Integrated temperature sensing diode
- Multi-sensing arrays

MARKETS & APPLICATIONS

- Consumer
- Ambient air quality monitoring
- Smartphone sensors
- Sports/activities health monitoring
- Domestic & Industrial Security
- Refrigerant leak detection
- Fire detection
- Building air quality monitoring
- Automotive
- In-vehicle air quality monitoring
- Emissions testing & monitoring
- Medical/Home Healthcare
- Personalised healthcare monitoring
- Breath analysis and biosensing

Our patented CMOS MEMS technology enables sensor miniaturisation, significantly lower power consumption, ultra-fast response times, embedded intelligence, and consumer volume production at highly competitive costs.

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BR-MHP002-05/13