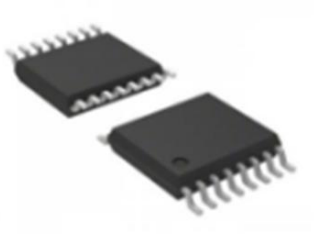
Low Noise, Low Power, 16-/24-Bit Σ-Δ ADC

PRODUCT DESCRIPTION

The MS5192T/MS5193T is a 16-bit / 24-bit adc with low power , low noise, three differential input channel. When the gain is set to 64 and the update rate is 4.17Hz, the root mean square noise is 25nV. The device integrate precision low noise, low drift internal band gap reference, can also use external differential reference voltage.the programmable excitation current source, burnout current source and bias voltage generator are also integrated on -chip. The bias voltage generator can set the channel common-mode voltage to 0.5*AVDD. The chip uses an external clock or 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 MS5192T/MS5193T is in TSSOP16 package.



TSSOP16

FEATURES

- RMS noise：25nV@4.17Hz;30nV@16.7Hz;
- Power consumption:380uA(typ)
- integrated programmable gain amplifier
- integrated low-temperature drift voltage reference
- Update rate: 4.17Hz to 470Hz
- integrated 50Hz/60Hz rejection filter
- integrated programmable current source
- integrated bias voltage generator
- Power supply voltage: 2.7V to 5.25V
- Operating temperature range: -40℃ to 105℃

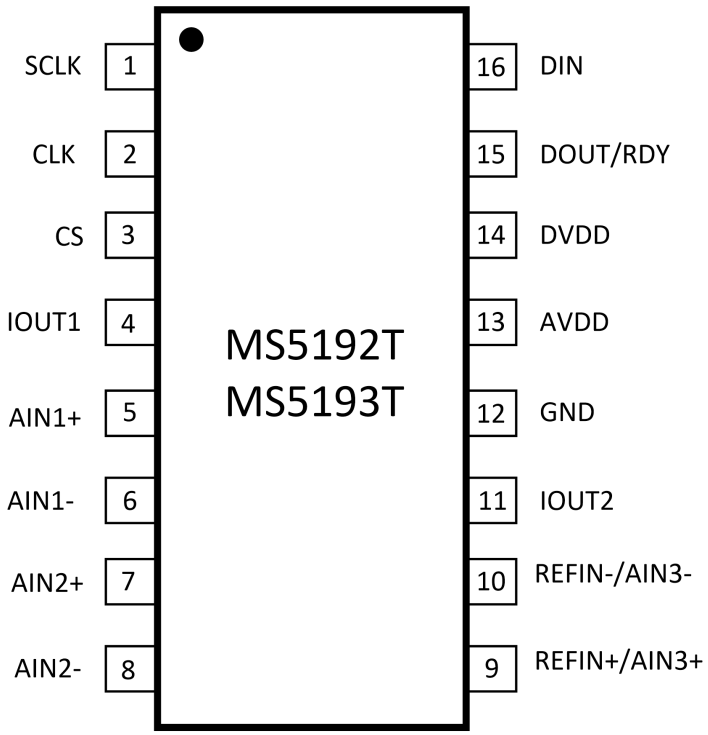
APPLICATIONS

- Thermocouple and RTD measurement
- Stress detection
- Gas analysis and blood analysis
- Industrial process control and instrumentation a
- Liquid and gas chromatograph
- 6-digit DVM

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS5192T	TSSOP16	MS5192T
MS5193T	TSSOP16	MS5193T

PIN CONFIGURATION

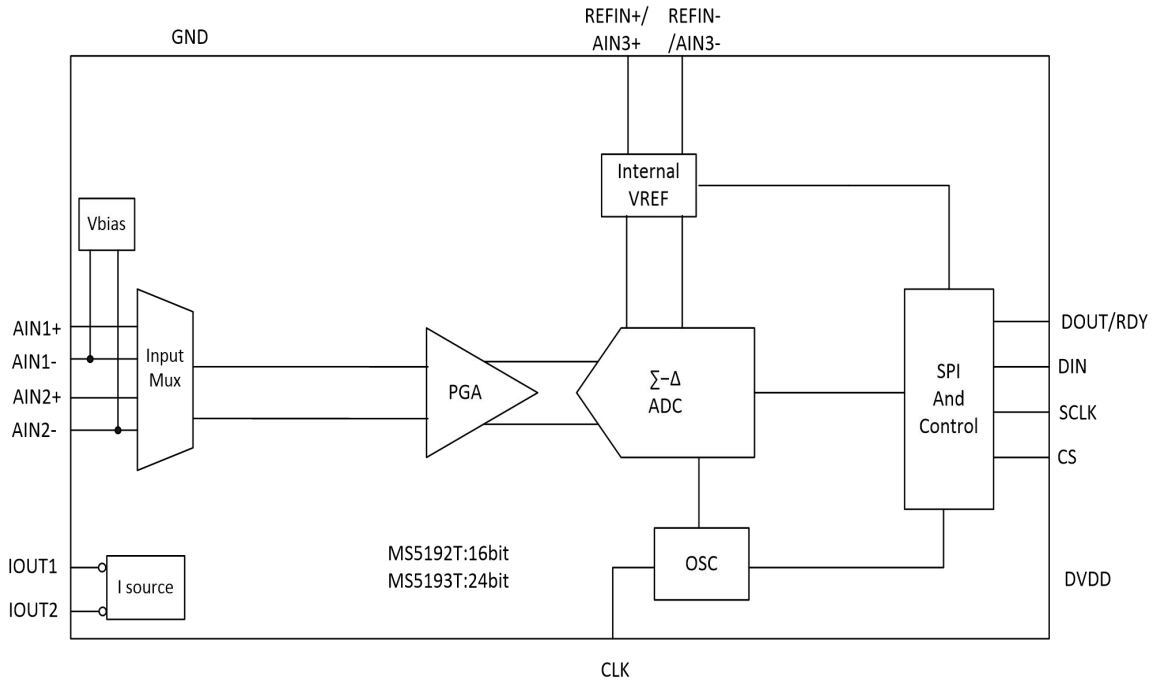


TSSOP16

PIN DESCRIPTION

Pin	Name	Type	Description
1	SCLK	I	Serial clock input
2	CLK	I	clock input/clock output, this pin can provide external clock, or disable internal clock
3	CS	I	Chip Select Input
4	IOUT1	O	internal excitation current source
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+/AIN3+	I	Positive reference voltage input pin.In addition, this pin can be used as analog channel 3 positive input
10	REFIN-/AIN3-	I	Negative reference voltage input pin.In addition, this pin can be used as analog channel 3 negative input
11	IOUT2	O	Internal excitation current source
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	℃
Storage Temperature range	Tstg	-60 to 150	℃
Lead Temperature(10 sec)		260	℃
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	fADC＜242Hz，for MS5193T		24/16		Bits
Resolution	See table 5 and 8				
Integral Nonlinearity				±15	ppmofFSR
Offset Error			±1		uV
Offset Error Drift vs. Temperature4			±10		nV/℃
Full-Scale Error			±10		uV
Gain Drift vs. Temperature			1		ppm/℃
Power Supply Rejection	AIN=1V/gain，GAIN＞4	100			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/℃
Unbuffered Mode,Average Input Current			±400		nA/V
Unbuffered Mode,Average Input Current Drift			±50		pA/V/℃
Common-Mode Rejection	DC,AIN = 1 V/gain, gain ≥ 4	100			dB
	50 ± 1 Hz, 60 ± 1 Hz (FS[3:0] = 1010)	100			dB
	50 ± 1 Hz (FS[3:0] = 1001), 60 ± 1 Hz (FS[3:0] = 1000)	100			dB
Internal Reference					
Accuracy			1.17±		V

			0.01%		
Reference Drift			10	15	ppm/℃
External Reference					
REFIN Voltage Limits2		0.1	2.5	AVDD	V
Average Reference Input Current			400		nA/V
Average Reference Input Current Drift			±0.03		nA/V/℃
Common-Mode Rejection			100		dB
EXCITATION CURRENT SOURCES（IEXC1 and IEXC2）					
Output Current			10/210 /1000		uA
Initial Tolerance at 25℃			±5		%
Drift			200		ppm/℃
Current Matching			±0.5		%
Drift Matching			50		ppm/℃
Line Regulation			2		%/V
Load Regulation			0.2		%/V
Output Compliance	Output Current：10uA、210uA	GND-30mV		AVDD-0.65	V
	Output Current：1mA	GND-30mV		AVDD-1.1	V
TEMPERATURE SENSOR					
Accuracy			±2		℃
Sensitivity			0.82		mV/℃
BIAS VOLTAGE GENERATOR					
VBIAS			AVDD/2		V
CLOCK					
Internal Clock Frequency			64±3%		KHz
Internal Clock Duty Cycle			50:50		%
External Clock Frequency			64		KHz
External Clock Duty Cycle		45:55		55:45	%
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 hyteresis	DVDD=5V	0.1		0.17	V
	DVDD=3V	0.06		0.13	V
Input Currents Input Capacitance				±10	uA
Input Capacitance			10		pF
LOGIC OUTPUTS					

Output High Voltage	AVDD=3 V, ISOURCE=100 μA	DVDD-0.6			V
	AVDD=5 V, ISOURCE=200 μA	4			V
Output High Voltage	AVDD=3 V, ISINK=100 μA			0.4	V
	AVDD=5 V, ISINK=1.6mA			0.4	V
Floating-State Leakage Current				±10	uA
Floating-State Output Capacitance			10		pF
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 or2		130	180	uA
	AVDD=5V			165	180	uA
	AVDD=3V	MS5192,gain=4 to 128		300	400	uA
	AVDD=5V			350	400	uA
	AVDD=3V	MS5193,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 MS5192T and MS5193T 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 5 Output RMS Noise (uV) vs Gain and Update Rate for MS5192T and MS5193T(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	0.282	0.225	0.101	0.056	0.023	0.021
8.33Hz	0.541	0.518	0.372	0.270	0.177	0.052	0.028	0.030
16.7Hz	0.992	0.902	0.439	0.237	0.161	0.069	0.034	0.029
33.2Hz	1.488	1.037	0.552	0.366	0.172	0.075	0.044	0.040
62Hz	2.344	1.893	0.890	0.473	0.220	0.096	0.062	0.054
123Hz	3.922	2.209	1.071	0.563	0.369	0.187	0.069	0.080
242Hz	5.409	4.778	2.490	1.104	0.589	0.344	0.147	0.173
470Hz	7.753	5.567	2.671	1.155	0.687	0.373	0.180	0.158

Table 6 Typical Resolution (Bits) vs. Gain and Update Rate for the MS5193T(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	23.0	22.4	21.8	21.1	21.3	21.1	21.4	20.5
8.33Hz	22.8	21.9	21.4	20.8	20.5	21.2	21.1	20.0
16.7Hz	22.0	21.1	21.1	21.0	20.6	20.8	20.8	20.1
33.2Hz	21.4	20.9	20.8	20.4	20.5	20.7	20.5	19.6
62Hz	20.7	20.0	20.1	20.0	20.1	20.3	20.0	19.2
123Hz	20.0	19.8	19.9	19.8	19.4	19.4	19.8	18.6
242Hz	19.5	18.7	18.6	18.8	18.7	18.5	18.7	17.5
470Hz	19.0	18.5	18.5	18.8	18.5	18.4	18.4	17.6

Table 7 Typical Resolution (Bits) vs. Gain and Update Rate for the MS5192T(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	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
8.33Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
16.7Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
33.2Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
62Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
123Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
242Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
470Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0

OUTPUT NOISE AND RESOLUTION SPECIFICATIONS (Internal Reference)

The table below gives the output RMS noise for MS5192T and MS5193T with some update rate and gain settings.The data provided are for bipolar input ranges and 2.5V internal 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 8 Output RMS Noise (uV) vs Gain and Update Rate for MS5192T and MS5193T(internal 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	0.607	0.553	0.260	0.200	0.112	0.047	0.025	0.025
8.33Hz	0.845	0.607	0.385	0.200	0.141	0.045	0.029	0.038
16.7Hz	1.257	1.528	0.396	0.366	0.167	0.083	0.030	0.031
33.2Hz	1.712	1.365	0.623	0.317	0.183	0.078	0.043	0.035
62Hz	2.363	2.363	0.759	0.447	0.219	0.110	0.070	0.059
123Hz	3.901	2.417	1.235	0.764	0.336	0.133	0.074	0.071
242Hz	5.267	6.762	1.804	0.986	0.607	0.261	0.110	0.105
470Hz	7.673	7.727	2.108	1.151	0.578	0.436	0.146	0.079

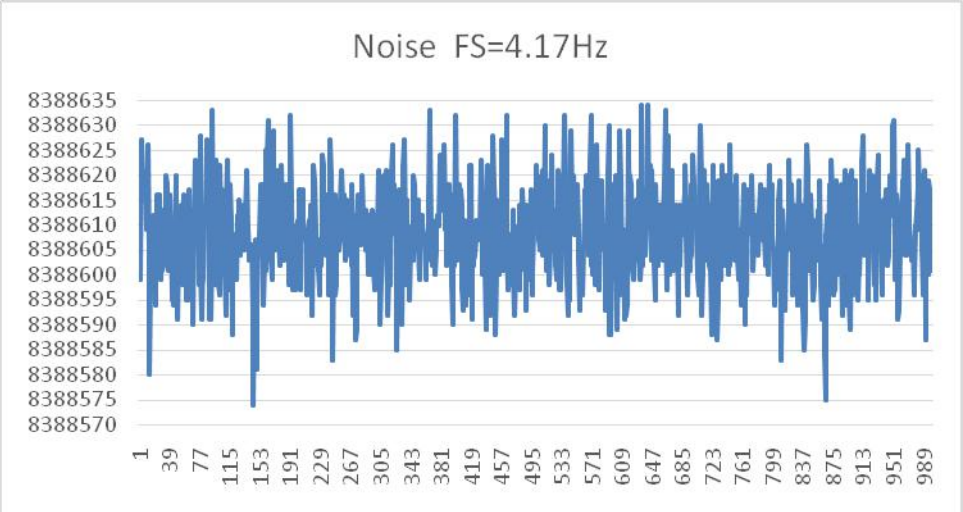
Table 9 Typical Resolution (Bits) vs. Gain and Update Rate for the MS5193T(Internal 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	22.7	21.8	21.9	21.3	21.1	21.4	21.3	20.3
8.33Hz	22.2	21.7	21.3	21.3	20.8	21.4	21.1	19.7
16.7Hz	21.6	20.4	21.3	20.4	20.5	20.5	21.0	20.0
33.2Hz	21.2	20.5	20.6	20.6	20.4	20.6	20.5	19.8
62Hz	20.7	19.7	20.4	20.1	20.2	20.1	19.8	19.0
123Hz	20.0	19.7	19.7	19.4	19.5	19.9	19.7	18.8
242Hz	19.6	18.2	19.1	19.0	18.7	18.9	19.2	18.2
470Hz	19.0	18.0	18.9	18.8	18.8	18.2	18.7	18.6

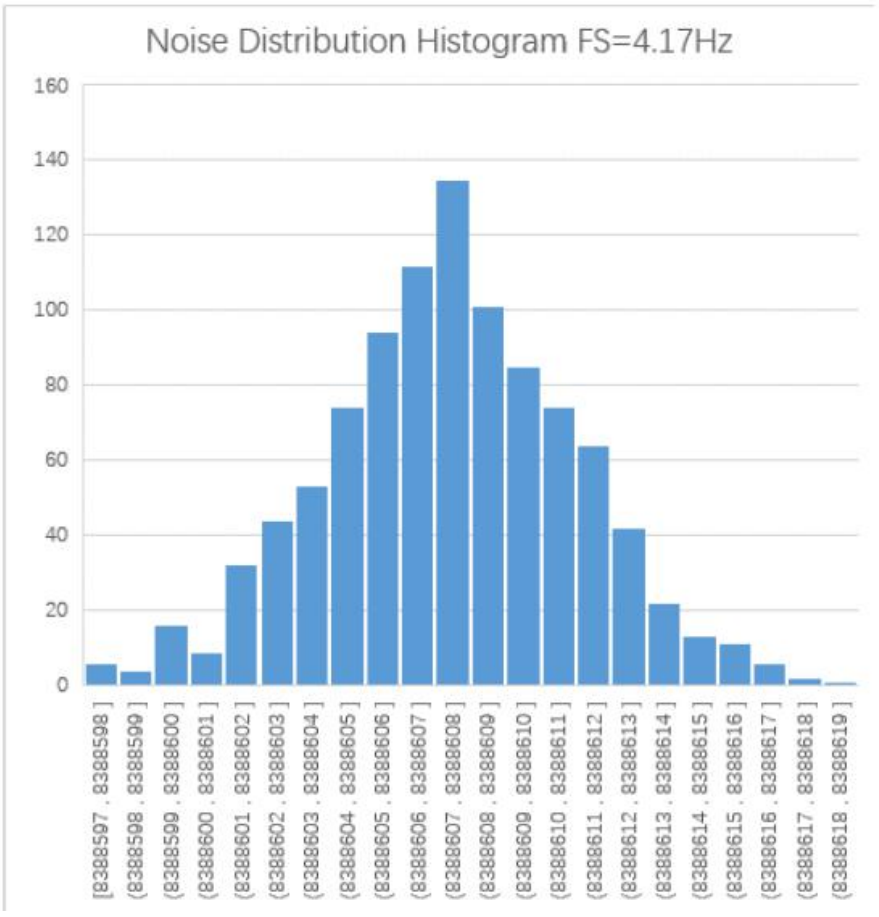
Table 10 Typical Resolution (Bits) vs. Gain and Update Rate for the MS5192T(Internal 2.5 V REF)

Update Rate	GAIN=1	GAIN=2	GAIN=4	GAIN=8	GAIN=16	GAIN=32	GAIN=64	GAIN=128
4.17Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
8.33Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
16.7Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
33.2Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
62Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
123Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
242Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
470Hz	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0

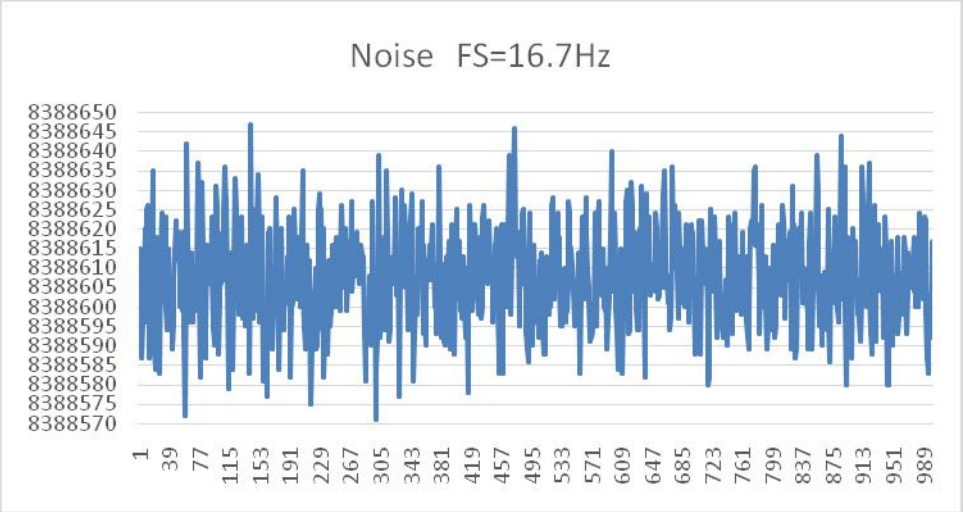
TYPICAL PERFORMANCE CHARACTERISTICS



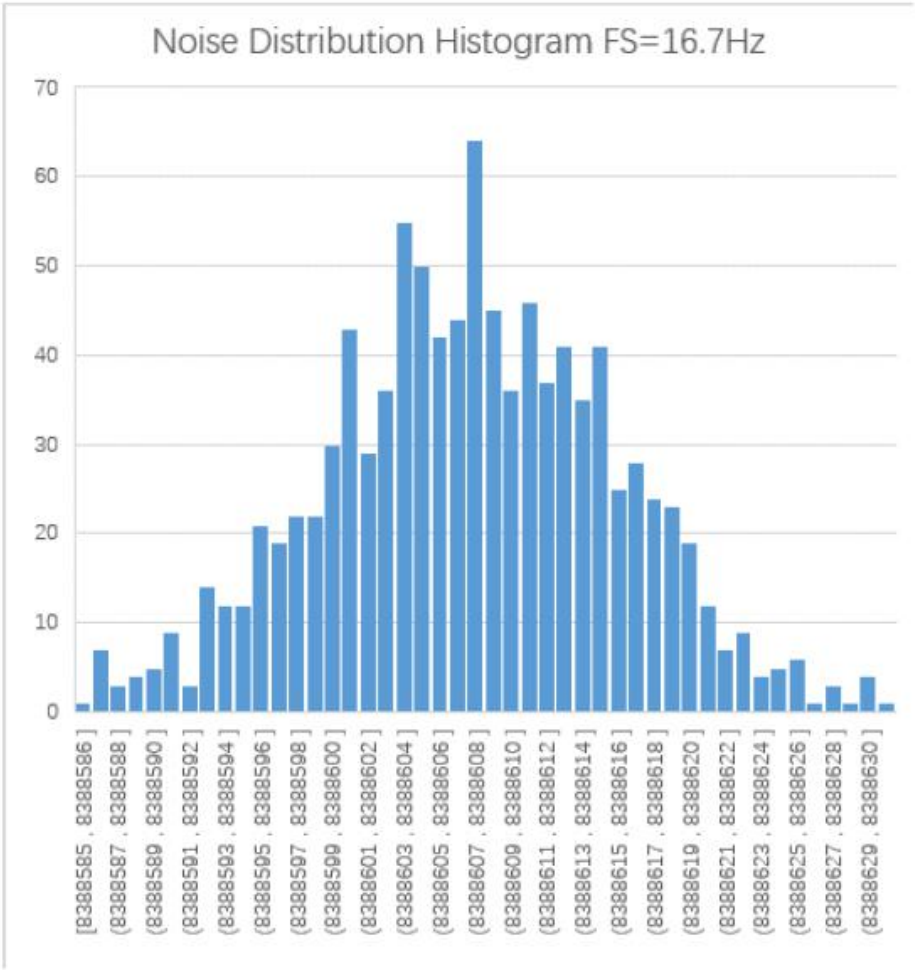
MS5193T Noise Plot（AVDD=4V,VREF = 2.048, Gain = 64, Update Rate = 4.17 Hz）



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



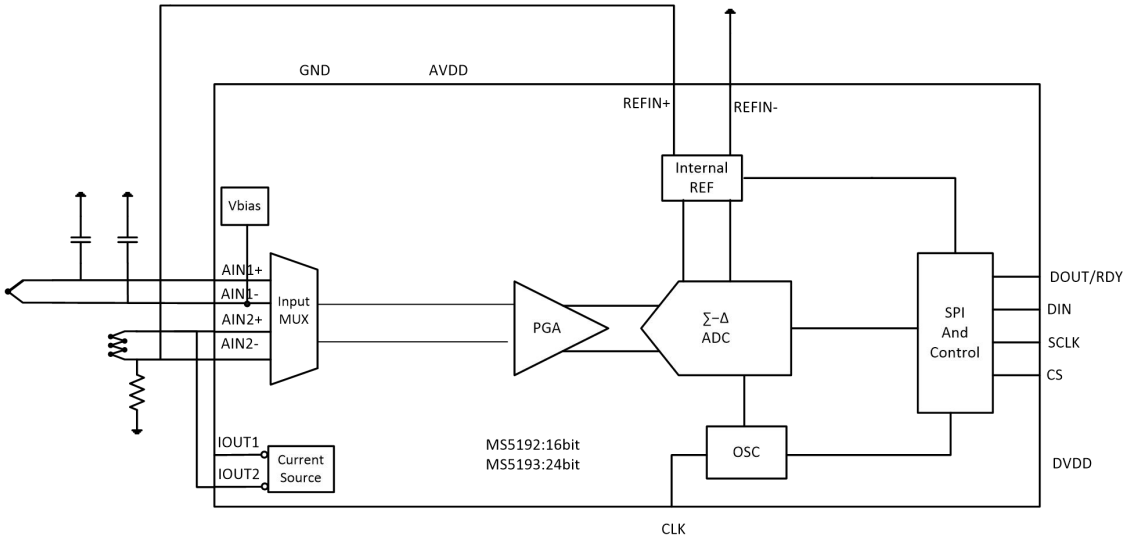
MS5193T Noise Plot（AVDD=4V,VREF = 2.048, Gain = 64, Update Rate = 16.7 Hz）



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

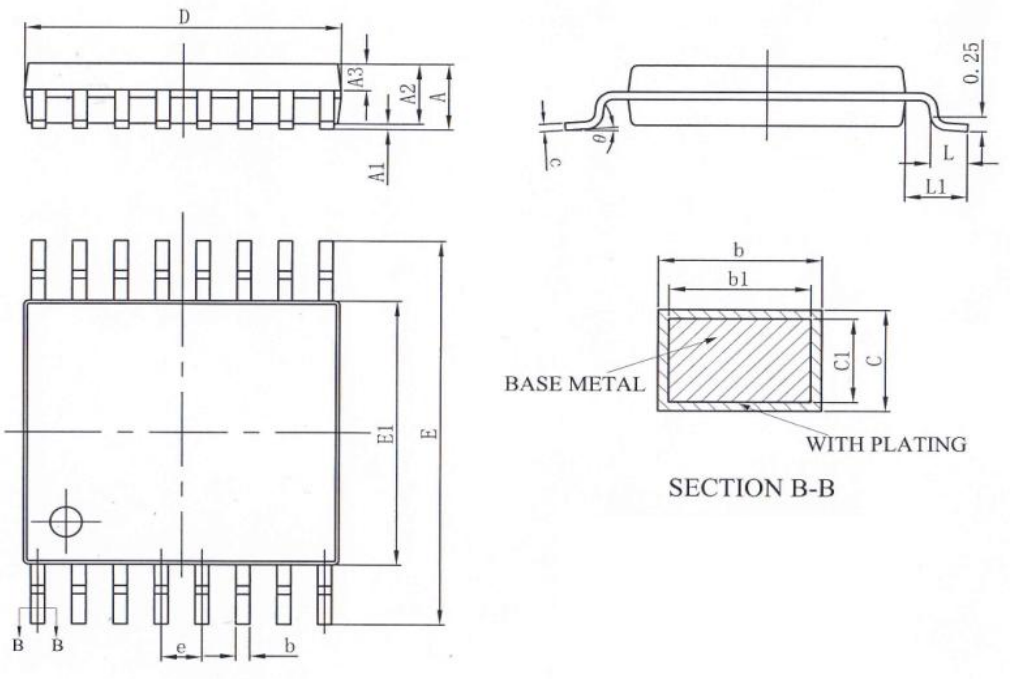
APPLICATIONS INFORMATION

The blow figure is a connection from a thermocouple measurement application for the MS5192T/MS5193T.



PACKAGE OUTLINE DIMENSIONS

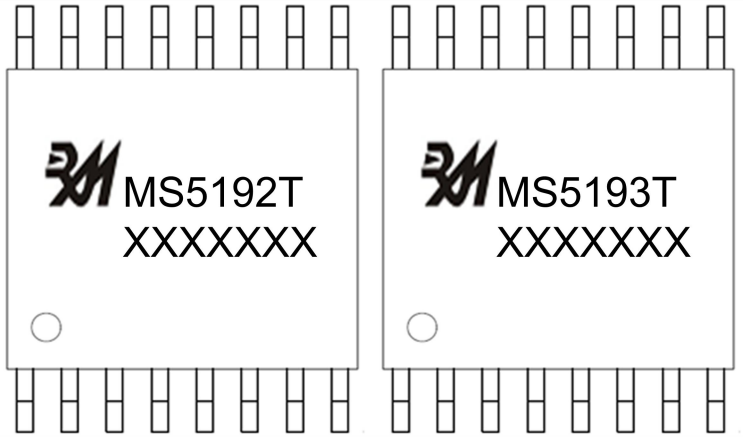
TSSOP16：



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



MS5192T、MS5193T： Product Name
XXXXXXX： Product Code

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
MS5192T	TSSOP16	3000	1	3000	8	24000
MS5193T	TSSOP16	3000	1	3000	8	24000

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