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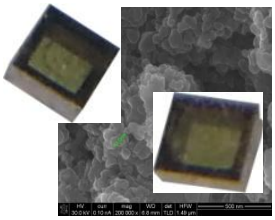
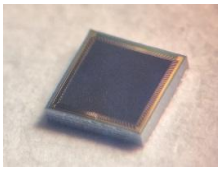
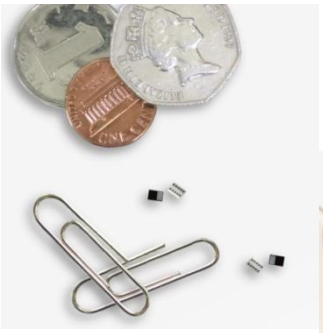
The AIR111 is a MEMS Thermopile sensor with ASIC for non-contact infrared temperature measurement solutions.







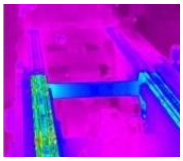
WISE' infrared sensing technologies are playing a vital role in creating a healthier, easier and safer tomorrow. WISE has gained worldwide recognition for the design and production of high-performance thermopile detectors with ASIC which contribute to safeguarding homes, saving energy, and providing comfort. From motion and presence detection to gas detection, thermometry and indoor climate control applications, WISE' IR sensing technologies and growing IR product range are meeting your challenges. WISE now offers Thermopile Detectors with ASIC in compact SMD housings.
Containing pre-installed software and specific algorithms is designed for detecting infrared and ambient temperature compensation.

Advantages

Small SMD packaging (**2.3 x 3.4 x 1.2mm**) with ROIC
Smallest Die : 1.0 x 1.0 x 0.3 mm(or 1.6 x 1.6 x 0.3 mm)
Self-Temperature compensation
High sensitivity
High reliability & stability
Reasonable price
Various sensor packaging : Metal(TO 45), PCB, Ceramic
Continuous temperature monitoring
Real-time motion detection

Applications

Indoor home safety and security
Energy conservation and comfort
Home appliances applications
Thermometry for healthier Families & Safer industries
Non-contact infrared thermometer
Motion sensor (light, human, thermal)
Internet Of Things applications
Consumer appliance: micro-oven, air conditioner, refrigerator, printer, etc.



Technical Details of Thermopile Sensor

Parameter	Symbol	AIR111	Unit
Sensor Size	A	1.0	mm^2
Number of Junctions	N_j	128	ea
Signal Voltage	O_v	12	mV (125℃, 7um cutoff filter)
Active area	A	0.7*0.7	mm^2
Responsivity	S_V	100	V/W (227℃, 1Hz)
Time Constant	τ	10	ms
Noise Voltage	V_{RMS}	0.02	$\mu VHz^{1/2}$
Detectivity	D*	$1.5*10^8$	$cmHz^{1/2}/W$
Operating Temperature		-10~120	℃
Related Humidity		5~95	%RH

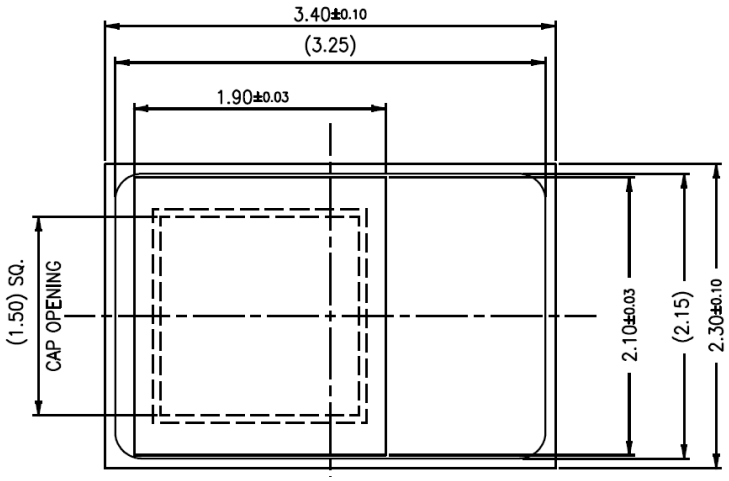
Electrical Characteristics(With ASIC)

Parameter	Condition	Min	Typ	Max	Units
Supply Voltage	3V connection	2.4	3.3	3.7	V
Supply current			1		mA
ambient temperature range		-40		120	℃
Storage temperature range		-40		125	℃
Object temperature range		-30		500	℃
Ambient operating humidity		15		85	%RH
Temperature Resolution	0.1				℃
Filter	Si(AR Coating)	Cut on 5.5um Wavelength 7.5 to 13.5um			
Filter Transmission		70			%
Field of View			110		°
Maximum soldering profile	Reflow soldering	280℃ for 30s			

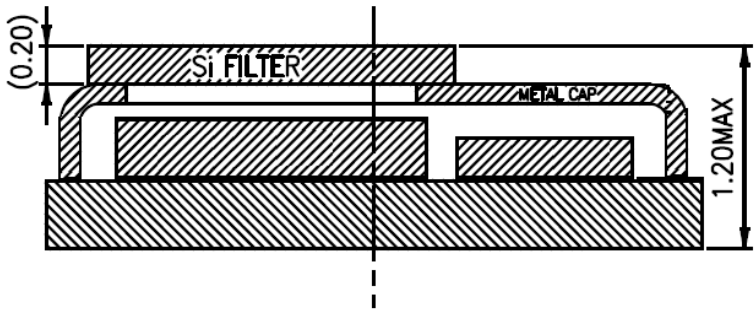
Package Outline Dimensions

The package is compatible with SMD assembly process. AIR111 has Si(0.2mm) Filter.

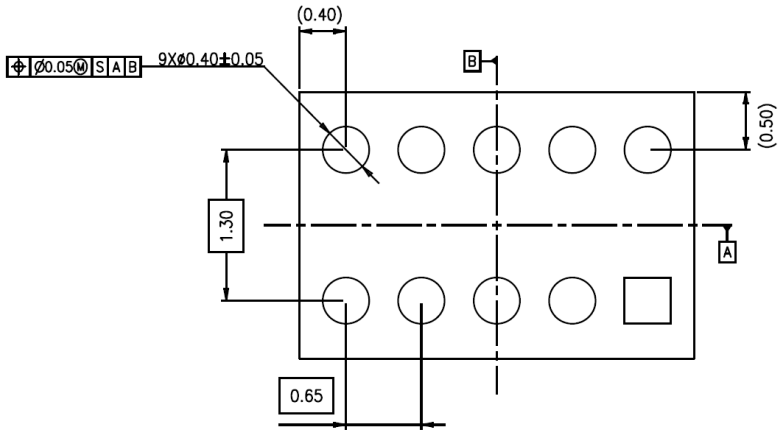
Top View



Side View

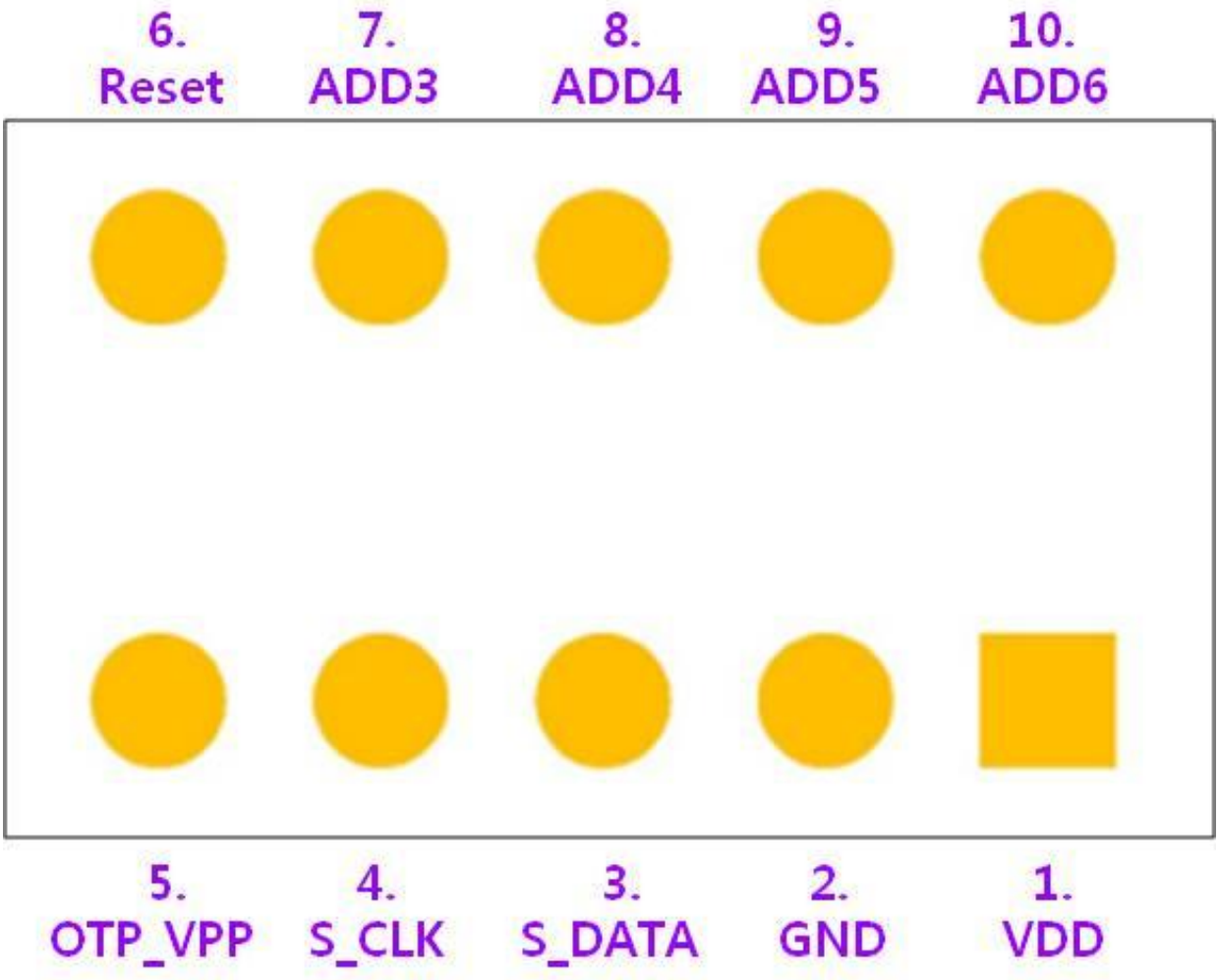


Bottom View



Pin Assignment

AIR111 has 10 pins and it's description is as following table.



ROIC Bottom view

ROIC Pin Assign

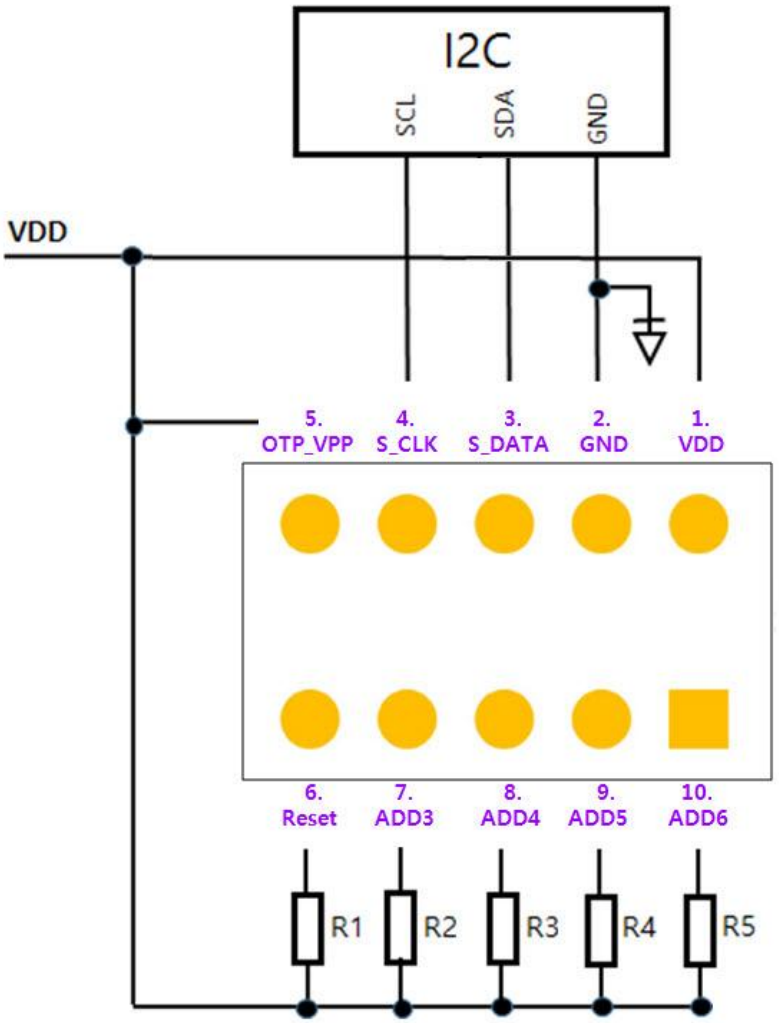
Pin Number	Name	Description	Input Voltage Min (V)	Input Voltage Max (V)
1	VDD	Analog power supply voltage	2.4	3.6
2	GND	Analog power supply ground	0	
3	S_DATA	I_2C Data Line	-	3.3
4	S_CLK	I_2C Clock Line	-	3.3
5	OTP_VPP	OTP driving power	3.3	
6	$\overline{\text{RESET}}$	ROIC reset pin	0 or 3.3	
7	ADD3	Sensor address setting pin	0 or 3.3	
8	ADD4	Sensor address setting pin	0 or 3.3	
9	ADD5	Sensor address setting pin	0 or 3.3	
10	ADD6	Sensor address setting pin	0 or 3.3	

Pin Function Description

Pin No.	Mnemonic	Function
1	VDD	ROIC Driving Power Input 3.3 V
2	GND	Common Ground VDD GND, I2C GND, OTP GND, RESET GND, ADDx GND
3	S_DATA	Data Line of I2C Communication
4	S_CLK	Clock Line of I2C Communication
5	OTP_VPP	OTP Driving Power ROIC Calibration Data is stored in OTP Need to Copy OTP data to Register after ROIC operation Driving power supply required for OTP when copying data to Register
6	$\overline{\text{RESET}}$	ROIC Hardware Reset Pin Reset at 0V
7	ADD3	Address Setting Pin I2C Address (0x1x ~ 0xFx) can be set by power input control to ADD3 ~ 6 Pin Input 0 V : Low signal Input 3.3 V : High signal Address MSB Pin : ADD3 Address LSB Pin : ADD6
8	ADD4	Same as ADD3
9	ADD5	Same as ADD3
10	ADD6	Same as ADD3

Circuit Component

Reference Diagram



Example Circuit Components : Set to Address 15(0xFx)

ROIC Pin Assign		
Component	**Value**	**Remarks**
R1	10KΩ	Pull-up resistor for $\overline{\text{RESET}}$
R2	10KΩ	Pull-up resistor for ADDRESS 3
R3	10KΩ	Pull-up resistor for ADDRESS 4
R4	10KΩ	Pull-up resistor for ADDRESS 5
R5	10KΩ	Pull-up resistor for ADDRESS 6

I2C Communication

According to the concept in IoT, ROIC provides I2C interface.

Address Setting At I2C ADD Part

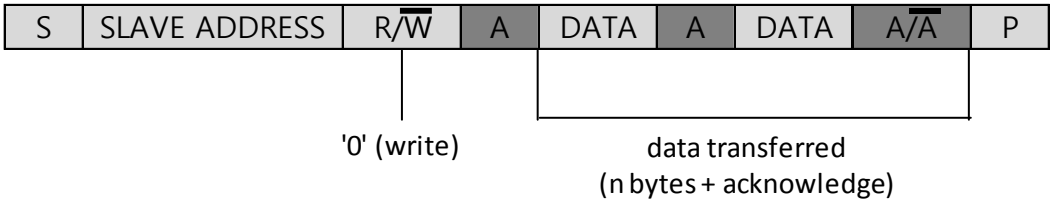
7	6	5	4	3	2	1	0
I2C_ADD6	I2C_ADD5	I2C_ADD4	I2C_ADD3	0	0	0	R/$\overline{W}$

Configuring Addresses on the I2C Protocol

I2C Address Setting

- — ROIC supports I2C Communication
- — To access ROIC set in circuit, you need to set address on I2C Protocol
- — Unlike general I2C address configuration, Bit 1 ~ 3 are not used
- — Bit 0 is set according to Read / Write purpose as in I2C standard
  - — 0 : Write signal
  - — 1 : Read signal

I2C Write Protocol



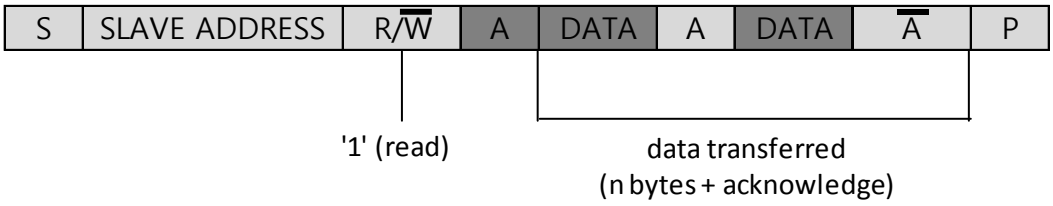
From Master to Slave
From Slave to Master

A = acknowledge (SDA LOW)
$\overline{A}$ = not acknowledge (SDA HIGH)
S = START condition
P = STOP condition

I2C Write Protocol

- — Follow the usual I2C protocol
- — Start signal transmission
- — I2C address transfer for write purposes
- — ACK check
- — Data transmission
  - — 1st Data: Call Start Register Address
  - — 2nd Data: Data to be stored in the register located consecutively starting from the corresponding register address
- — Transmission of stop signal after completion of transmission

I2C Read Protocol



From Master to Slave
From Slave to Master

A = acknowledge (SDA LOW)
$\overline{A}$ = not acknowledge (SDA HIGH)
S = START condition
P = STOP condition

I2C Read Protocol

— Follow the usual I2C protocol
— Set register value to start reading
— Start signal transmission
— I2C address transfer for read purposes
— ACK check
— Read data sequentially
— ACK check every step
— NACK transmission
— STOP transmission

ROIC Register

ROIC has a register which is a data storage space.

ROIC Register Map

Register Address MSB	Register Address LSB	OTP Address MSB	OTP Address LSB	Read/ Write	Name	Description
56		56		RW	ANALOG_CNTL_0	[7] [6] [5] [4] FREQ<1:0> FREQ_DSP EN_OSC
71	70	-		R	TEMPERATURE_OUTPUT	TEMPERATURE(℃) = TEMPERATURE_OUTPUT / 256
75	74	-		R	IR_OUTPUT	IR(℃) = IR_OUTPUT / 128
76		-		R	STATUS	EN_IR [6] EN_TEMP PEN OTP_RD OTP_WR PROG PTM
76		-		W	COMMAND	0 : initialize ROIC (OTP to Register) 1 : restart ROIC 6 : write data to OTP 7 : read data from OTP 8 : stop ROIC

ROIC Register Map

Register Map Description

— There are two kinds of storage devices in ROIC

— OTP

Calibration data is stored

Write once (impossible to write after)

Similar to ROM (Read Only Memory)

Nonvolatile Data

— Register

Storage space of ROIC internal calculation result

Initialization to copy OTP data to Register after inputting drive voltage to VDD

Similar to RAM (Random Access Memory)

Volatile Data

— Each register size is 8 bits (1 byte)

Register Function Description

Register	Function	Description
Register 56	FREQ	AFE Clock selection 2 bit configuration Requires 0x08 setting at ROIC Initialization (see. ROIC Initialize Sequence)
	FREQ_DSP	Digital Signal Process Clock selection 1 bit configuration Requires high setting at ROIC Initialization
	EN_OSC	Internal VCO enable 1 bit configuration Requires high setting at ROIC Initialization
Register 70, 71	Temperature Output	Temperature Sensor Output 2 bytes 16 bit Signed Integer (-32768 ~ 32767) / 256 = Current temperature (℃) R available (W not available)
Register 74, 75	IR Output	IR Sensor Output (Not supported) 2 bytes 16 bit Unsigned Integer (0 ~ 65535) R available (W not available)

Register 76	Write(Read)	cmd 0 : Copy OTP Data to Register cmd 1 : Restart ROIC cmd 6 : OTP Write Command cmd 7 : OTP Read Command cmd 8 : Stop ROIC

ROIC Initialize

Initialization is required to use ROIC after driving power input

Write the following data in the Register described below (Register No. 56, 76)

ROIC Initialize Sequence

Sequence No.	Register No.(Hex)	Register Data Hex Value	Function Hex Value
1	56 (0x38)	0x0B 0 0 0 0 1 0 1 1	PREQ (AFE Clock selection) : 0x08 0 0 0 0 1 0 0 0 PREQ_DSP (DSP Clock selection) : 0x02 0 0 0 0 0 0 1 0 EN_OSC (Internal VCO enable) : 0x01 0 0 0 0 0 0 0 1
2	76 (0x4C)	0x00 0 0 0 0 0 0 0 0	Cmd 0 : 0x00 0 0 0 0 0 0 0 0