16bit, 4/8-channel, 250kSPS, SAR ADC

FEATURES

- 16-bit No Missing Resolution
- Integrated Multiplexer: 4-channel (MS51682N), 8-channel (MS51689N)
- Optical Input Configuration: Unipolar and Bipolar Inputs, Single-ended and Differential Inputs
- INL (@External Reference 2.048V): +0.5LSB (Typ), ±1.5LSB (Max)
- Dynamic range: 93.8dB
- SINAD (@External Reference 2.048V）: 92.5dB(20kHz)；
  THD: -100dB (20kHz)
- Analog Input Range: 0 to VREF (VREF up to VDD)
- Multiple References: Internal 2.5V or 4.096V, External Reference
- Internal Temperature Sensor
- Channel Sequencer
- Single Power Supply: 2.3V to 5.5V,
  Logical Power Supply: 1.8V to 5.5V
- Serial Interface: Compatible with SPI, MICROWIRE, QSPI and DSP
- Power Dissipation: 3.5mW(2.5V@200kSPS), 12.5mW(5V@200kSPS)
- Standby Current: 50nA

APPLICATIONS

- Multichannel System Monitoring
- Battery-powered Equipment
- Medical Devices: ECG, EKG
- Mobile Communication: GPS
- Power Line Monitoring
- Data Acquisition
- Seismic Data Acquisition System
- Instrumentation
- Process Control

PRODUCT DESCRIPTION

The MS51682N/MS51689N is a 4/8-channel, 16bit, charge redistribution successive approximation analog-to-digital converter, which adopts single power supply. The MS51682N/MS51689N is integrated with a 16-bit no missing code SAR ADC internally, a low crosstalk multiplexer, the internal low-drift reference voltage source(2.5V or 4.096V can be selected), a temperature sensor, an optional single-pole filter, and a sequencer that is useful when multiple channels are sequentially sampled.

The MS51682N/MS51689N adopts SPI interface to configure registers and read converted data. SPI interface uses a separate power supply (VIO).

The MS51682N/MS51689N is available in QFN20 package, whose operating temperature range is from -40°C to +125°C.

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS51682N	QFN20	MS51682
MS51689N	QFN20	MS51689

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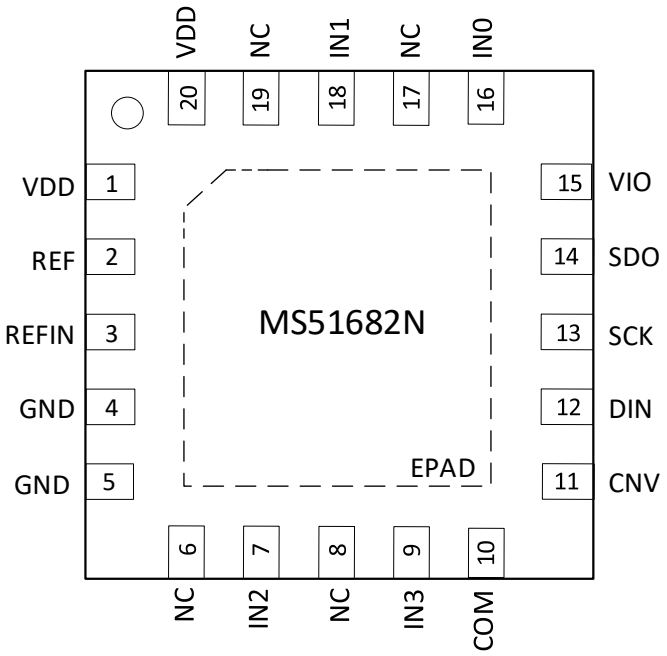
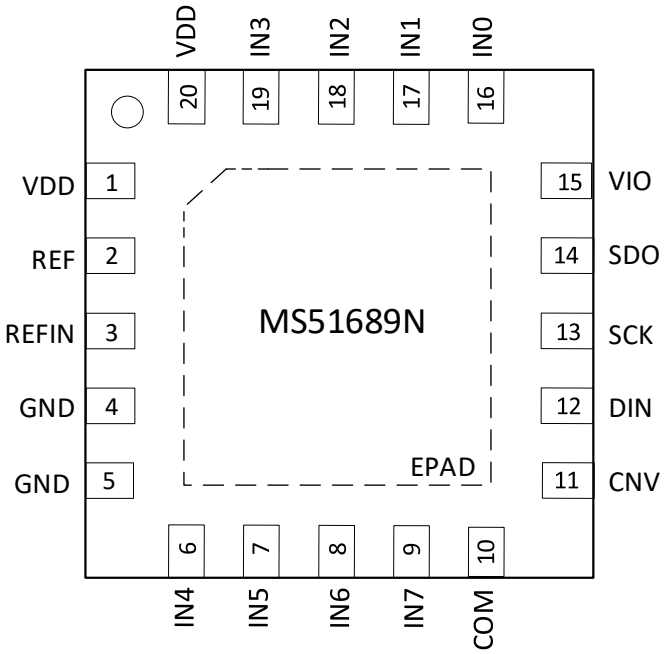
PIN CONFIGURATION



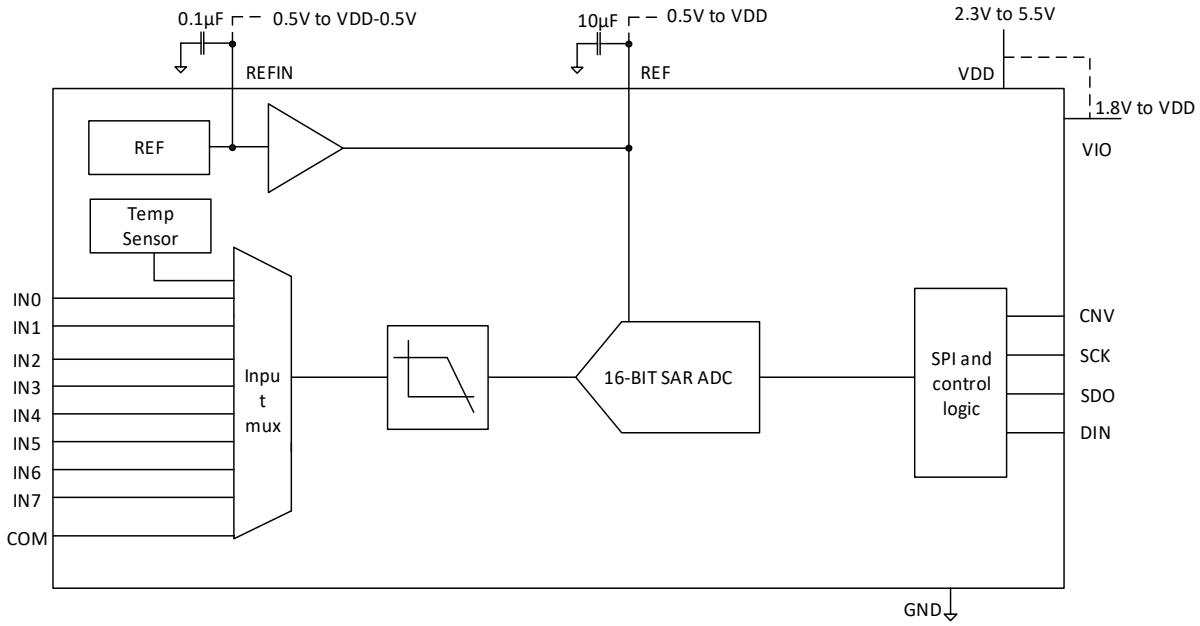


PIN DESCRIPTION

Pin	Name		Type	Description
	MS51682N	MS51689N		
1,20	VDD	VDD	-	Power Supply. Nominal value is from 2.3V to 5.5V when using external reference and decoupled with 10µF and 100nF capacitors. The minimum value is 3.0V when using 2.5V internal reference source. The minimum value is 4.5V when using 4.096V internal reference source.
2	REF	REF	I/O	Reference Voltage Input/Output. A 10µF decoupling capacitor is required. When enabling internal reference source, 2.5V or 4.096V referenced voltage outputs on the pin. When the internal reference source is disabled and the internal buffer is enabled, the external reference voltage of REFIN outputs on the REF thorough buffer.
3	REFIN	REFIN	I/O	Internal Reference Output/Reference Voltage Buffer Input. When internal reference source is used, the internal output is unbuffered reference voltage and a 0.1µF decoupling capacitor is required. When the internal reference voltage buffer is enabled, a reference source from 0.5V to (VDD-0.5V) can be applied and buffered to the REF pin.
4	GND	GND	-	Ground
5	GND	GND	-	Ground
6	NC	IN4	I	MS51682N: No Connection MS51689N: Analog Input Channel 4
7	IN2	IN5	I	MS51682N: Analog Input Channel 2 MS51689N: Analog Input Channel 5

Pin	Name		Type	Description
	MS51682N	MS51689N		
8	NC	IN6	I	MS51682N: No Connection MS51689N: Analog Input Channel 6
9	IN3	IN7	I	MS51682N: Analog Input Channel 3 MS51689N: Analog Input Channel 7
10	COM	COM	I	Common-mode Channel Input. All input channels (IN7~IN0) can be referred to a common-mode point of 0V or V_{REF}/2V.
11	CNV	CNV	I	Conversion Input. CNV initiates the conversion on the rising edge. During the conversion, if CNV remains low, the busy indicator is enabled.
12	DIN	DIN	I	Data Input. Used to write to 14-bit configuration register. The configuration register can be written during and after conversion.
13	SCK	SCK	I	Serial Data Clock Input.
14	SDO	SDO	O	Serial Data Output.
15	VIO	VIO	-	Input/Output Interface Digital Power Supply. The nominal power supply is same as the master interface. (1.8V, 2.5V, 3V or 5V).
16	IN0	IN0	I	Analog Input Channel 0
17	NC	IN1	I	MS51682N: No Connection MS51689N: Analog Input Channel 1
18	IN1	IN2	I	MS51682N: Analog Input Channel 1 MS51689N: Analog Input Channel 2
19	NC	IN3	I	MS51682N: No Connection MS51689N: Analog Input Channel 3
-	EPAD	EPAD	-	Exposed pad, Connected to the GND is recommended.

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
Power Supply	V_{DD}	-0.3 ~ +7.0	V
Analog Input Voltage	V_{IN}	-0.3 ~ V_{DD}+0.3	V
Reference Voltage	V_{REFIN}	-0.3 ~ V_{DD}+0.3	V
Digital Input Voltage		-0.3 ~ V_{IO}+0.3	V
Digital Output Voltage		-0.3 ~ V_{IO}+0.3	V
Input Current		10	mA
Operating Temperature	T_A	-40 ~ 125	°C
Storage Temperature	T_{STG}	-65 ~ 150	°C
Lead Temperature (10s)		260	°C
ESD (HBM)	V_{ESD}	±2500	V
ESD (CDM)		±500	

ELECTRICAL CHARACTERISTICS

V_{DD}=2.3V to 5.5V, V_{IO} =1.8V to V_{DD}, reference voltage(V_{REF})=V_{DD}, T_A = -40°C to +85°C.

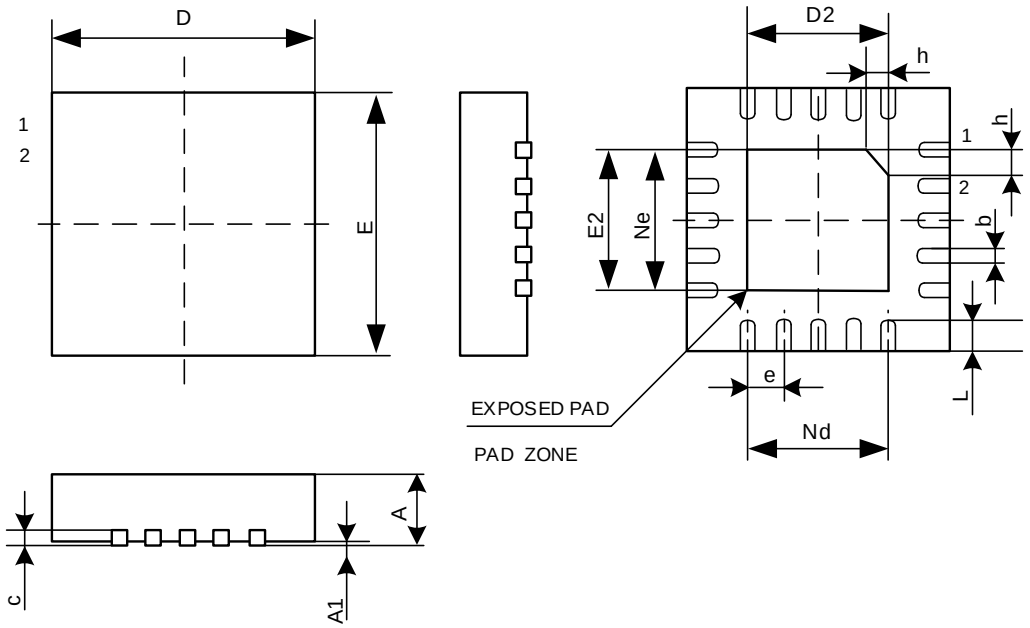
Parameter	Condition	Min	Typ	Max	Unit
Analog Input					
Analog Input Voltage	Unipolar mode	0		$+V_{REF}$	V
	Bipolar mode	$-V_{REF}/2$		$+V_{REF}/2$	
Absolute Input Voltage	Positive input, unipolar and bipolar modes	-0.1		V_{REF}+0.1	V
	Negative or COM input, unipolar mode	-0.1		+0.1	V
	Negative or COM input, bipolar mode	$V_{REF}/2$-0.1	$V_{REF}/2$	$V_{REF}/2$+0.1	V
Analog Input CMRR	f_{IN}=200kHz		68		dB
Leakage Current@25°C	Acquisition phase		1		nA
Conversion Rate					
Full Bandwidth	V_{DD}=4.5V to 5.5V	0		250	kSPS
	V_{DD}=2.3V to 4.5V	0		200	kSPS
1/4 Bandwidth	V_{DD}=4.5V to 5.5V	0		62.5	kSPS
	V_{DD}=2.3V to 4.5V	0		50	kSPS
Transient Response	Full-scale step, full bandwidth		2		µs
	Full-scale step, 1/4 bandwidth		12		µs
Accuracy					
No Missing Codes			16		Bits
INL	reference voltage(V_{REF}) = 2.048V	-1.5	±0.5	+1.5	LSB
DNL	reference voltage(V_{REF}) = 2.048V	-1	±0.25	+1	LSB
Transition Noise	V_{REF}=V_{DD}=5V		0.5		LSB
Gain Error		-8	±1	+8	LSB
Gain Error Match		-4	±0.5	+4	LSB
Gain Error Temperature Drift			±1		ppm/°C

Parameter	Condition	Min	Typ	Max	Unit
Offset Error	V_{DD}=4.5V to 5.5V	-8	±1	+8	LSB
	V_{DD}=2.3V to 4.5V		±5		LSB
Offset Error Match		-4	±0.5	+4	LSB
Offset Error Temperature Drift			±1		ppm/°C
Power Supply Sensitivity	V_{DD}=5V±5%		±1.5		LSB
AC Accuracy					
SNR	f_{IN}=20kHz,V_{REF}=5V	92.5	93.5		dB
	f_{IN}=20kHz, Internal V_{REF}=4.096V	91	92.3		
SINAD	f_{IN}=20kHz, Internal V_{REF}=2.5V	87.5	88.8		dB
	f_{IN}=20kHz,V_{REF}=5V	91	92.5		
	f_{IN}=20kHz,V_{REF}=5V,-60dB input		33.5		
	f_{IN}=20kHz, Internal V_{REF}=4.096V	90	91		
THD	f_{IN}=20kHz		-100		dB
SFDR	f_{IN}=20kHz		110		dB
Crosstalk between Channels	f_{IN}=100kHz		-125		dB
Sampling Dynamics					
-3dB Input Bandwidth	Full bandwidth		1.6		MHz
	1/4 bandwidth		0.4		MHz
Aperture Delay	V_{DD}=5V		2.5		ns
Internal Reference Voltage					
REF Output Voltage	2.5V@25°C	2.490	2.500	2.510	V
	4.096V@25°C	4.086	4.096	4.106	V
REFIN Output Voltage	2.5V@25°C		1.2		V
	4.096V@25°C		2.3		V
REF Output Current			±300		µA
Temperature Drift			±10		ppm/°C
Voltage Regulation	V_{DD}=5V±5%		±15		ppm/V
Set-up Time	C_{REF}=10µF		4		ms

Parameter	Condition	Min	Typ	Max	Unit
External Reference Voltage					
Voltage Range	REF input	0.5		V_{DD}+0.3	V
	REFIN input	0.5		V_{DD}-0.5	V
Leakage Current	200kSPS, V_{REF}=5V		50		µA
Temperature Sensor					
Output Voltage	@25°C		320		mV
Temperature Sensitivity			1		mV/°C
Digital Input					
Low-level Input Voltage		-0.3		+0.3×V_{IO}	V
High-level Input Voltage		0.7×V_{IO}		V_{IO}+0.3	V
Low-level Input Current		-1		+1	µA
High-level Input Current		-1		+1	µA
Digital Output					
High-level Output Voltage	I_{SOURCE}=-500µA	V_{IO}-0.3			V
Low-level Output Voltage	I_{SINK}=+500µA			0.4	V
Output Leakage Current				80	mA
Power Supply					
VDD	Specified Performance	2.3		5.5	V
VIO	Specified Performance	1.8		V_{DD}+0.3	V
Standby Current	V_{DD}=V_{IO}=5V,25°C		50		nA
Operating Current	V_{DD}=2.5V, 100kSPS Conversion Rate		0.7		mA
	V_{DD}=2.5V, 200kSPS Conversion Rate		1.4		
	V_{DD}=5V, 200kSPS Conversion Rate		2.5	3	
	V_{DD}=5V, 200kSPS Conversion Rate, Internal Reference Source		3.2	4	

PACKAGE OUTLINE DIMENSIONS

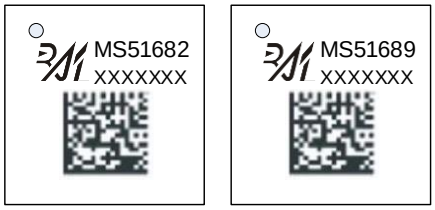
QFN20



Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	1.90	2.00	2.10
e	0.50BSC		
Ne	2.00BSC		
Nd	2.00BSC		
E	3.90	4.00	4.10
E2	1.90	2.00	2.10
L	0.35	0.40	0.45
h	0.25	0.30	0.35

MARKING and PACKAGING SPECIFICATION

1. **Marking Drawing Description**



Product Name: MS51682, MS51689

Product Code: XXXXXXX

2. Marking Drawing Demand

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

3. **Packaging Specification**

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS51682N	QFN20	1000	8	8000	4	32000
MS51689N	QFN20	1000	8	8000	4	32000

STATEMENT

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- 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.

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