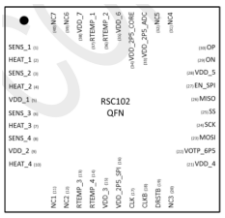
Unified Multi-Channel/Multi-Mode Read-out IC
RSC102 Series



RSC102 Series for Unified Multi-Channel/Multi-Mode Read-out IC

The **RSC102** is a readout-IC (ROIC) which is designed to have multi-channel/multi-mode operations for various sensor applications. It has four input channels to cooperate with multiple sensors, and each input can also accept different types of signals from the sensor such as voltage, current, resistance, or capacitance.

It has an input common-mode range from 0.1 V to 0.8 V, and has a variable voltage gain from 0 dB to 41.5 dB in order to compensate the drift or deviation in the response of the sensors. Also, the embedded power control block is activated depending on the types of applied sensors.

The **RSC102** supports a unified sensing interface for different kinds of the sensors and embedded calibration functions with memory devices. The ROIC is also suitable for battery-powered IT devices since it has a small size and a low power consumption.

CONTENTS

IMPORTANT NOTE:
OPERATING CONDITIONS IN WHICH RNSLAB PRODUCTS ARE USED WILL VARY WITH EACH CUSTOMER'S SPECIFIC APPLICATIONS. RNSLAB STRONGLY RECOMMENDS CONSULTING OUR TECHNICAL STAFF BEFORE DEPLOYING RNSLAB PRODUCTS IN YOUR APPLICATION AND, IN PARTICULAR, WHEN CUSTOMER'S TARGET VALUES ARE NOT LISTED HEREIN. RNSLAB CANNOT ASSUME ANY RESPONSIBILITY FOR ANY USE OF ITS PRODUCTS IN A PRODUCT OR APPLICATION FOR WHICH PRODUCT HAS NOT BEEN SPECIFICALLY TESTED BY RNSLAB.

1. FEATURES

- Highly integrated multi-channel ROIC
  - 4-channel inputs
  - Internal 16-bit ADC
  - **OTP** [1)]
- Multi-mode sensing operations
  - Unified sensing modes for voltage, current, resistance, and capacitance
- Power control and calibration functions
  - Embedded power control for sensors
  - Baseline/sensitivity calibrations
- Low power consumption
  - Less than 20 mW

1) One Time Programmable Devices

2. APPLICATIONS

- Sensor Readout IC
- Home appliances
- Automotive equipment parts
- Industry/office ventilation systems
- IoT devices

3. DESCRIPTION

The RSC102 is a readout-IC (ROIC) which is designed to have multi-channel/multi-mode operations for various sensor applications. It has four input channels to cooperate with multiple sensors, and each input can also accept different types of signals from the sensor such as voltage, current, resistance, or capacitance.

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Device information

Part No	Package	Size (mm)
RSC102	QFN (40)	6.0 × 6.0

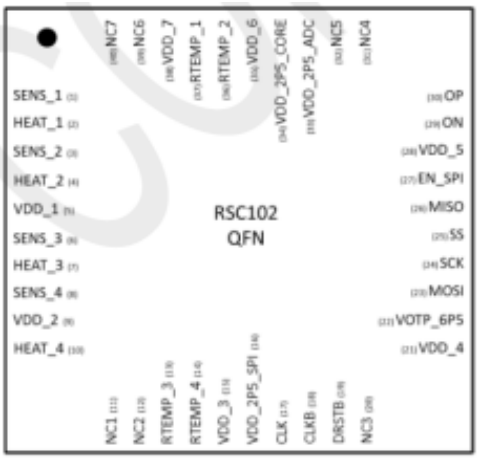

FIGURE 1. RSC102 QFN

3.1 Functional block diagram

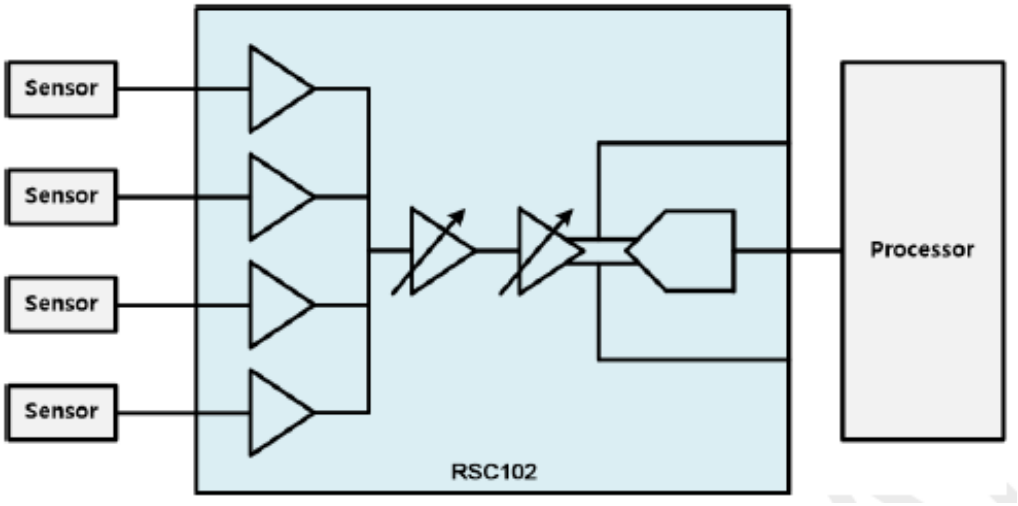

FIGURE 2. FUNCTIONAL BLOCK DIAGRAM

3.2 Typical application circuit

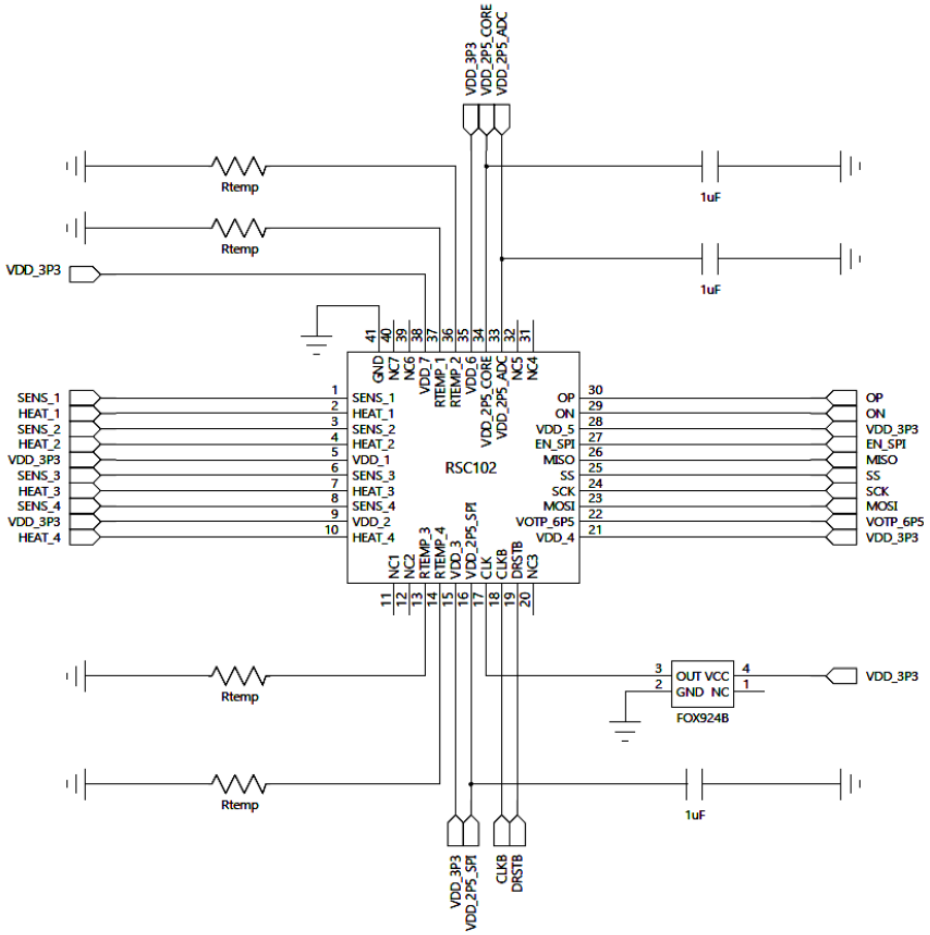

FIGURE 3. TYPICAL APPLICATION CIRCUIT

4. PIN CONFIGURATION AND FUNCTION

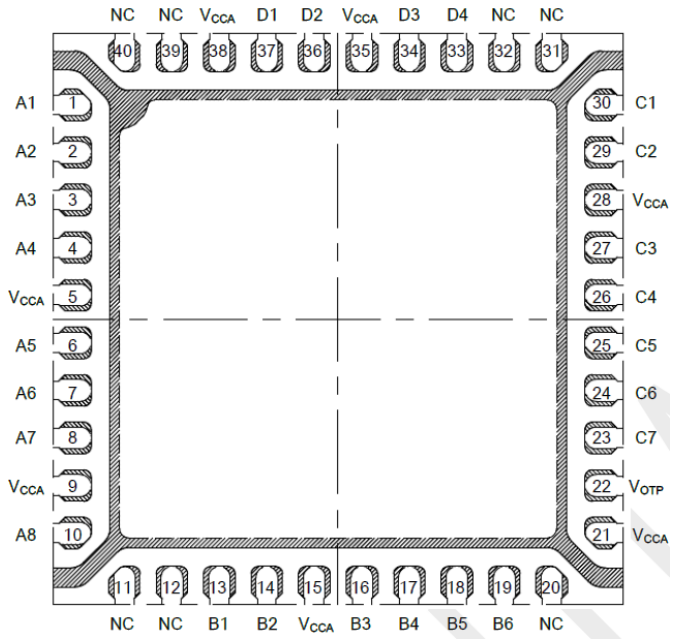

FIGURE 4. TOP VIEW PIN MAP

- External capacitors are required on 16,33, and 34 pins (must be over 1 uF with low ESR).
- External resistors are required on 13, 14, 36, and 37 pins (close to 10-times of heater's resistance is recommended).
- External oscillator (XTAL or TCXO) is required on 17 and 18 pins.

Pin functions

PIN		Type[1)]	FUNCTION
NAME	NO.	I/O	
A1	1	I/O	Sensing in CH1
A2	2	I/O	Heater power in CH1
A3	3	I/O	Sensing in CH2
A4	4	I/O	Heater power in CH2
V_{CCA}	5	P	External supply voltage (2.6 V ≤ VCCA ≤ 3.6 V)
A5	6	I/O	Sensing in CH3
A6	7	I/O	Heater power in CH3
A7	8	I/O	Sensing in CH4
V_{CCA}	9	P	External supply voltage
A8	10	I/O	Heater power in CH4
NC	11	--	NC
NC	12	--	NC
B1	13	I/O	Monitoring heater power in CH3
B2	14	I/O	Monitoring heater power in CH4

V_{CCA}	15	P	External supply voltage
B3	16	I/O	Supply voltage of SPI
B4	17	I/O	External reference CLK (16 MHz)
B5	18	I/O	External reference CLKB
B6	19	I/O	Reset signal (Active low)
NC	20	--	NC
V_{CCA}	21	P	External supply voltage
V_{OTP}	22	P	External supply voltage for OTP (6.5 V)
C7	23	I/O	Serial input data
C6	24	I/O	Serial input CLK (≤ 1 MHz)
C5	25	I/O	Slave select (Active low)
C4	26	I/O	Serial output data
C3	27	I/O	Chip enable
V_{CCA}	28	P	External supply voltage
C2	29	I/O	Analog negative output
C1	30	I/O	Analog positive output
NC	31	--	NC
NC	32	--	NC
D4	33	I/O	Supply voltage of ADC
D3	34	I/O	Supply voltage of ROIC
V_{CCA}	35	P	External supply voltage
D2	36	I/O	Monitoring heater power in CH2
D1	37	I/O	Monitoring heater power in CH1
V_{CCA}	38	P	External supply voltage
NC	39	--	NC
NC	40	--	NC

1) Type: I=input, O=output, I/O=input and output, P=power supply, GND=ground

5. Specifications

	Unit	Min	Typ	Max
Input signal types [1)]	Voltage (V)/current (I)/resistance (R)/capacitance (C)			
Input DC voltage	V	0.0	0.4	0.8
Sensing resistance	K-ohm	-	-	80
Sensing capacitance	pF	-	-	-
Gain tuning range	dB	0	-	41.5
Gain step	dB	0.5	-	6.0
Input-referred noise [2)]	nV/Hz	1.24	-	1.52
Heater power control range	V	0.9	-	2.7
Current consumption	mA	7.11	7.16	7.22

1) It is referenced to V/I sensing modes
2) It is integrated from 1 Hz to 100 Hz at R_{SENSE}=1 G-ohm (VCCA=3.3V, temp=–40℃ to 90℃)

5.1 Absolute Maximum Ratings[1)]

		Unit	Min	Max
V_{CCA}	Supply voltage range	V	0	4.7
I_O [2)]	Continuous current through V_{CCA} or GND	mA	0	14.8
ESD	Human body model	V	-2,000	2,000
ESD	Machine model	V	N/A	N/A
ESD	Charged device model	V	N/A	N/A

1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions are not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2) The maximum current is determined as one-channel is activated with the maximum supply voltage.

5.2 Recommended Operating Conditions

		Unit	Min	Max
V_{CCA}	Supply voltage range	V	2.6	3.7
V_O	Output DC voltage range	V	1.21	1.21
I_O	Continuous current through VCCA or GND	mA	6.56	7.54

1) Temp=27 ℃

5.3 Typical Characteristics

5.3.1 DC-offset Characteristic

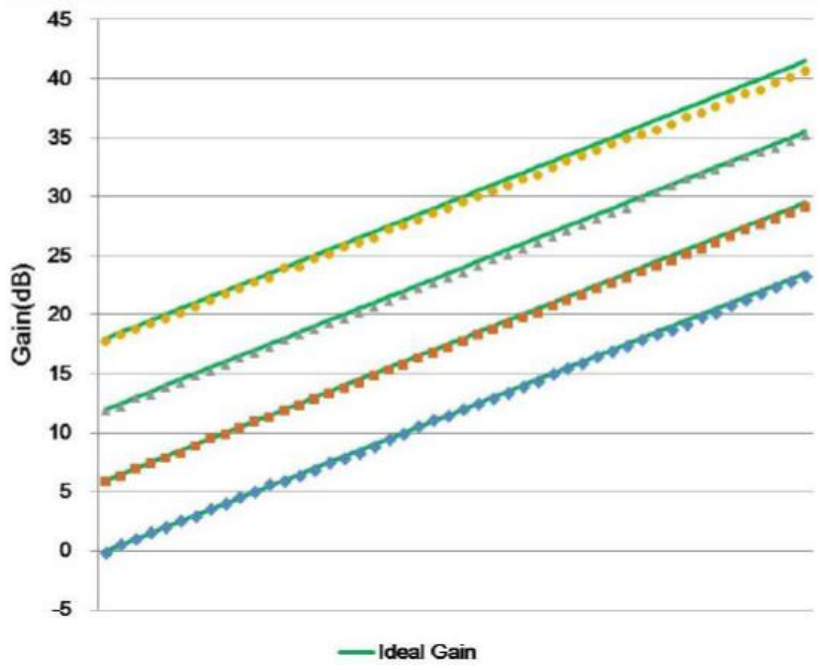

FIGURE 5. VOLTAGE GAIN

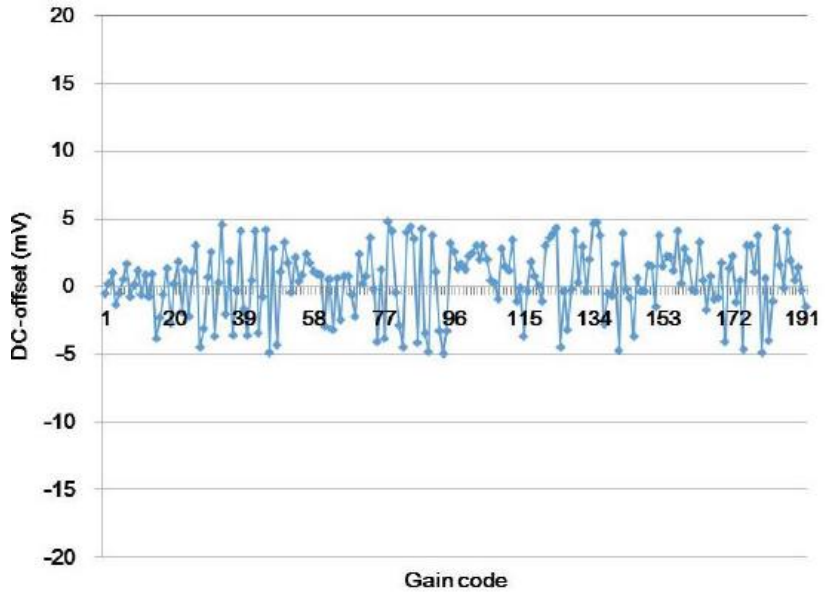

FIGURE 6. DC-OFFSET CHARACTERISTIC

5.3.2 LDO Output Characteristic

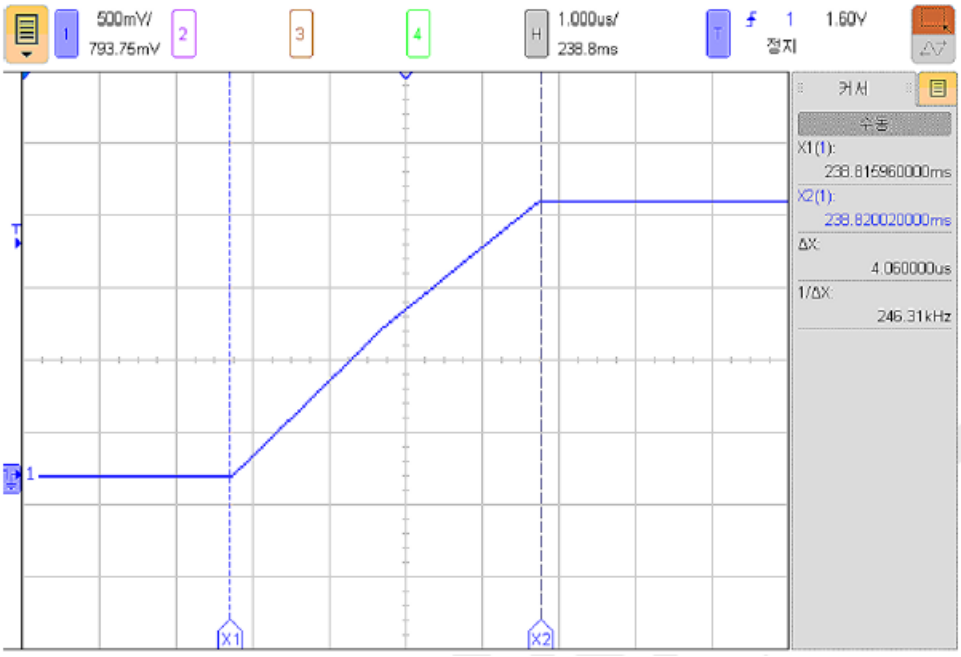

FIGURE 7. LDO OUTPUT (VOUT=1.6V, RISING TIME=4.06US)

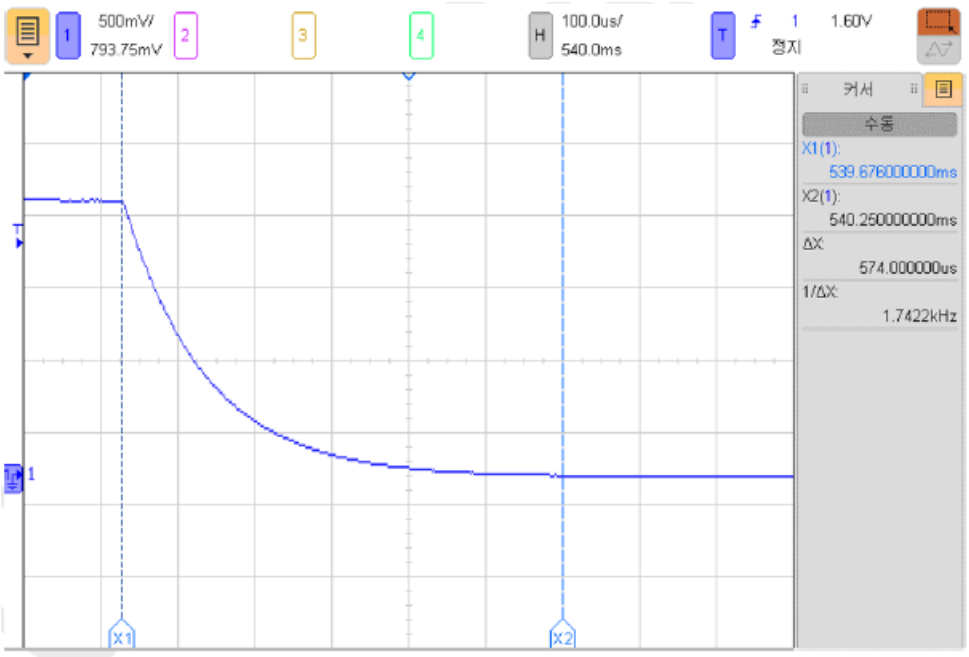

FIGURE 8. LDO OUTPUT (VOUT=1.6V, RISING TIME=574US)

5.3.3 Heater Power Control Range

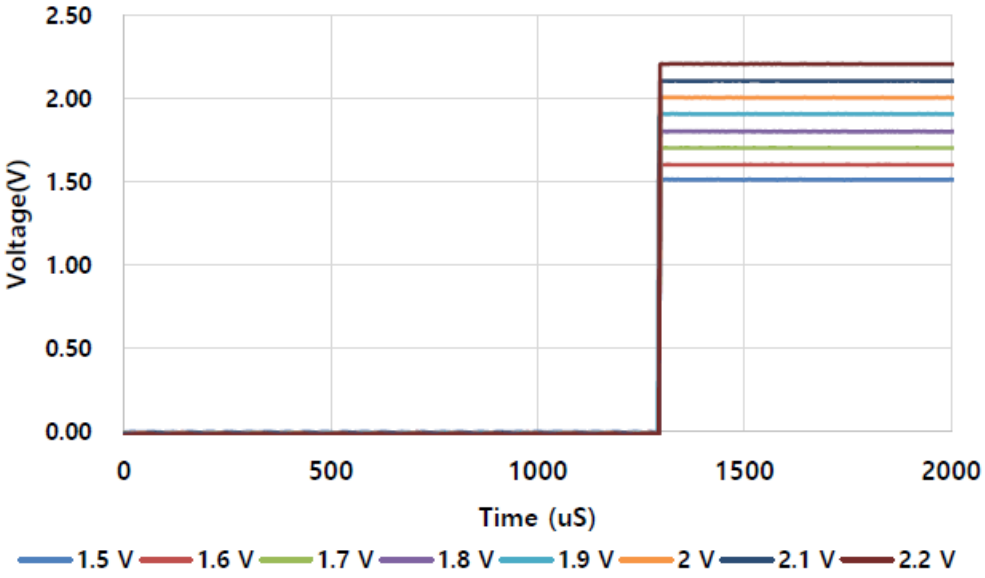

FIGURE 9. HEATER POWER CONTROL RANGE (1)

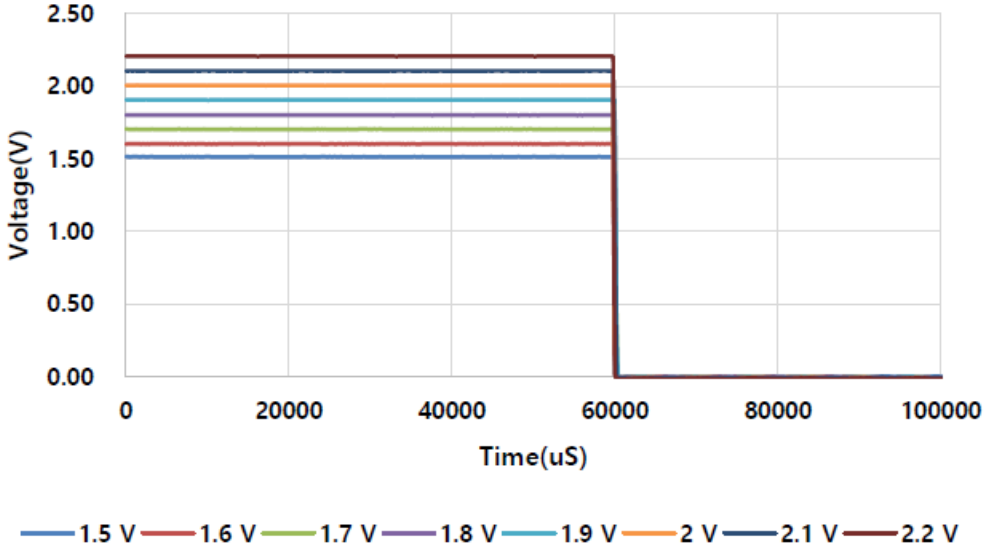

FIGURE 10. HEATER POWER CONTROL RANGE (2)

5.3.4 Gain variation over channel and temperature

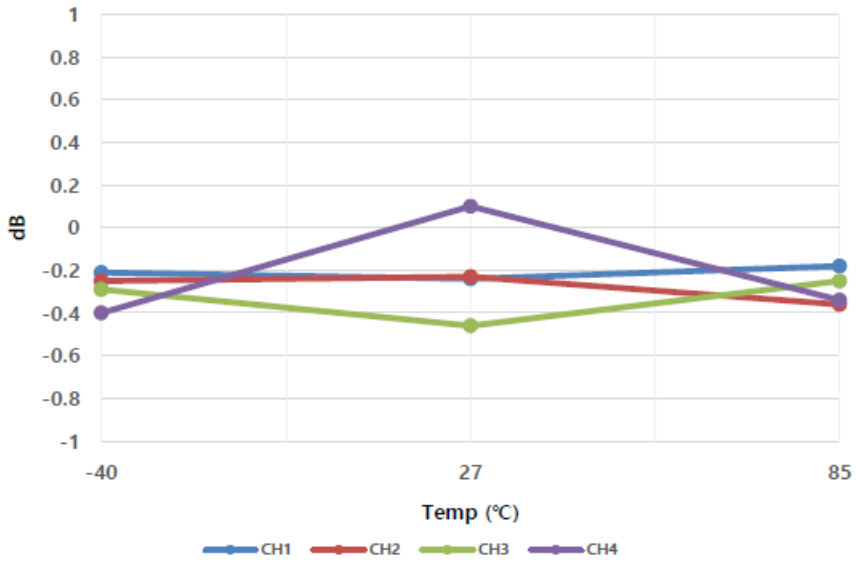

FIGURE 11. GAIN VARIATION OVER CHANNEL AND TEMPERATURE (G=0dB)

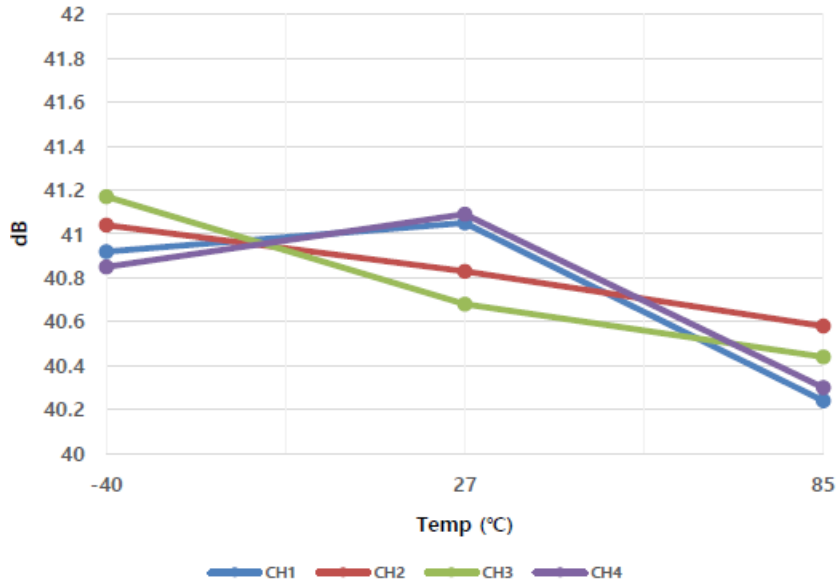

FIGURE 12. GAIN VARIATION OVER CHANNEL AND TEMPERATURE (G=41.5dB)

5.3.5 Test current variation over channel and temperature

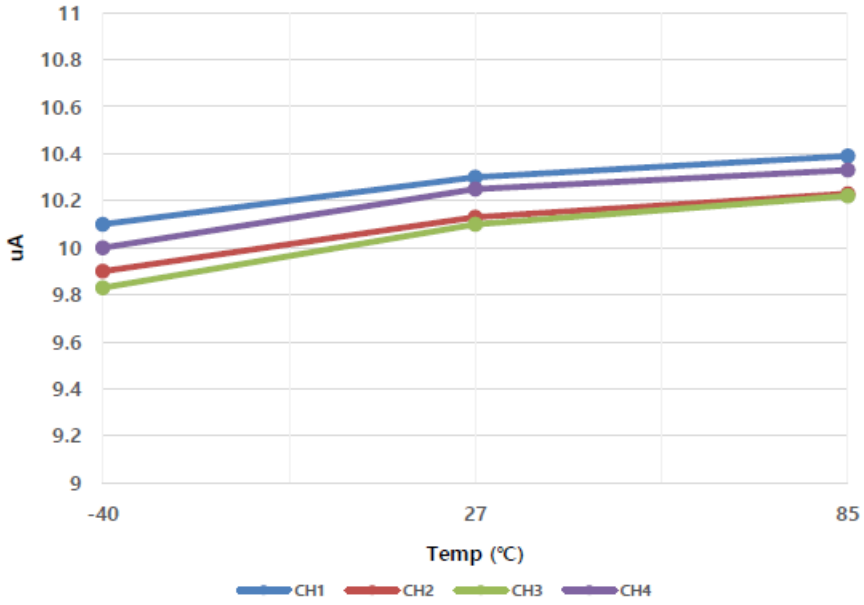

FIGURE 13. TEST CURRENT VARIATION OVER CHANNEL AND TEMPERATURE (I_{TEST}=10UA)

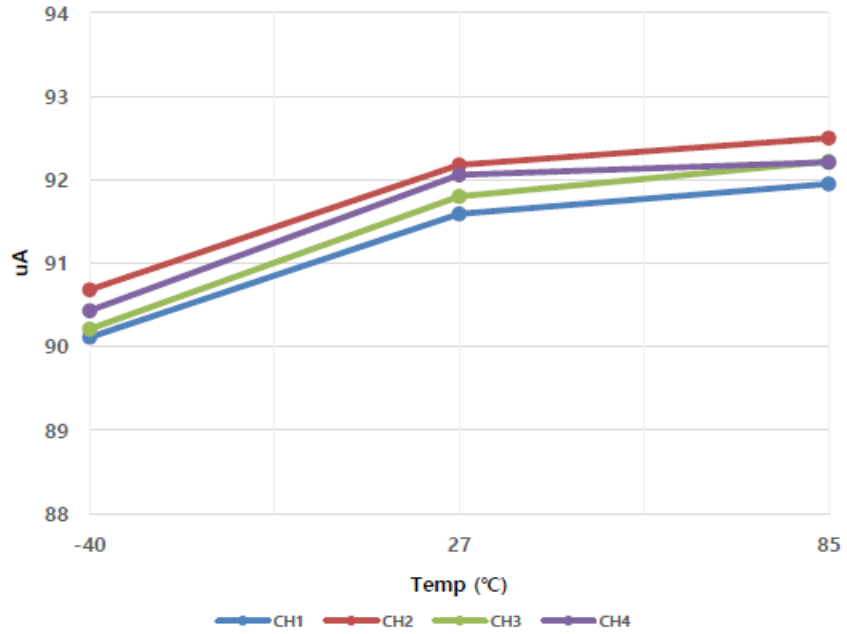

FIGURE 14. TEST CURRENT VARIATION OVER CHANNEL AND TEMPERATURE (I_{TEST}=100UA)

5.3.6 Oscillation frequency variation over channel and temperature

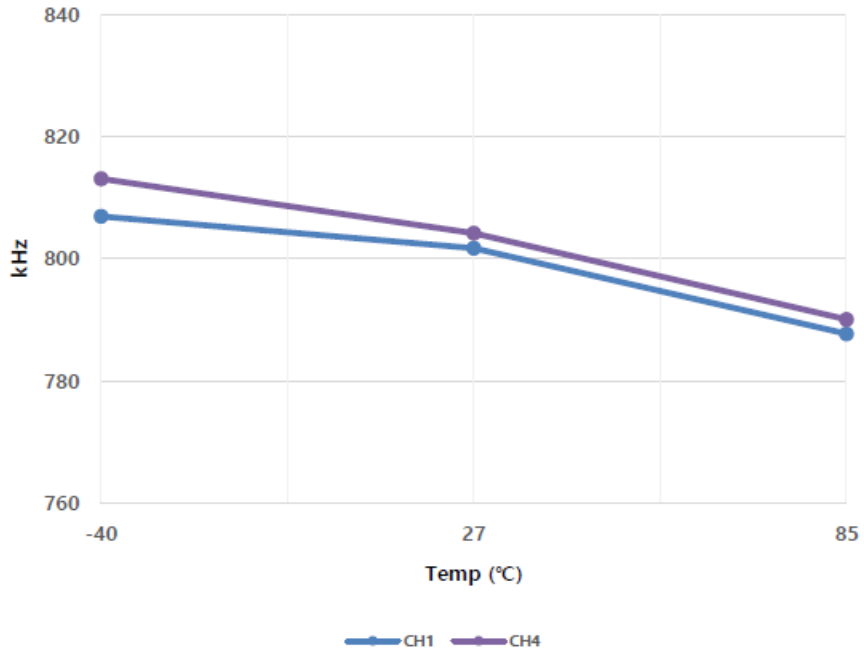

FIGURE 15. OSCILLATION FREQUENCY VARIATION OVER CHANNEL AND TEMPERATURE (FREE OSCILLATION)

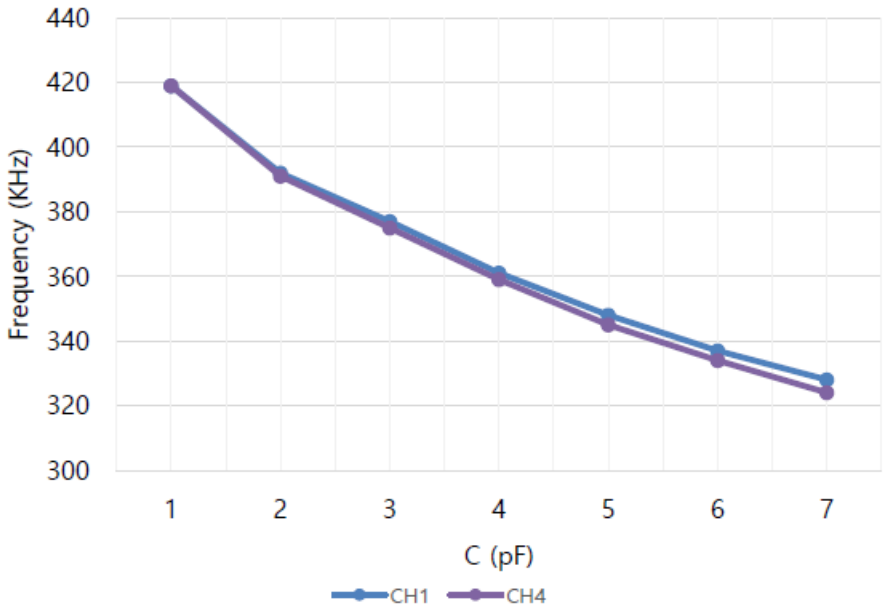

FIGURE 16. OSCILLATION FREQUENCY VARIATION OVER CHANNEL AND TEMPERATURE (AFTER PCB PARASITIC CALIBRATION)

6. APPLICATION GUIDANCE

The RSC102 can process the various types of the signal in the form of voltage, current, resistance, and capacitance. Thus, the external elements of the ROIC are changed depending on the sensing modes.

Voltage/Current sensing
For the voltage signal, the RSC102 gives very high input impedance and wide gain dynamic range to obtain high SNR. In the current sensing mode, the shut resistor is required to convert the current to voltage.

$$V_{convert} = I_{sensor} \times R_{shunt}$$

Resistance sensing
Some gas sensor shows the concentration of the gas by its resistance variation. The RSC102 generates the current, I_{TEST}, which measures the resistance of the sensor, R_{SENSOR}, as follows:

$$V_{test} = I_{test} \times R_{sensor}$$
$$I_{test} = 10\ uA / 100\ uA$$

Capacitance sensing
The RSC102 has the tunable oscillator circuits depending on the external sensing capacitance. However, the sensing capacitance can be easily affected by the parasitic effects such as coupling capacitance between PCB lines, package, connectors. The detailed calibration is described in the application notes.

LDO monitoring
In order to measure the output current of the LDO, the reference current is produced and changed in the ROIC. By the external resistor, R_{TEMP}, the reference current converts to the reference voltage as follows:

$$V_{temp} = I_{ref} \times R_{temp}$$
$$I_{ref} = Current\ of\ the\ LDO \times \frac{1}{100}$$

7. PACKAGE OUTLINE DIMENSIONS

Quad-Flat Non-leaded Package [mm]

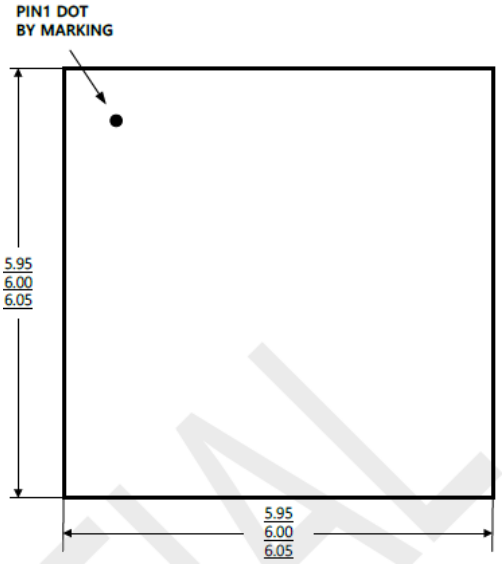

FIGURE 17. TOP VIEW

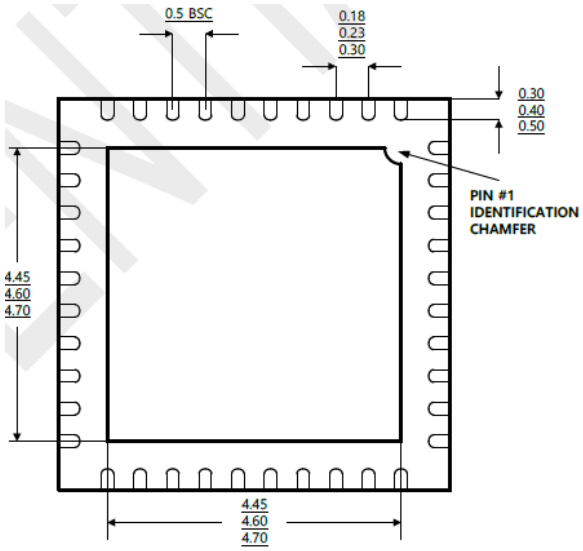

FIGURE 18. BOTTOM VIEW

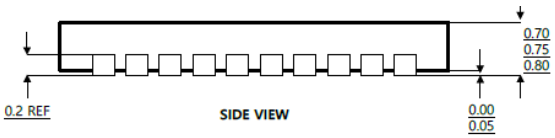

FIGURE 19. SIDE VIEW

8. REVISION HISTORY

Rev. No	Chapter	Description of modification	Date
0.1		Initial release	April. 2021

For inquiries about ROIC products, please contact us below.

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