16bit, 8-channel, 500kSPS, SAR ADC

FEATURES

- 16-bit No Missing Resolution
- Integrated Multiplexer: 8-channel 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: 92dB
- SINAD (@External Reference2.048V）: 92dB(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: 5.0V, Logical Power Supply: 1.8V to 5.0V
- Serial Interface: Compatible with SPI, MICROWIRE, QSPI and DSP
- Power Dissipation: 7.5mW(5V@100kSPS), 23mW(5V@500kSPS)
- Standby Current: 200nA@5V

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 MS51688N is a 8-channel, 16bit, charge redistribution successive approximation analog-to-digital converter, which adopts single power supply. The MS51688N is featured with all necessary components for the system which has multiple channels and can perform low power dissipation acquisition, including: a 16-bit no missing code SAR ADC. These can configure the input as single-ended input (use or not use reference ground), differential input or bipolar input crosstalk multiplexer with 8 channels, the internal low-drift reference voltage source(4.096V), a buffer, a temperature sensor, an optional single-pole filter, and a sequencer that is useful when multiple channels are sequentially sampled.

The MS51688N adopts SPI interface to write configuration registers and read converted data. SPI interface uses a separate power supply (VIO), which is set to master logic level. Power dissipation is proportional to conversion rate.

The MS51688N is available in QFN20 package, whose operating temperature range is from -40°C to +125°C.

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS51688N	QFN20	MS51688

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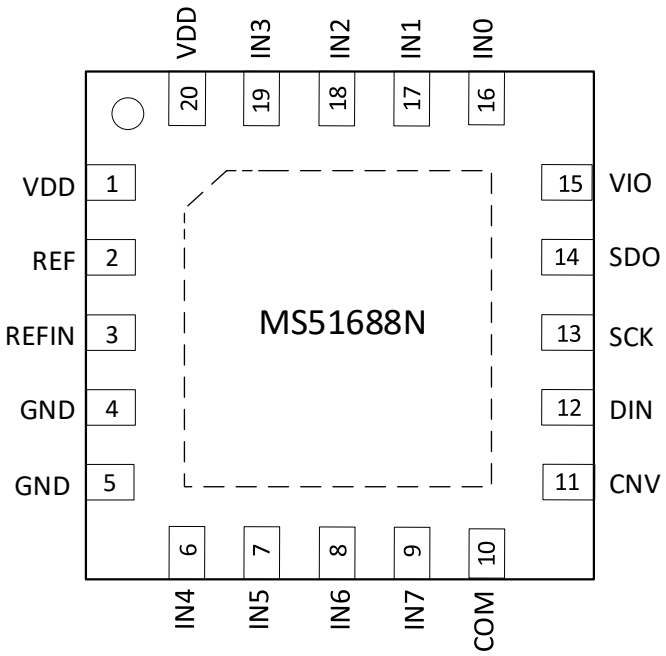
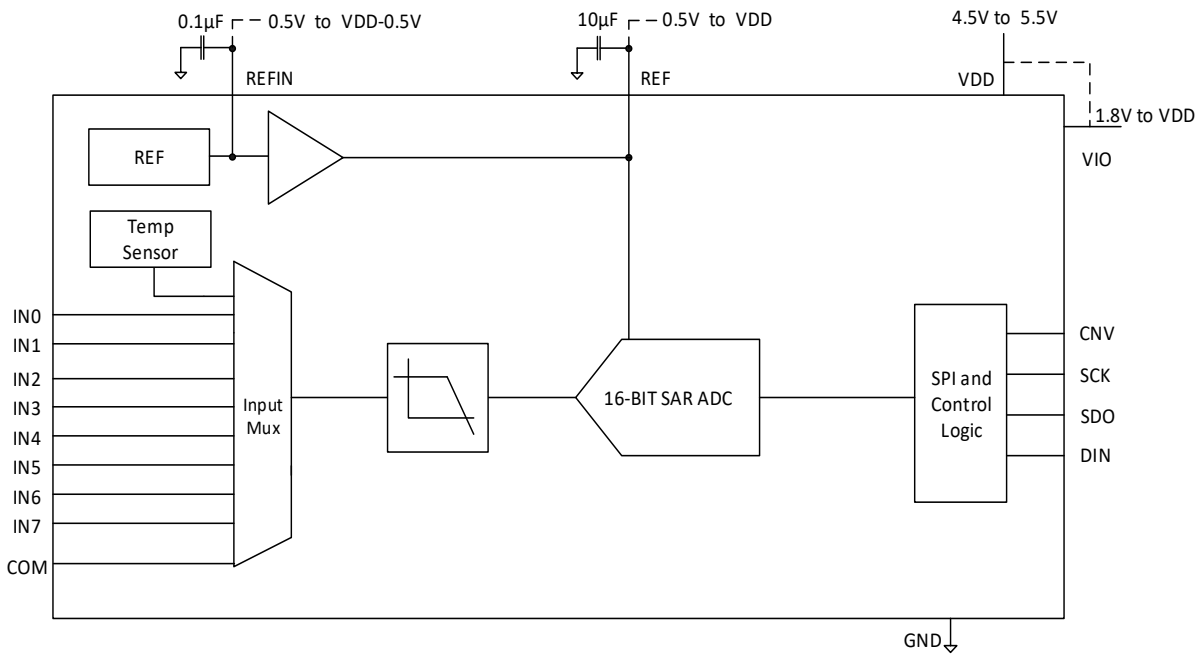
PIN CONFIGURATION



PIN DESCRIPTION

Pin	Name	Type	Description
1,20	VDD	-	Power Supply. Nominal value is from 4.5V to 5.5V when using external reference and decoupled with 10µF and 100nF capacitors. Minimum 4.5V when using internal reference source 4.096V
2	REF	I/O	Reference Voltage Input/Output. A 10µF decoupling capacitor is required and placed as close to REF as possible. This pin can output 2.5V or 4.096V reference voltage when enabling internal reference source. When the internal reference source is disabled and the internal buffer is enabled, the REFIN voltage is output to the REF pin through the buffer.
3	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	-	Ground
5	GND	-	Ground
6	IN4	I	Analog Input Channel 4
7	IN5	I	Analog Input Channel 5
8	IN6	I	Analog Input Channel 6
9	IN7	I	Analog Input Channel 7
10	COM	I	Common-mode Channel Input. All input channels can be referenced to a common-mode point of 0V or V_{REF}/2V.
11	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	I	Data Input. Used to write to 14bit configuration register. The configuration register can be written during and after conversion.
13	SCK	I	Serial Data Clock Input.
14	SDO	O	Serial Data Output.
15	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	I	Analog Input Channel 0
17	IN1	I	Analog Input Channel 1
18	IN2	I	Analog Input Channel 2
19	IN3	I	Analog Input Channel 3

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}=4.5V to 5.5V, V_{IO} =3.3V, V_{REF}= 4.096V, T_A = -40°C to +85°C.

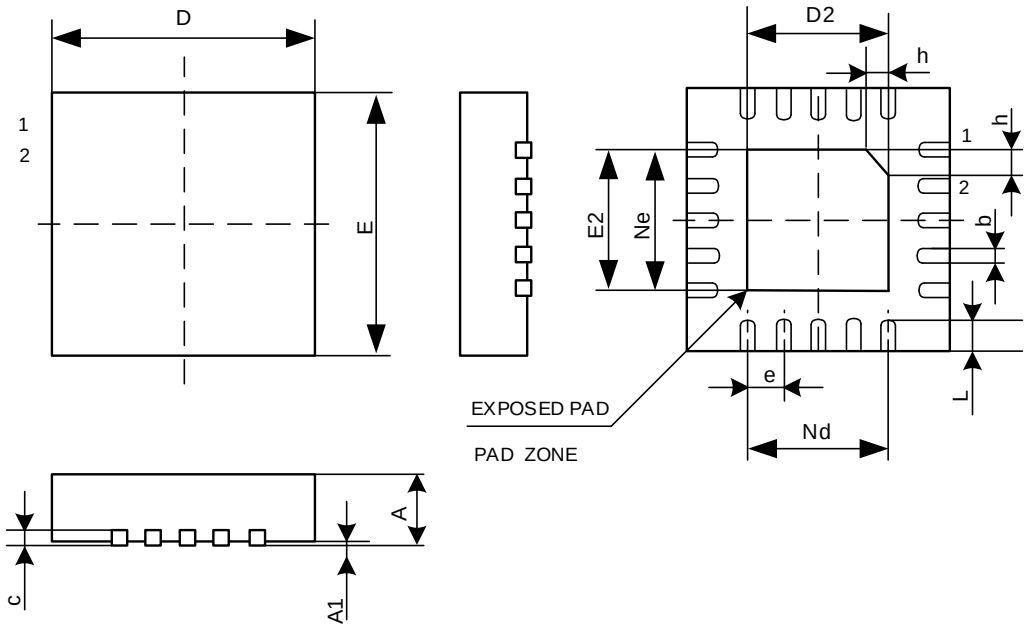
Parameter	Condition	Min	Typ	Max	Unit
Analog Input					
Analog Input Voltage	Unipolar mode	0		$+V_{REF}$	V
	Bipolar mode	$-V_{REF}/2$		$+V_{REF}/2$	
Absolute Input Voltage	Positive input, unipolar and bipolar modes	-0.1		V_{REF}+0.1	V
	Negative or COM input, unipolar mode	-0.1		+0.1	V
	Negative or COM 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		500	kSPS
1/4 Bandwidth	V_{DD}=4.5V to 5.5V	0		125	kSPS
Transient Response	Full-scale step, full bandwidth		0.4		µs
	Full-scale step, 1/4 bandwidth		1.6		µs
Accuracy					
No Missing Codes			16		Bits
INL		-1.5	±0.5	+1.5	LSB
DNL		-1	±0.5	+1	LSB
Gain Error		-8	±1	+8	LSB
Gain Error Match		-4	±0.5	+4	LSB
Gain Error Temperature Drift			±0.3		ppm/°C
Offset Error	V_{DD}=4.5V to 5.5V	-10	±1	+10	LSB
Offset Error Match		-4	±1	+4	LSB
Offset Error Temperature Drift			±0.3		ppm/°C
Power Supply Sensitivity	V_{DD}=5V±5%		±1.5		LSB

Parameter	Condition	Min	Typ	Max	Unit
AC Accuracy					
SNR	f_{IN}=20kHz	91.5	92		dB
	f_{IN}=20kHz, Internal V_{REF}=4.096V	91	92		
SINAD	f_{IN}=20kHz	91	91.5		dB
	f_{IN}=20kHz,-60dB Input		33.5		
	f_{IN}=20kHz, Internal V_{REF}=4.096V	90	91		
THD	f_{IN}=20kHz		-96		dB
SFDR	f_{IN}=20kHz		110		dB
Crosstalk between Channels	f_{IN}=100kHz		-124		dB
Sampling Dynamics					
-3dB Input Bandwidth	Full bandwidth		12		MHz
	1/4 bandwidth		3		MHz
Aperture Delay	V_{DD}=5V		2.5		ns
Internal Reference Voltage					
REF Output Voltage	4.096V@25°C	4.086	4.096	4.106	V
REFIN Output Voltage	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		5		ms
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		100		µA
Temperature Sensor					
Output Voltage	@25°C		320		mV
Temperature Sensitivity			1		mV/°C

Parameter	Condition	Min	Typ	Max	Unit
Digital Input					
Low-level Input Voltage		-0.3		+0.3×V_{IO}	V
High-level Input Voltage		0.75×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
Power Supply					
VDD	Specified Performance	4.5		5.5	V
VIO	Specified Performance	1.8		V_{DD}+0.3	V
Standby Current	V_{DD}=V_{IO}=5V, 25°C		200		nA
Power Dissipation	V_{DD}=5V, 100kSPS Conversion Rate,Internal Reference Source		7.5	10	mW
	V_{DD}=5V, 500kSPS Conversion Rate,Internal Reference Source		23	28	mW

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: MS51688

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
MS51688N	QFN20	1000	8	8000	4	32000

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.

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