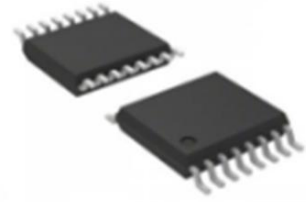


Low Noise, Low Power, 16-/24-Bit Σ - Δ ADC

PRODUCT DESCRIPTION

The MS5198T/MS5199T is a 16-bit / 24-bit ADC with low power, low noise, three differential input channels. When the gain is set to 64 and the update rate is 4.17Hz, the root mean square noise is 10nV. The device integrate input buffer and PGA. The chip uses an internal clock, and the output data rate can be set from 4.17Hz to 470Hz by software. The supply voltage range is 2.7V to 5.25V. The MS5198T/MS5199T is in TSSOP16 package.



TSSOP16

FEATURES

- RMS Noise: MS5199T:27nV@4.17Hz;65nV@16.7Hz;
- RMS Noise: MS5198T:40nV@4.17Hz;85nV@16.7Hz;
- Power Consumption:380uA(typ)
- Integrated Programmable Gain Amplifier
- Update Rate: 4.17Hz to 470Hz
- Integrated 50Hz/60Hz Rejection Filter
- Internal Clock
- Integrated Power Supply Detect
- Reference Detect
- Power Supply Voltage: 2.7V to 5.25V
- Operating Temperature Range: -40°C to 105°C

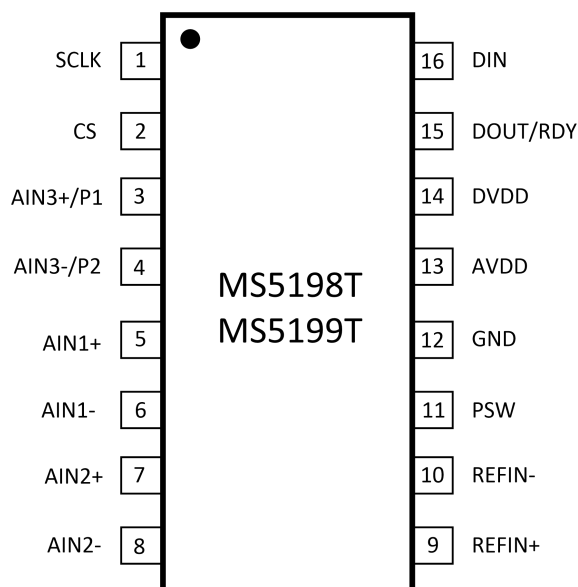
APPLICATIONS

- Thermocouple and RTD Measurement
- Stress Detection
- Gas Analysis and Blood Analysis
- Industrial Process Control and Instrumentation
- Liquid and Gas Chromatograph
- 6-digit DVM

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS5198T	TSSOP16	MS5198T
MS5199T	TSSOP16	MS5199T

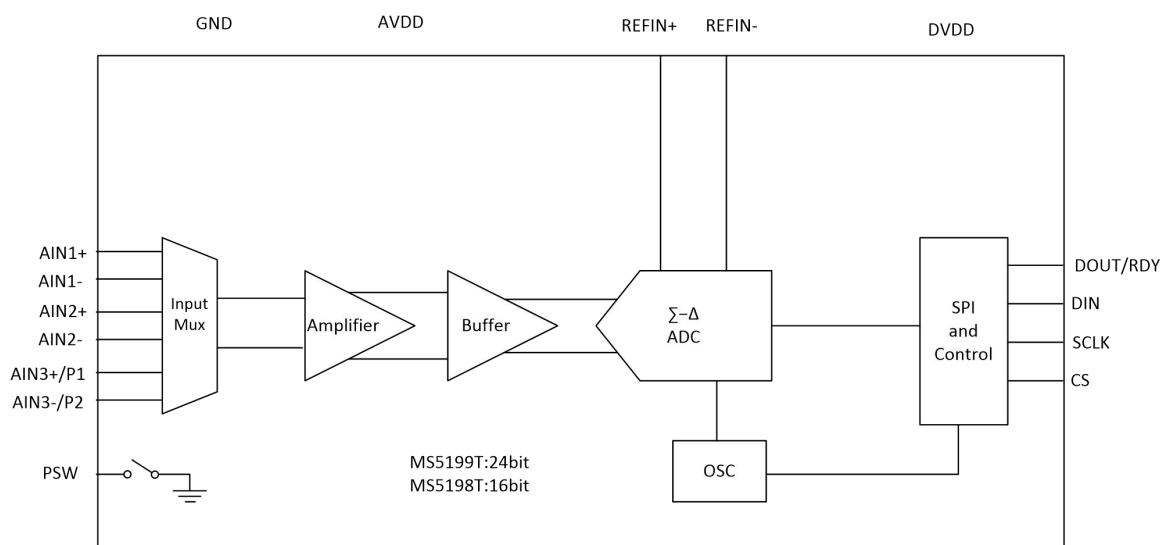
PIN CONFIGURATION



PIN DESCRIPTION

Pin	Name	Type	Description
1	SCLK	I	Serial Clock Input
2	CS	I	Chip Select Input
3	AIN1+/P1	I	Analog channel 1 positive input, this pin also can function as a general-purpose output
4	AIN1-/P2	I	Analog channel 1 negative input, this pin also can function as a general-purpose output
5	AIN1+	I	Analog Channel 1 Positive Input
6	AIN1-	I	Analog Channel 1 Negative Input
7	AIN2+	I	Analog Channel 2 Positive Input
8	AIN2-	I	Analog Channel 2 Negative Input
9	REFIN+	I	Positive Reference Voltage Input Pin
10	REFIN-	I	Negative Reference Voltage Input Pin
11	PSW	O	Low-Side Power Switch to GND
12	GND	I	GND
13	AVDD	Power	Analog Power Supply Voltage (2.7V to 5.25V)
14	DVDD	Power	Digital Interface Power Pin
15	DOUT/RDY	O	Serial Data Output/Data Ready Output Pin
16	DIN	I	Serial Data Input

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Symbol	Range	Unit
Analog Power	AVDD	-0.3 to +7.0	V
Digital Power	DVDD	-0.3 to +7.0	V
Analog Input Range	AIN	-0.3 to AVDD+0.3	V
Reference Voltage Range	VREFIN	-0.3 to AVDD+0.3	V
Digital Input Range		-0.3 to DVDD+0.3	V
Digital Output Range	V(LE)	-0.3 to DVDD+0.3	V
Input Current		10	mA
Operating Temperature Range		-40 to 105	°C
Storage Temperature Range	Tstg	-60 to 150	°C
Lead Temperature(10 sec)		260	°C
ESD(HBM)		4000	V

ELECTRICAL CHARACTERISTICS

AVDD=2.7V to 5.25V;DVDD=2.7V to 5.25V;GND=0V;REFIN(+)=AVDD;REFIN(-)=0V. All specifications TMIN to TMAX, unless otherwise noted.

Parameter	Condition	Min	Typ	Max	Unit
ADC Channel					
Output Update Rate			4.17 to 470		Hz
No Missing Codes			24/16		Bits
Resolution	See table1 to 4				
Integral Nonlinearity				±15	ppmofFSR
Offset Error			±1		uV
Offset Error Drift vs. Temperature			±10		nV/°C
Full-Scale Error			±10		uV
Gain Drift vs. Temperature			1		ppm/°C
Power Supply Rejection	AIN=1V/gain,GAIN>4	80			dB
Analog Inputs					
Differential Input Voltage Ranges		±VREF/gain			V
Common-Mode Voltage	VCM= (AINP + AINN)/2, GAIN = 4 to 128	0.5			V
Absolute AIN Voltage Limits	Enable buffer,Gain=1 or 2	GND- 30mV		AVDD+ 30mV	V
	Enable buffer,Gain=1 or 2	GND+ 100mV		AVDD+ 30mV	V
	Enable PGA,Gain=4 to 128	GND+ 300mV		AVDD- 1.1	V
Average Input Current	Buffered Mode or In-Amp Active,Gain = 1 or 2, Update Rate < 100 Hz			±1	nA
	Buffered Mode or In-Amp Active,Gain = 4 to 128, Update Rate < 100 Hz			±250	pA
	Gain = 1 or 2		±400		nA/V
Average Input Current Drift	Buffered Mode or In-Amp Active		±2		pA/°C
Unbuffered Mode, Average Input Current			±400		nA/V
Unbuffered Mode, Average Input Current Drift			±50		pA/V/°C

Parameter	Condition	Min	Typ	Max	Unit
Common-Mode Rejection	DC, AIN = 1 V/gain, Gain ≥ 4	100			dB
	50 $\pm$ 1 Hz, 60 $\pm$ 1 Hz (FS[3:0] = 1010)	100			dB
	50 $\pm$ 1 Hz (FS[3:0] = 1001), 60 $\pm$ 1 Hz (FS[3:0] = 1000)	100			dB
External Reference					
REFIN Voltage Limits ²		0.1	2.5	AVDD	V
Average Reference Input Current			400		nA/V
Average Reference Input Current Drift			± 0.03		nA/V/ $^{\circ}$ C
Common-Mode Rejection			100		dB
Low-Side Power Switch					
Ron	@AVDD=5V		5		Ω
Allowable Current			30		mA
Clock					
Internal Clock Frequency			64 $\pm$ 3%		kHz
Internal Clock Duty Cycle			50:50		%
Logic Inputs					
CS Input Low Voltage	DVDD=5V			0.8	V
	DVDD=3V			0.4	V
CS Input High Voltage		2.0			V
SCLK and DIN Input High Voltage	DVDD=5V	1.4		2	V
	DVDD=3V	0.9		2	V
SCLK and DIN Input Low Voltage	DVDD=5V	0.8		1.7	V
	DVDD=3V	0.4		1.35	V
SCLK and DIN input Hysteresis	DVDD=5V	0.1		0.17	V
	DVDD=3V	0.06		0.13	V
Input Currents Input Capacitance				± 10	μ A
Input Capacitance			10		pF
Logic Outputs					
Output High Voltage	AVDD=3 V, ISOURCE=100 μ A	DVDD-0.6			V
	AVDD=5 V, ISOURCE=200 μ A	4			V
Output High Voltage	AVDD=3 V, ISINK=100 μ A			0.4	V
	AVDD=5 V, ISINK=1.6mA			0.4	V
Floating-State Leakage Current				± 10	μ A
Floating-State Output Capacitance			10		pF

Parameter		Condition	Min	Typ	Max	Unit
System Calibration						
Full-Scale Calibration Limit					1.05*FS	V
Zero-Scale Calibration Limit			-0.05*FS		0.05*FS	V
Power Requirements						
Power Supply Voltage		AVDD	2.7		5.25	V
		DVDD	2.7		5.25	V
Power Supply Currents	AVDD=3V	Disable buffer		110	140	uA
	AVDD=5V			125	140	
	AVDD=3V	Enable buffer, Gain=1 or 2		130	180	uA
	AVDD=5V			165	180	uA
	AVDD=3V	MS5198T, Gain=4 to 128		300	400	uA
	AVDD=5V			350	400	uA
	AVDD=3V	MS5199T, Gain=4 to 128		380	500	uA
	AVDD=5V			440	500	uA
IDD (Power-Down Mode)					1	uA

OUTPUT NOISE and RESOLUTION SPECIFICATIONS (EXTERNAL REFERENCE)

The table below gives the output RMS noise for MS5199T with some update rate and gain settings. The data provided are for bipolar input ranges and 2.5V external reference voltage sources. These values are typical when the differential input voltage is 0V. It is important to note that the effective resolution is calculated from root mean square noise. These are typical values rounded to the nearest LSB.

Table 1 Output RMS Noise (uV) vs Gain and Update Rate for MS5199T(External 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	0.451	0.316	0.135	0.073	0.037	0.023	0.008	0.010
8.33Hz	0.676	0.473	0.259	0.090	0.068	0.032	0.017	0.019
16.7Hz	1.217	0.699	0.406	0.214	0.085	0.051	0.021	0.019
33.2Hz	1.893	1.420	0.834	0.372	0.256	0.094	0.058	0.042
62Hz	1.938	1.555	0.856	0.417	0.194	0.096	0.057	0.052
123Hz	3.246	2.998	1.138	0.659	0.287	0.144	0.068	0.075
242Hz	8.880	5.657	1.893	1.195	0.696	0.424	0.168	0.140
470Hz	5.229	4.711	2.558	1.037	0.552	0.317	0.156	0.175

Table 2 Typical Resolution (Bits) vs. Gain and Update Rate for the MS5199T(External 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	23.1	22.6	22.8	22.7	22.7	22.4	22.8	21.6
8.33Hz	22.5	22.0	21.9	22.4	21.8	21.9	21.8	20.7
16.7Hz	21.7	21.5	21.3	21.2	21.5	21.3	21.5	20.7
33.2Hz	21.0	20.5	20.2	20.4	19.9	20.4	20.1	19.5
62Hz	21.0	20.3	20.2	20.2	20.3	20.3	20.1	19.2
123Hz	20.3	19.4	19.8	19.6	19.8	19.8	19.8	18.7
242Hz	18.8	18.5	19.0	18.7	18.5	18.2	18.5	17.8
470Hz	19.6	18.7	18.6	18.9	18.8	18.6	18.6	17.5

The table below gives the output RMS noise for MS5198T with some update rate and gain settings. The data provided are for bipolar input ranges and 2.5V external reference voltage sources. These values are typical when the differential input voltage is 0V. It is important to note that the effective resolution is calculated from root mean square noise. These are typical values rounded to the nearest LSB.

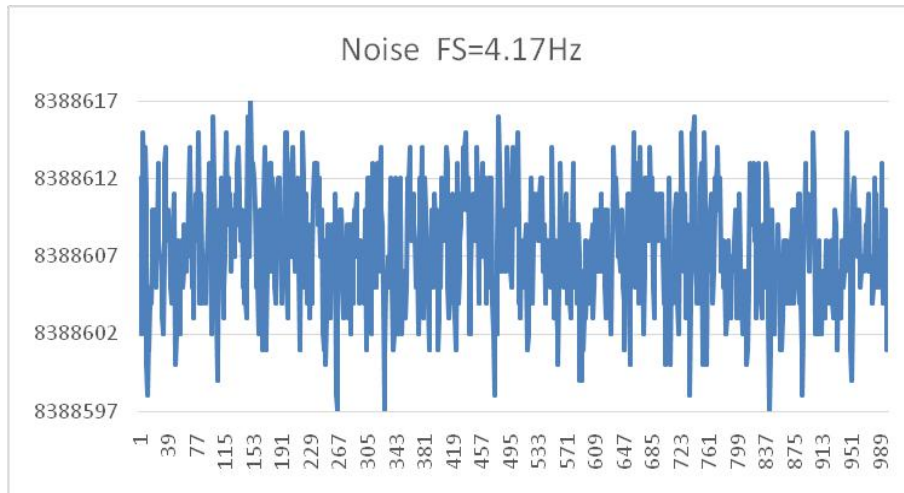
Table 3 Output RMS Noise (uV) vs Gain and Update Rate for MS5198T(External 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	0.496	0.361	0.180	0.079	0.042	0.021	0.011	0.013
8.33Hz	0.676	0.473	0.237	0.135	0.073	0.030	0.018	0.012
16.7Hz	1.082	0.947	0.349	0.225	0.099	0.046	0.025	0.016
33.2Hz	1.668	1.172	0.518	0.304	0.144	0.072	0.042	0.026
62Hz	2.164	1.916	0.687	0.423	0.194	0.108	0.050	0.059
123Hz	3.065	2.840	1.183	0.642	0.344	0.182	0.101	0.061
242Hz	6.626	7.708	2.783	1.268	0.716	0.347	0.164	0.206
470Hz	5.860	6.897	2.660	1.211	0.569	0.256	0.132	0.165

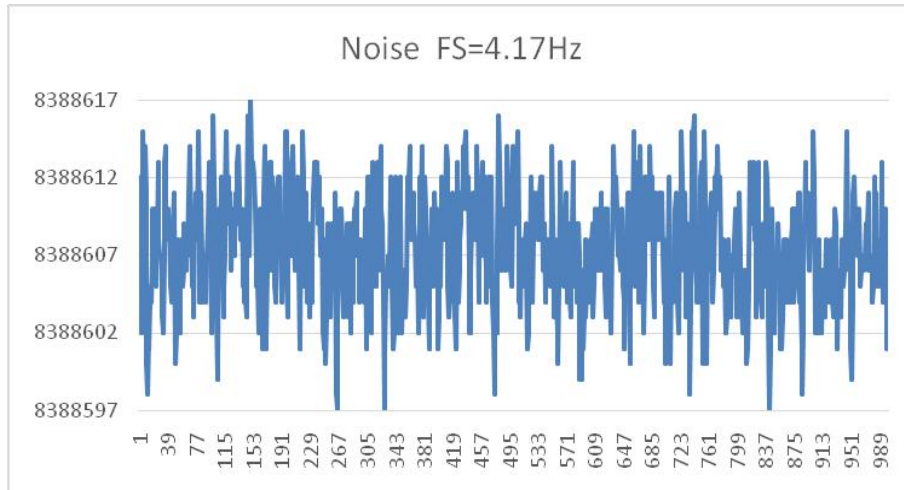
Table 4 Typical Resolution (Bits) vs. Gain and Update Rate for the MS5198T(External 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	16	16	16	16	16	16	16	16
8.33Hz	16	16	16	16	16	16	16	16
16.7Hz	16	16	16	16	16	16	16	16
33.2Hz	16	16	16	16	16	16	16	16
62Hz	16	16	16	16	16	16	16	16
123Hz	16	16	16	16	16	16	16	16
242Hz	16	16	16	16	16	16	16	16
470Hz	16	16	16	16	16	16	16	16

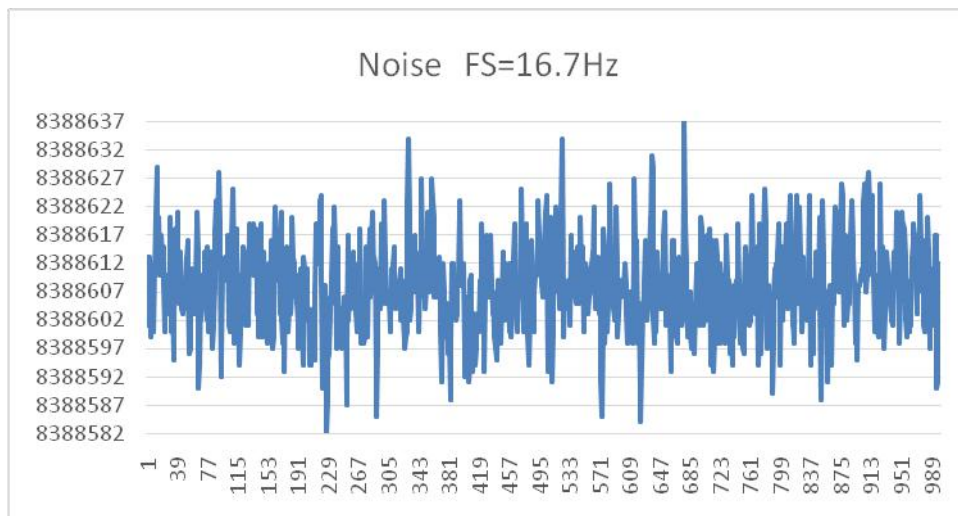
TYPICAL PERFORMANCE CHARACTERISTICS



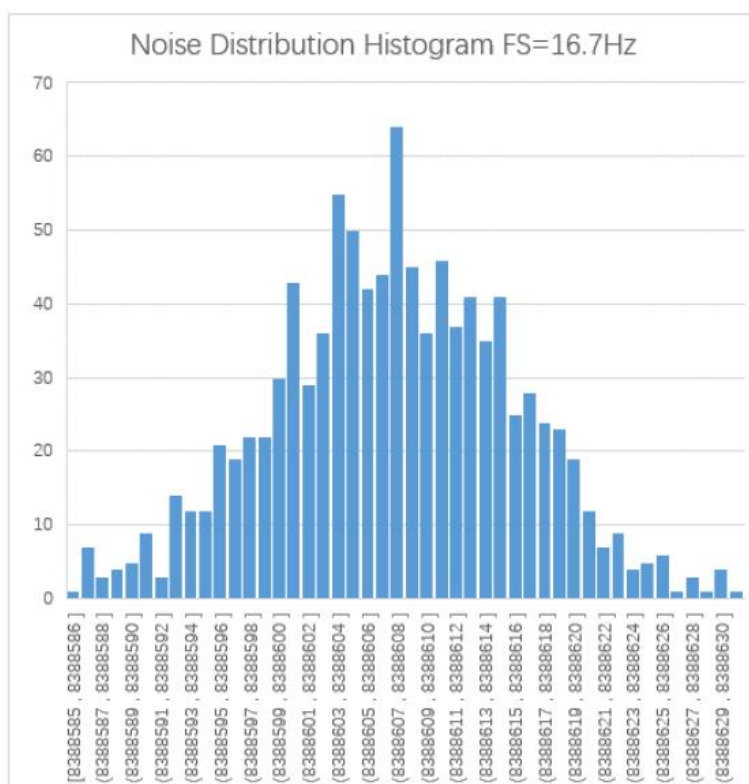
MS5193T Noise Plot (AVDD=4V, VREF = 2.048, Gain = 64, Update Rate = 4.17 Hz)



MS5193T Noise Distribution Histogram (AVDD=4V, VREF = 2.048, Gain = 64, Update Rate = 4.17 Hz)



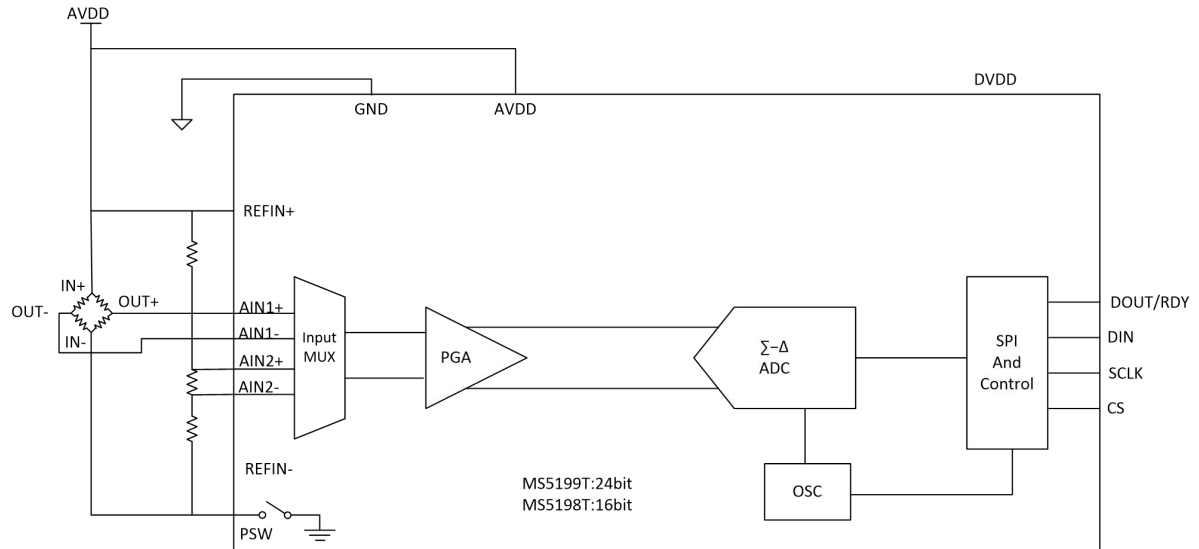
MS5193T Noise Plot (AVDD=4V, VREF = 2.048, Gain = 64, Update Rate = 16.7 Hz)



MS5193T Noise Distribution Histogram (AVDD=4V,VREF = 2.048, Gain = 64, Update Rate = 16.7 Hz)

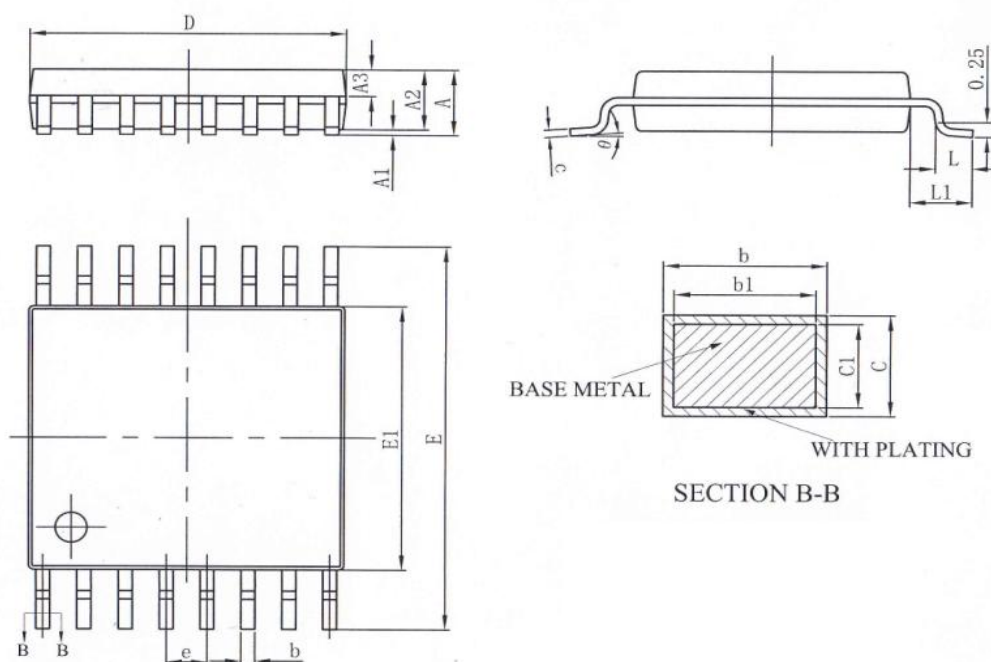
APPLICATIONS INFORMATION

The blow figure is a connection from weigh scale application for the MS5198T/MS5199T.

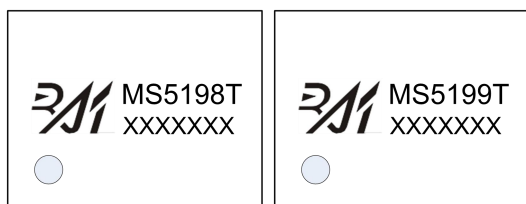


PACKAGE OUTLINE DIMENSIONS

TSSOP16



Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	-	-	1.20
A1	0.05	-	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	-	0.29
b1	0.19	0.22	0.25
c	0.13	-	0.18
c1	0.12	0.13	0.14
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	-	8°

MARKING and PACKAGING SPECIFICATIONS
1. Marking Drawing Description


Product Name: MS5198T, MS5199T

Product Code: XXXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specifications

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS5198T	TSSOP16	3000	1	3000	8	24000
MS5199T	TSSOP16	3000	1	3000	8	24000

STATEMENT

- All Revision Rights of Datasheets Reserved for Ruimeng. Don't release additional notice.
Customer should get latest version information and verify the integrity before placing order.
- When using Ruimeng products to design and produce, purchaser has the responsibility to observe safety standard and adopt corresponding precautions, in order to avoid personal injury and property loss caused by potential failure risk.
- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

**MOS CIRCUIT OPERATION PRECAUTIONS**

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.



+86-571-89966911



Rm701, No.9Building, No. 1 WeiYe Road, Puyan Street, Binjiang District, Hangzhou, Zhejiang



[http:// www.relmon.com](http://www.relmon.com)