

ADS7057 14 位, 2.5 MSPS, 差分输入, 小型低功耗 SAR ADC

1 特性

- 2.5 MSPS 吞吐量
- 封装尺寸小:
 - X2QFN-8 封装 (1.5mm × 1.5mm)
- 全差分输入范围: $\pm AVDD$
- 宽工作电压范围:
 - AVDD: 2.35V 至 3.6V
 - DVDD: 1.65V 至 3.6V (与 AVDD 无关)
 - 温度范围: -40°C 至 +125°C
- 性能优异:
 - 14 位 NMC DNL, ± 0.9 -LSB INL
 - 79.5dB SINAD (2kHz 时)
 - 77dB SINAD (1MHz 时)
- 低功耗:
 - 3.6mW (2.5 MSPS, 3.3V AVDD 时)
 - 160 μ W (100kSPS, 3.3V AVDD 时)
 - 82 μ W (100kSPS, 2.5V AVDD 时)
- 集成失调电压校准
- 与 SPI 兼容的串行接口: 60MHz
- 符合 JESD8-7A 标准的数字 I/O

2 应用

- 光学编码器
- 声纳接收器
- 探鱼器
- I/Q 解调器
- 光线路卡和模块
- 热成像摄像机
- 超声波流量计
- 手持无线电

3 说明

ADS7057 器件属于引脚对引脚兼容的高速低功耗、单通道逐次逼近型寄存器 (SAR) 类型的模数转换器 (ADC) 系列。该器件系列包含多个分辨率、吞吐量和模拟输入型号 (有关器件列表, 请参阅 [表格1](#))。

ADS7057 是一款 14 位 2.5 MSPS SAR ADC, 支持 $\pm AVDD$ 范围内的全差分输入, AVDD 的范围为 2.35V 至 3.6V。

内部失调电压校准功能在整个 AVDD 和工作温度范围内可保持优异的失调电压规格。

该器件支持由 $\overline{CS}$ 和 SCLK 信号控制的兼容 SPI 的串行接口。输入信号通过 $\overline{CS}$ 下降沿进行采样, 而 SCLK 用于转换和串行数据输出。该器件支持宽数字电源范围 (1.65V 至 3.6V), 可直接连接到各种主机控制器。

ADS7057 的标称 DVDD 范围 (1.65V 至 1.95V) 符合 JESD8-7A 标准。

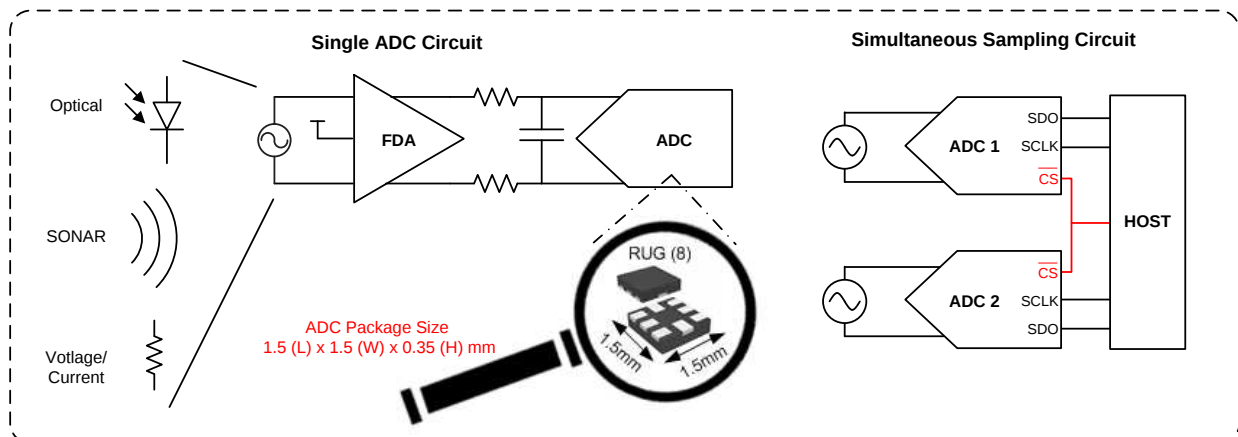
ADS7057 采用 8 引脚小型 X2QFN 封装, 可以在广泛的工业温度范围 (-40°C 至 +125°C) 内正常工作。该器件体积小, 功耗极低, 非常适合需要高速高分辨率数据采集的空间受限型 电池供电 应用。

器件信息⁽¹⁾

部件名称	封装	封装尺寸 (标称值)
ADS7057	X2QFN (8)	1.50mm x 1.50mm

(1) 如需了解所有可用封装, 请参阅数据表末尾的可订购产品附录。

典型应用



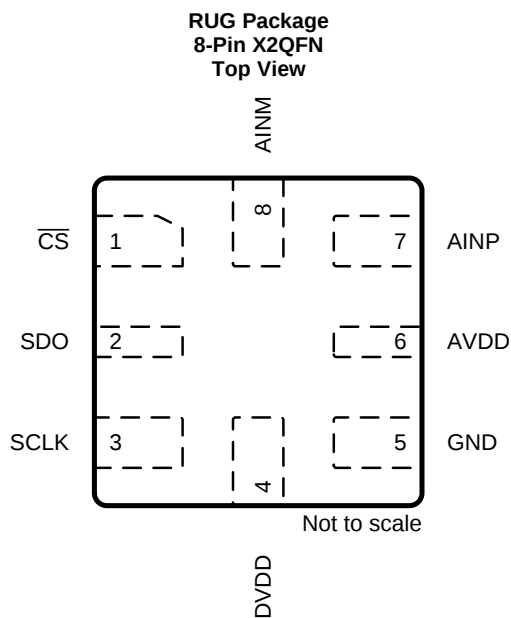
目录

1	特性	1	8.4	Device Functional Modes.....	20
2	应用	1	9	Application and Implementation	24
3	说明	1	9.1	Application Information.....	24
4	修订历史记录	2	9.2	Typical Applications	24
5	Pin Configuration and Functions	3	10	Power Supply Recommendations	29
6	Specifications	4	10.1	AVDD and DVDD Supply Recommendations.....	29
6.1	Absolute Maximum Ratings	4	10.2	Optimizing Power Consumed by the Device	29
6.2	ESD Ratings.....	4	11	Layout	30
6.3	Recommended Operating Conditions.....	4	11.1	Layout Guidelines	30
6.4	Thermal Information	4	11.2	Layout Example	31
6.5	Electrical Characteristics.....	5	12	器件和文档支持	32
6.6	Timing Requirements	7	12.1	器件支持	32
6.7	Switching Characteristics	7	12.2	文档支持	32
6.8	Typical Characteristics.....	9	12.3	接收文档更新通知	32
7	Parameter Measurement Information	14	12.4	社区资源	32
7.1	Digital Voltage Levels	14	12.5	商标	32
8	Detailed Description	15	12.6	静电放电警告	32
8.1	Overview	15	12.7	Glossary	33
8.2	Functional Block Diagram	15	13	机械、封装和可订购信息	34
8.3	Feature Description.....	16			

4 修订历史记录

日期	修订版本	说明
2017 年 12 月	*	初始发行版

5 Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	$\overline{\text{CS}}$	Digital input	Chip-select signal, active low
2	SDO	Digital output	Serial data out
3	SCLK	Digital input	Serial clock
4	DVDD	Supply	Digital I/O supply voltage
5	GND	Supply	Ground for power supply, all analog and digital signals are referred to this pin
6	AVDD	Supply	Analog power-supply input, also provides the reference voltage to the ADC
7	AINP	Analog input	Analog signal input, positive
8	AINM	Analog input	Analog signal input, negative

6 Specifications

6.1 Absolute Maximum Ratings⁽¹⁾

	MIN	MAX	UNIT
AVDD to GND	−0.3	3.9	V
DVDD to GND	−0.3	3.9	V
AINP to GND	−0.3	AVDD + 0.3	V
AINM to GND	−0.3	AVDD + 0.3	V
Input current to any pin except supply pins	−10	10	mA
Digital input voltage to GND	−0.3	DVDD + 0.3	V
Storage temperature, T _{stg}	−60	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

	VALUE	UNIT
V _(ESD) Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000
	Charged device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±1000

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

	MIN	NOM	MAX	UNIT
AVDD Analog supply voltage range	2.35	3.3	3.6	V
DVDD Digital supply voltage range	1.65	1.8	3.6	V
T _A Operating free-air temperature	−40	25	125	°C

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		ADS7057	UNIT
		RUG (X2QFN)	
		8 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	177.5	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	51.5	°C/W
R _{θJB}	Junction-to-board thermal resistance	76.7	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	1	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	76.7	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics

at AVDD = 3.3 V, DVDD = 1.65 V to 3.6 V, $f_{\text{sample}} = 2.5$ MSPS, and $V_{\text{CM}} = 1.65$ V (unless otherwise noted); minimum and maximum values for $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$; typical values at $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
ANALOG INPUT							
	Full-scale input voltage span ⁽¹⁾			–AVDD		AVDD	V
	Absolute input voltage range	AINP to GND		–0.1		AVDD + 0.1	V
		AINM to GND		–0.1		AVDD + 0.1	
	Common-mode voltage	(AINP + AINM) / 2		(AVDD / 2) – 0.1		(AVDD / 2) + 0.1	V
C _S	Sampling capacitance			16			pF
SYSTEM PERFORMANCE							
	Resolution			14			Bits
NMC	No missing codes			14			Bits
INL ⁽²⁾	Integral nonlinearity			–3	±0.9	3	LSB ⁽³⁾
DNL	Differential nonlinearity			–0.99	±0.3	1	LSB
E _O ⁽²⁾	Offset error	After calibration ⁽⁴⁾		–6	±1	6	LSB
dV _{OS} /dT	Offset error drift with temperature			1.75			ppm/°C
E _G ⁽²⁾	Gain error			–0.1	±0.01	0.1	%FS
	Gain error drift with temperature			0.5			ppm/°C
SAMPLING DYNAMICS							
t _{CONV}	Conversion time			18 × t _{SCLK}			ns
t _{ACQ}	Acquisition time			95			ns
f _{SAMPLE}	Maximum throughput rate	60-MHz SCLK, AVDD = 2.35 V to 3.6 V				2.5	MHz
	Aperture delay			3			ns
	Aperture jitter, RMS			12			ps
DYNAMIC CHARACTERISTICS							
SNR	Signal-to-noise ratio ⁽⁵⁾	AVDD = 3.3 V, f _{IN} = 2 kHz		76	79.6		dB
		AVDD = 2.5 V, f _{IN} = 2 kHz			78.5		
THD	Total harmonic distortion ^{(5) (6)}	f _{IN} = 2 kHz			–92		dB
		f _{IN} = 500 kHz			–90.4		
		f _{IN} = 1000 kHz			–90.3		
SINAD	Signal-to-noise and distortion ⁽⁵⁾	f _{IN} = 2 kHz		76	79.3		dB
		f _{IN} = 500 kHz			78.1		
		f _{IN} = 1000 kHz			77.1		
SFDR	Spurious-free dynamic range ⁽⁵⁾	f _{IN} = 2 kHz			95		dB
		f _{IN} = 500 kHz			93.4		
		f _{IN} = 1000 kHz			92.4		
BW _(fp)	Full-power bandwidth	At –3 dB		200			MHz

(1) Ideal input span; does not include gain or offset error.

(2) See Figure 31, Figure 29, and Figure 30 for statistical distribution data for INL, offset error, and gain error.

(3) LSB means least significant bit.

(4) See the OFFCAL State section for details.

(5) All specifications expressed in decibels (dB) refer to the full-scale input (FSR) and are tested with an input signal 0.5 dB below full-scale, unless otherwise noted.

(6) Calculated on the first nine harmonics of the input frequency.

Electrical Characteristics (continued)

at AVDD = 3.3 V, DVDD = 1.65 V to 3.6 V, $f_{\text{sample}} = 2.5$ MSPS, and $V_{\text{CM}} = 1.65$ V (unless otherwise noted); minimum and maximum values for $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$; typical values at $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
DIGITAL INPUT/OUTPUT (CMOS Logic Family)						
V _{IH}	High-level input voltage ⁽⁷⁾		0.65 DVDD		DVDD + 0.3	V
V _{IL}	Low-level input voltage ⁽⁷⁾		−0.3		0.35 DVDD	V
V _{OH}	High-level output voltage ⁽⁷⁾	At I _{source} = 500 μA	0.8 DVDD		DVDD	V
		At I _{source} = 2 mA	DVDD − 0.45		DVDD	
V _{OL}	Low-level output voltage ⁽⁷⁾	At I _{sink} = 500 μA	0		0.2 DVDD	V
		At I _{sink} = 2 mA	0		0.45	
POWER-SUPPLY REQUIREMENTS						
AVDD	Analog supply voltage		2.35	3	3.6	V
DVDD	Digital I/O supply voltage		1.65	3	3.6	V
I _{AVDD}	Analog supply current	AVDD = 3.3 V, f _{SAMPLE} = 2.5 MSPS		1100	1400	μA
		AVDD = 3.3 V, f _{SAMPLE} = 100 kSPS		47	56	
		AVDD = 3.3 V, f _{SAMPLE} = 10 kSPS		5		
		AVDD = 2.5 V, f _{SAMPLE} = 2.5 MSPS		820		
		Static current with $\overline{\text{CS}}$ and SCLK high		0.02		
I _{DVDD}	Digital supply current	DVDD = 1.8 V, CS _{DO} = 20 pF, output code = 2AAAh ⁽⁸⁾		630		μA
		DVDD = 1.8 V, static current with $\overline{\text{CS}}$ and SCLK high		0.01		

(7) Digital voltage levels comply with the JESD8-7A standard for DVDD from 1.65 V to 1.95 V; see the [Parameter Measurement Information](#) section for details.

(8) See the [Estimating Digital Power Consumption](#) section for details.

6.6 Timing Requirements

all specifications are at AVDD = 2.35 V to 3.6 V, DVDD = 1.65 V to 3.6 V, and C_{LOAD-SDO} = 20 pF (unless otherwise noted); minimum and maximum values for T_A = –40°C to +125°C; typical values at T_A = 25°C

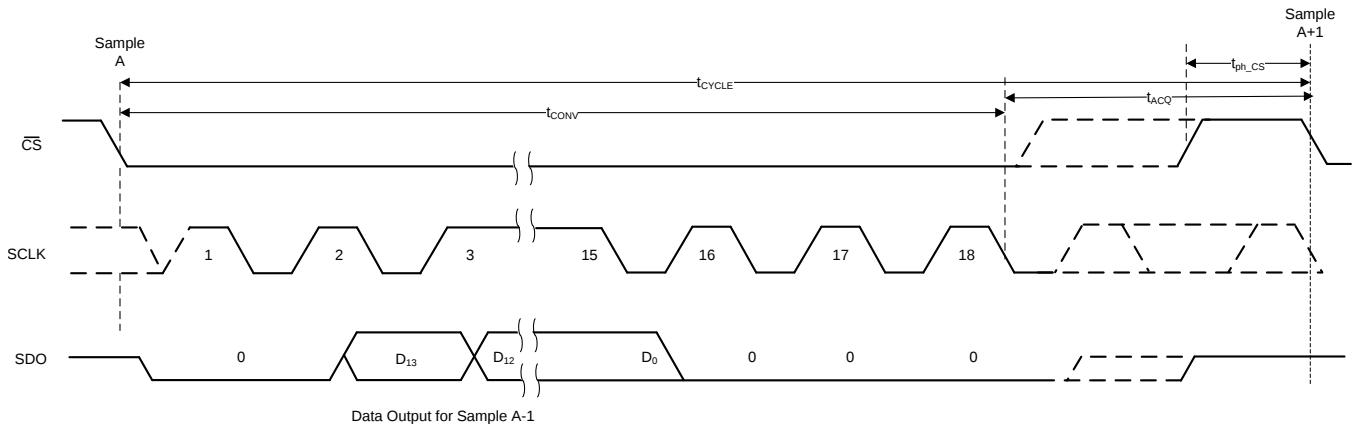
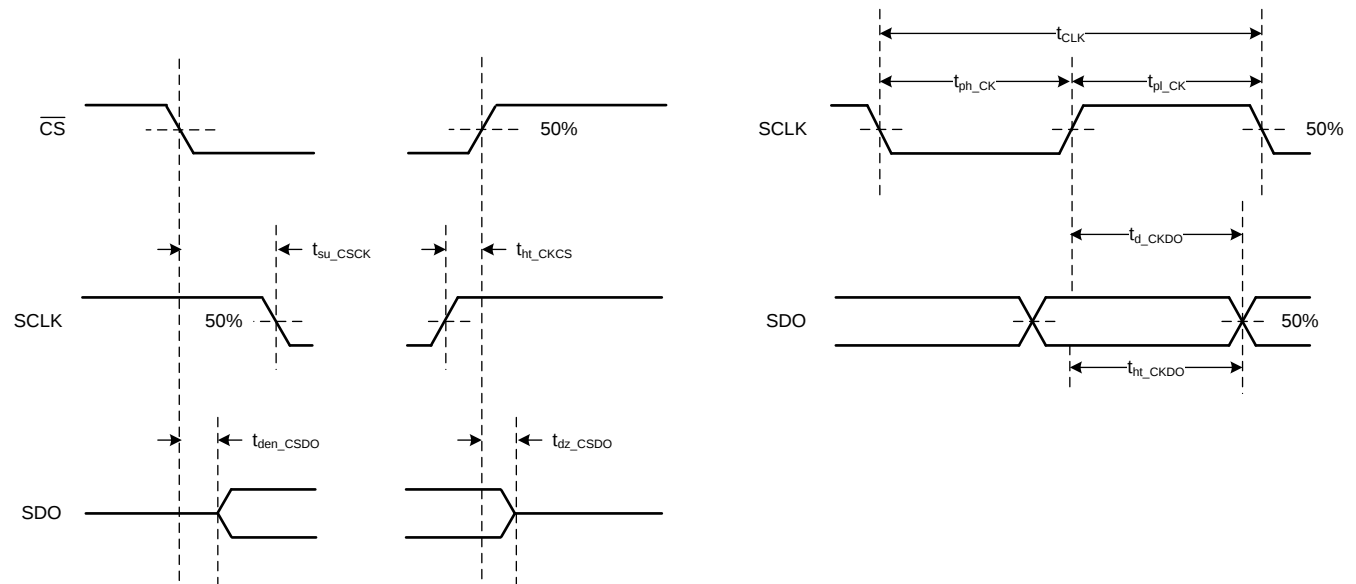
		MIN	TYP	MAX	UNIT
t _{CLK}	Time period of SCLK	16.66			ns
t _{SU_CSK}	Setup time: $\overline{CS}$ falling edge to SCLK falling edge	7			ns
t _{HT_CKCS}	Hold time: SCLK rising edge to $\overline{CS}$ rising edge	8			ns
t _{PH_CK}	SCLK high time	0.45		0.55	t _{SCLK}
t _{PL_CK}	SCLK low time	0.45		0.55	t _{SCLK}
t _{PH_CS}	$\overline{CS}$ high time	15			ns

6.7 Switching Characteristics

all specifications are at AVDD = 2.35 V to 3.6 V, DVDD = 1.65 V to 3.6 V, and C_{LOAD-SDO} = 20 pF (unless otherwise noted); minimum and maximum values for T_A = –40°C to +125°C; typical values at T_A = 25°C

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{CYCLE} ⁽¹⁾	Cycle time	400			ns
t _{CONV}	Conversion time		18 × t _{SCLK}		ns
t _{den_CSDO}	Delay time: $\overline{CS}$ falling edge to data enable			6.5	ns
t _{d_CKDO}	Delay time: SCLK rising edge to (next) data valid on SDO			10	ns
t _{ht_CKDO}	SCLK rising edge to current data invalid	2.5			ns
t _{dz_CSDO}	Delay time: $\overline{CS}$ rising edge to SDO going to tri-state	5.5			ns

(1) t_{CYCLE} = 1 / f_{SAMPLE}.


Figure 1. Serial Transfer Frame

Figure 2. Timing Specifications

6.8 Typical Characteristics

at $T_A = 25^\circ\text{C}$, $AVDD = 3.3\text{ V}$, $DVDD = 1.8\text{ V}$, $f_{IN} = 2\text{ kHz}$, and $f_{\text{sample}} = 2.5\text{ MSPS}$ (unless otherwise noted)

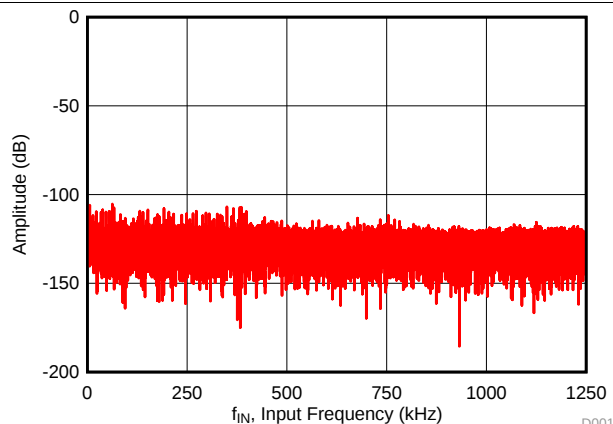


Figure 3. Typical FFT

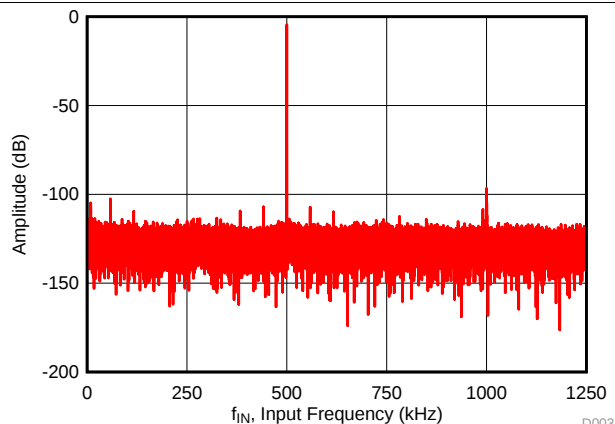


Figure 4. Typical FFT

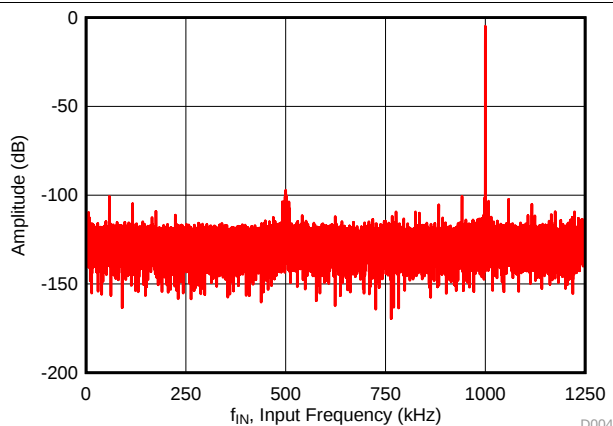


Figure 5. Typical FFT

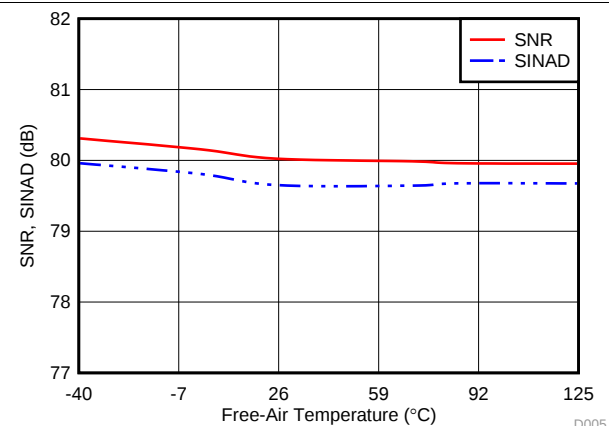


Figure 6. SNR and SINAD vs Temperature

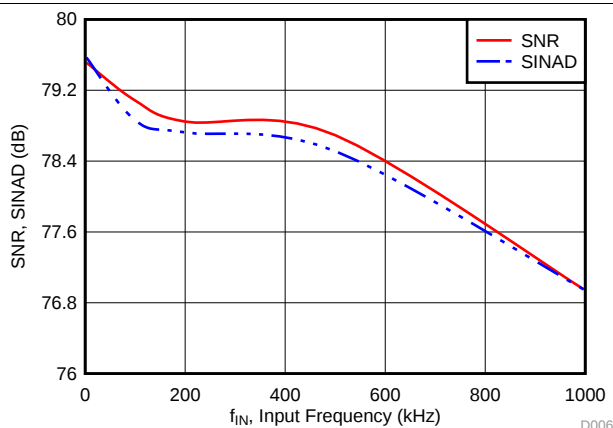


Figure 7. SNR and SINAD vs Input Frequency

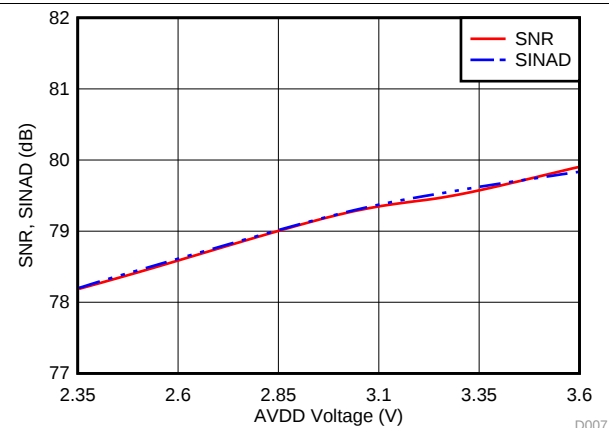


Figure 8. SNR and SINAD vs Reference Voltage (AVDD)

Typical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $AVDD = 3.3\text{ V}$, $DVDD = 1.8\text{ V}$, $f_{IN} = 2\text{ kHz}$, and $f_{sample} = 2.5\text{ MSPS}$ (unless otherwise noted)

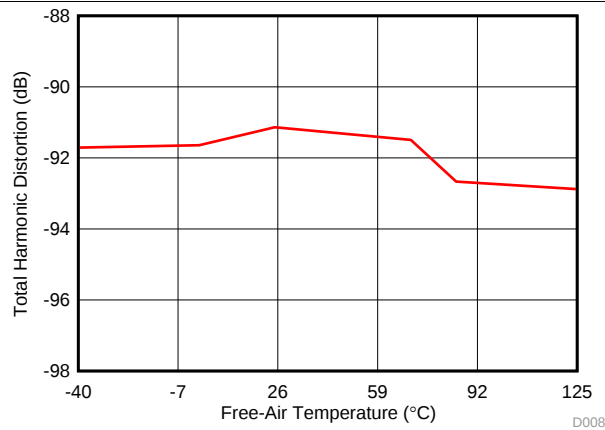


Figure 9. THD vs Temperature

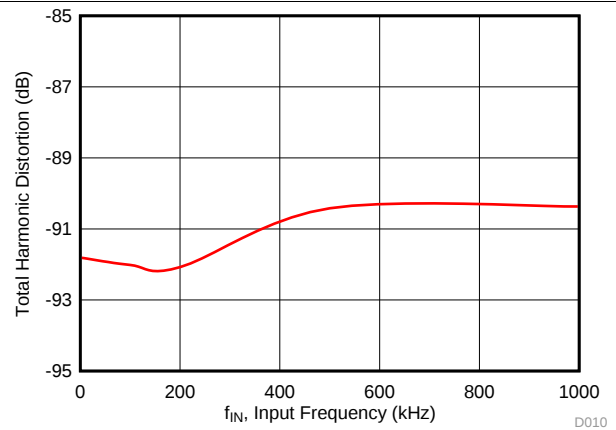


Figure 10. THD vs Input Frequency

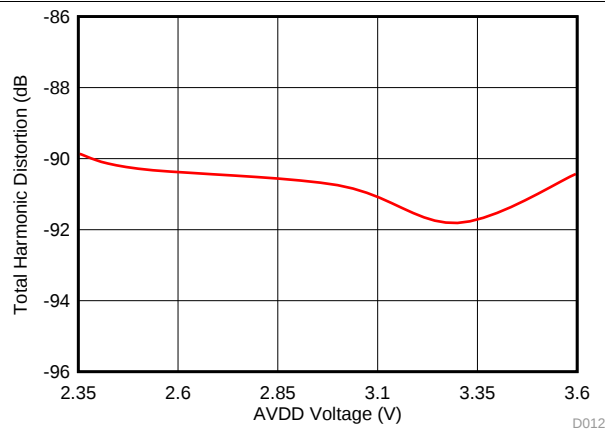


Figure 11. THD vs Reference Voltage (AVDD)

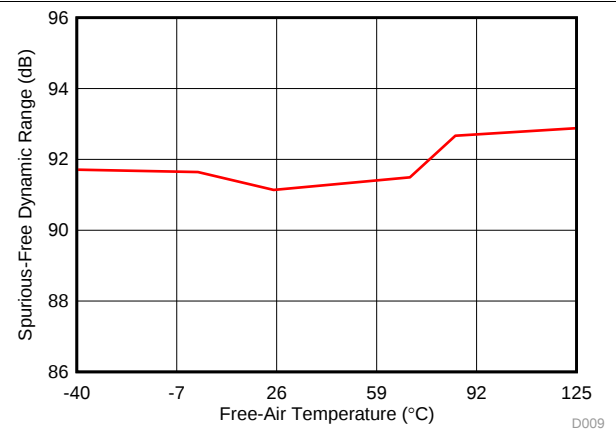


Figure 12. SFDR vs Temperature

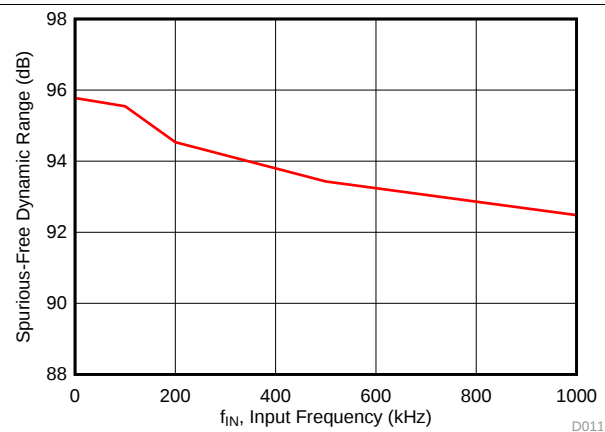


Figure 13. SFDR vs Input Frequency

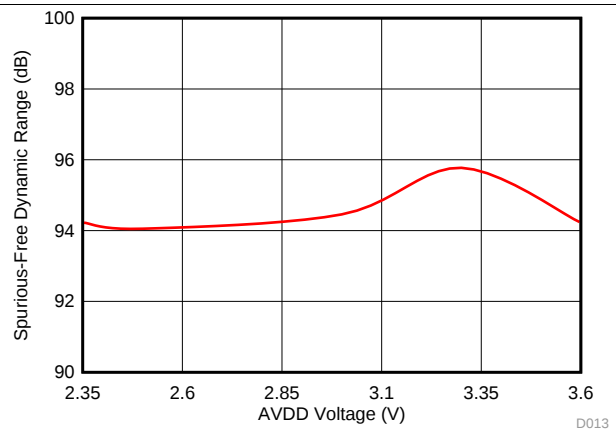


Figure 14. SFDR vs Reference Voltage (AVDD)

Typical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $AVDD = 3.3\text{ V}$, $DVDD = 1.8\text{ V}$, $f_{IN} = 2\text{ kHz}$, and $f_{sample} = 2.5\text{ MSPS}$ (unless otherwise noted)

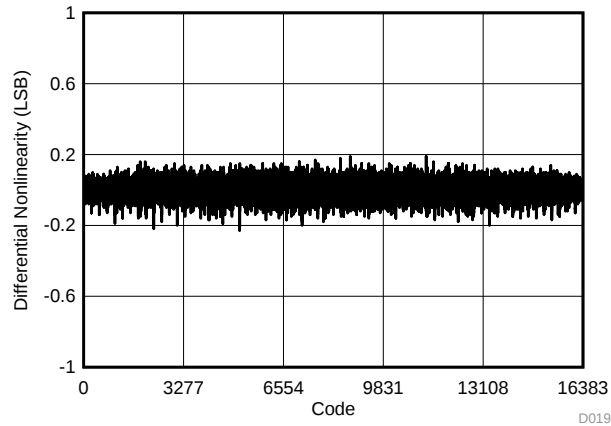


Figure 15. Typical DNL

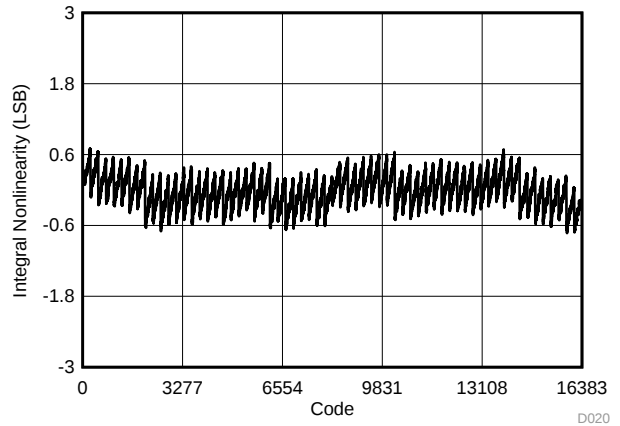


Figure 16. Typical INL

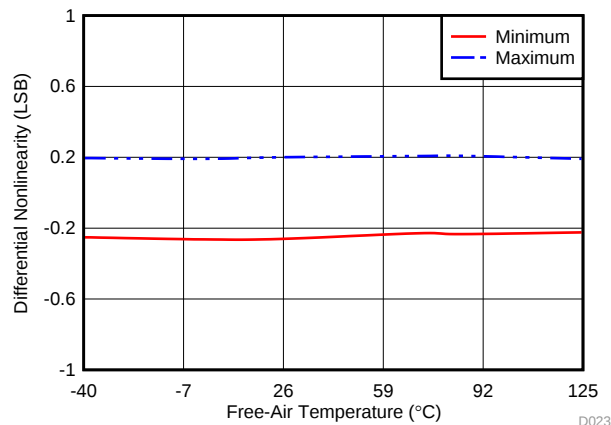


Figure 17. DNL vs Temperature

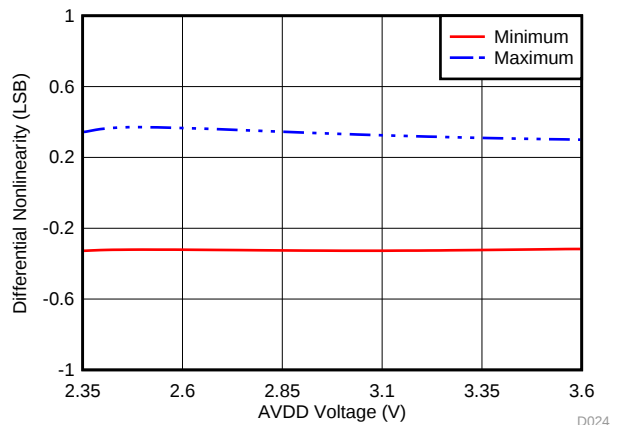


Figure 18. DNL vs Reference Voltage

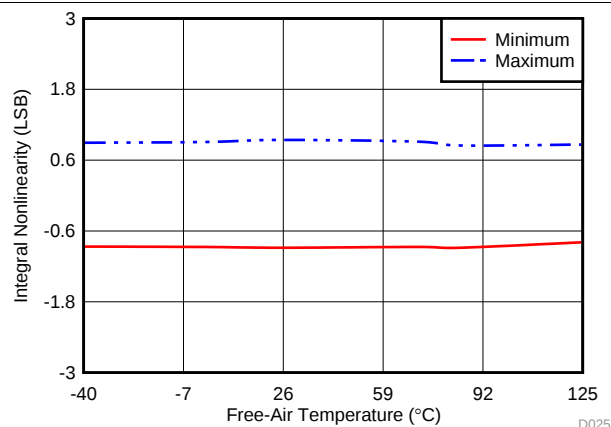


Figure 19. INL vs Temperature

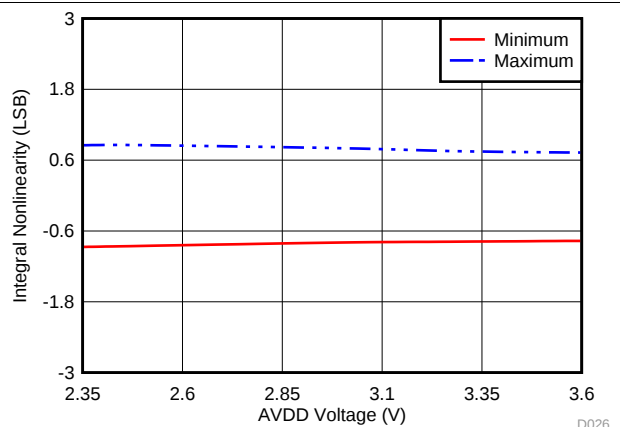


Figure 20. INL vs Reference Voltage

Typical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $AVDD = 3.3\text{ V}$, $DVDD = 1.8\text{ V}$, $f_{IN} = 2\text{ kHz}$, and $f_{sample} = 2.5\text{ MSPS}$ (unless otherwise noted)

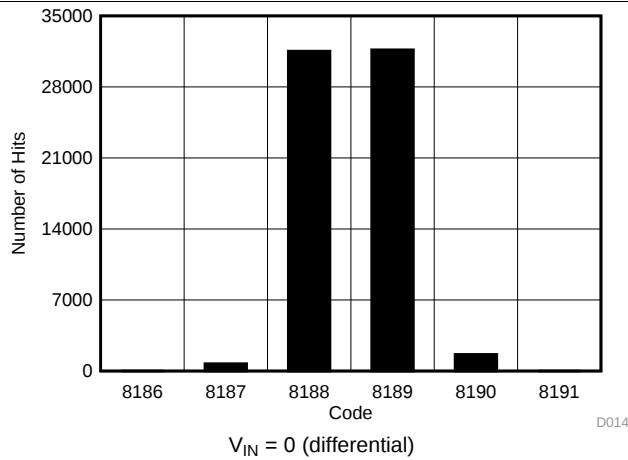


Figure 21. DC Input Histogram

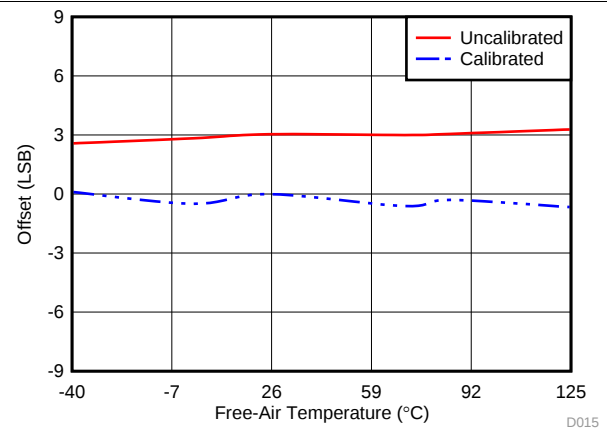


Figure 22. Offset vs Temperature

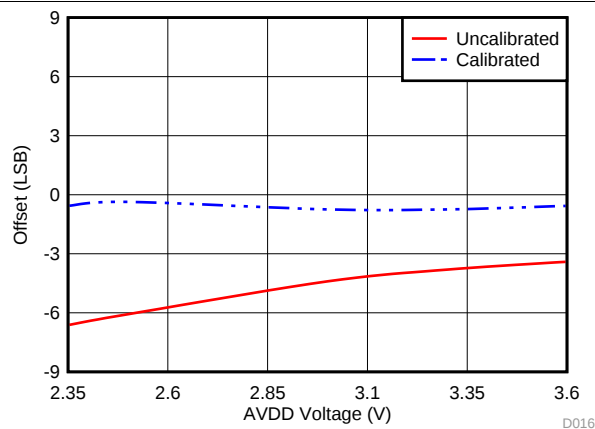


Figure 23. Offset vs Reference Voltage (AVDD)

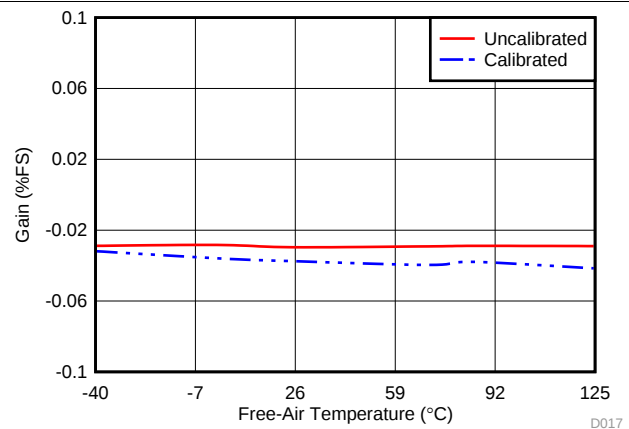


Figure 24. Gain Error vs Temperature

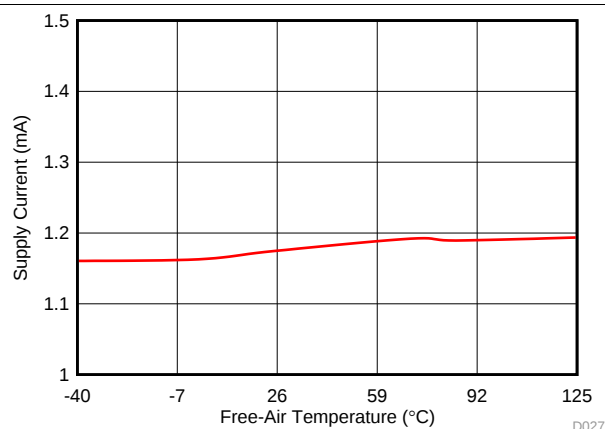


Figure 25. AVDD Current vs Temperature

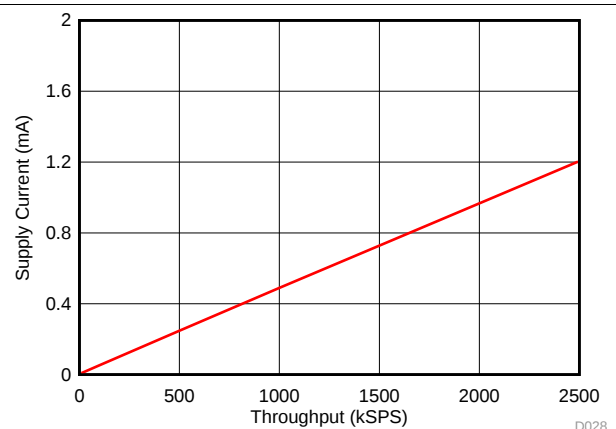


Figure 26. AVDD Current vs Throughput

Typical Characteristics (continued)

at $T_A = 25^\circ\text{C}$, $AVDD = 3.3\text{ V}$, $DVDD = 1.8\text{ V}$, $f_{IN} = 2\text{ kHz}$, and $f_{sample} = 2.5\text{ MSPS}$ (unless otherwise noted)

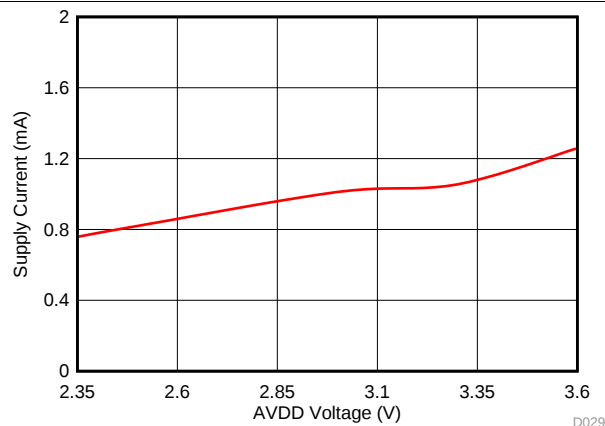


Figure 27. AVDD Current vs AVDD Voltage

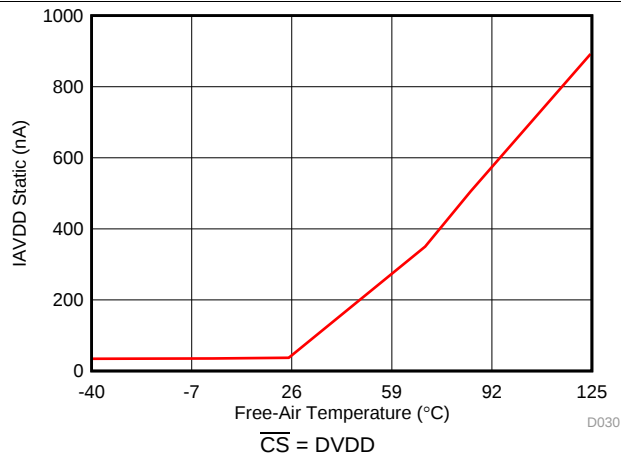


Figure 28. Static AVDD Current vs Temperature

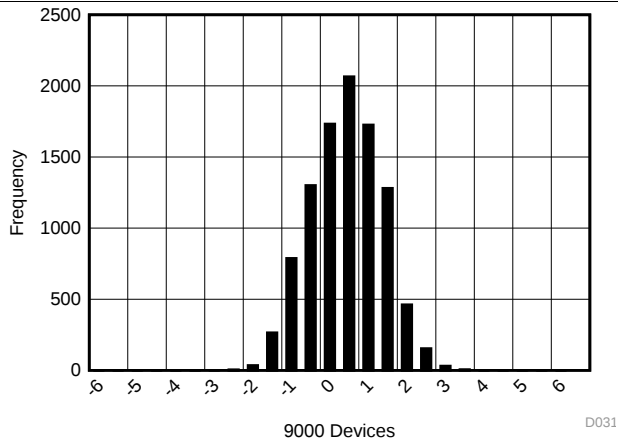


Figure 29. Typical Offset Error Distribution

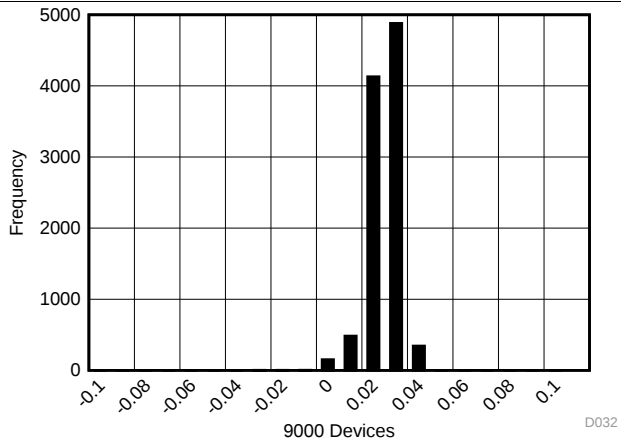


Figure 30. Typical Gain Error Distribution

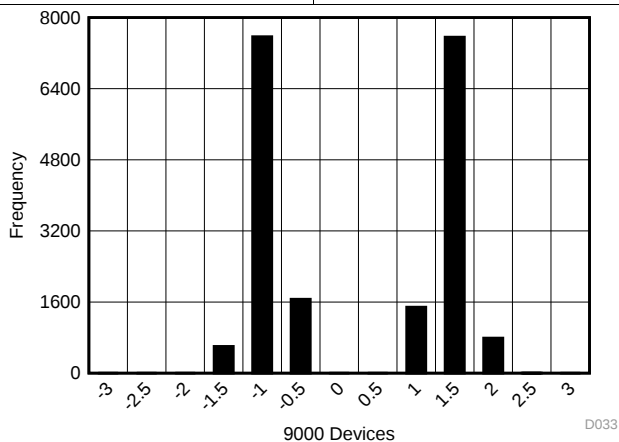


Figure 31. Typical INL Distribution

7 Parameter Measurement Information

7.1 Digital Voltage Levels

The device complies with the JESD8-7A standard for DVDD from 1.65 V to 1.95 V. [Figure 32](#) shows voltage levels for the digital input and output pins.

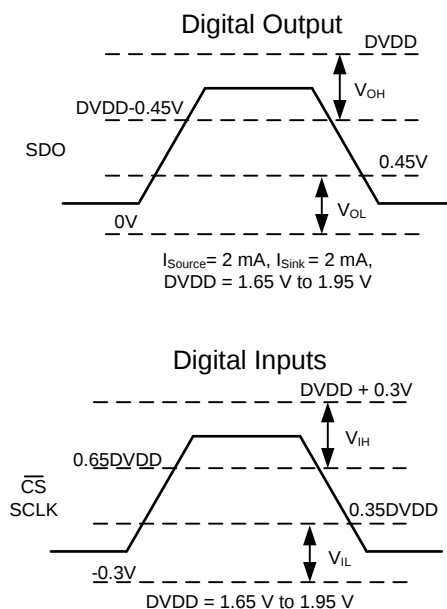


Figure 32. Digital Voltage Levels as per the JESD8-7A Standard

8 Detailed Description

8.1 Overview

The ADS7057 device belongs to a family of pin-to-pin compatible, high-speed, low-power, single-channel successive-approximation register (SAR) type analog-to-digital converters (ADCs). The device family includes multiple resolutions, throughputs, and analog input variants (see [Table 1](#) for a list of devices).

The ADS7057 is a 14-bit, 2.5-MSPS SAR ADC that supports fully-differential inputs in the range of $\pm AVDD$, for $AVDD$ in the range of 2.35 V to 3.6 V (see the [Analog Input](#) section for details on the analog input pins).

The internal offset calibration feature (see the [OFFCAL State](#) section) maintains excellent offset specifications over the entire $AVDD$ and temperature operating range.

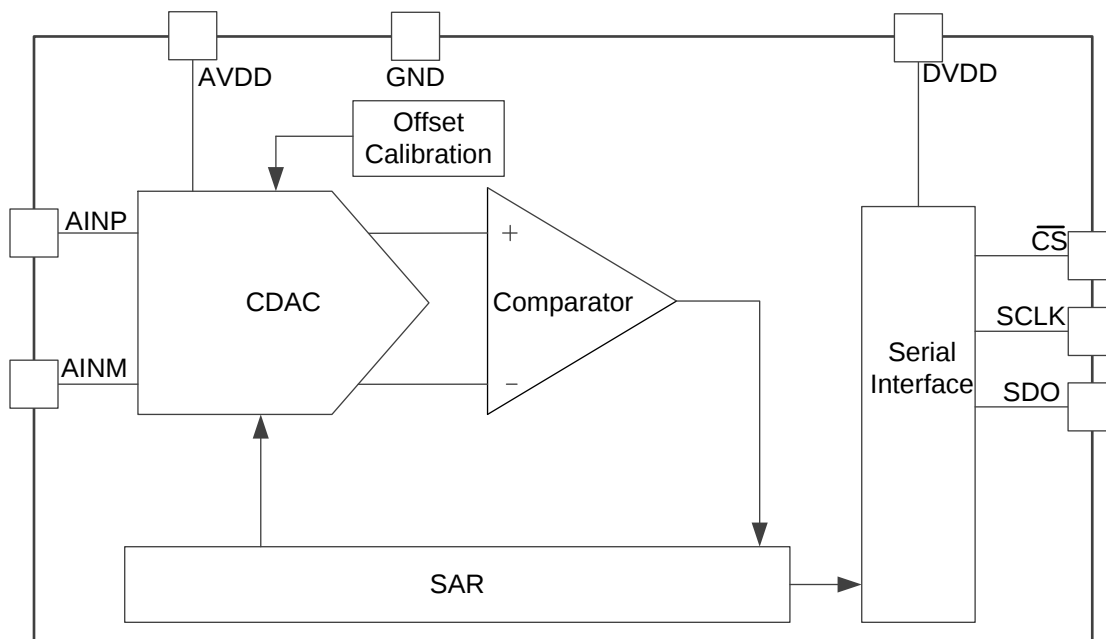
The device supports an SPI-compatible serial interface that is controlled by the $\overline{CS}$ and SCLK signals. The input signal is sampled with the $\overline{CS}$ falling edge and SCLK is used for both, conversion and serial data output (see the [Device Functional Modes](#) section, [Timing Requirements](#) table, and [Switching Characteristics](#) table).

The device supports a wide digital supply range (1.65 V to 3.6 V), enabling direct interfacing to a variety of host controllers. The ADS7057 complies with the JESD8-7A standard (see the [Digital Voltage Levels](#) section) for a normal DVDD range (1.65 V to 1.95 V).

The ADS7057 is available in an 8-pin, small, X2QFN package (see the [机械、封装和可订购信息](#) section for more details) and is specified over the extended industrial temperature range (-40°C to $+125^{\circ}\text{C}$).

The small form-factor and extremely-low power consumption make this device suitable for space-constrained and battery-powered applications that require high-speed, high-resolution data acquisition (see the [Application Information](#) section).

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Product Family

The devices listed in [Table 1](#) are all part of the same pin-to-pin compatible, high-speed, low-power, single-channel SAR ADC family. This device family includes multiple different ADC resolutions, throughputs, and analog input types to allow for greater flexibility in the end system. Devices in the same package are pin-compatible to offer a scalable family of devices for varying levels of end-system performance. The ADCs with device numbers ending in -Q1 are also AEC-Q100 qualified for automotive applications.

Table 1. Device Family Comparison

DEVICE NUMBER	RESOLUTION (Bits)	THROUGHPUT (MSPS)	INPUT TYPE	PACKAGES ⁽¹⁾
ADS7040	8	1	Single-ended	X2QFN (8): 1.5 mm × 1.5 mm VSSOP (8): 2.0 mm × 3.1 mm
ADS7041	10	1	Single-ended	X2QFN (8): 1.5 mm × 1.5 mm VSSOP (8): 2.0 mm × 3.1 mm
ADS7042	12	1	Single-ended	X2QFN (8): 1.5 mm × 1.5 mm VSSOP (8): 2.0 mm × 3.1 mm
ADS7043	12	1	Pseudo-differential	X2QFN (8): 1.5 mm × 1.5 mm VSSOP (8): 2.0 mm × 3.1 mm
ADS7044	12	1	Fully-differential	X2QFN (8): 1.5 mm × 1.5 mm VSSOP (8): 2.0 mm × 3.1 mm
ADS7029-Q1	8	2	Single-ended	VSSOP (8): 2.0 mm × 3.1 mm
ADS7039-Q1	10	2	Single-ended	VSSOP (8): 2.0 mm × 3.1 mm
ADS7049-Q1	12	2	Single-ended	VSSOP (8): 2.0 mm × 3.1 mm
ADS7046	12	3	Single-ended	X2QFN (8): 1.5 mm × 1.5 mm
ADS7047	12	3	Fully-differential	X2QFN (8): 1.5 mm × 1.5 mm
ADS7052	14	1	Single-ended	X2QFN (8): 1.5 mm × 1.5 mm
ADS7054	14	1	Fully-differential	X2QFN (8): 1.5 mm × 1.5 mm
ADS7056	14	2.5	Single-ended	X2QFN (8): 1.5 mm × 1.5 mm
ADS7057	14	2.5	Fully-differential	X2QFN (8): 1.5 mm × 1.5 mm

(1) Devices listed in the same package are pin-compatible.

8.3.2 Analog Input

The device supports a unipolar, fully-differential analog input signal. Figure 33 shows a small-signal equivalent circuit of the sample-and-hold circuit. The sampling switch is represented by a resistance (R_{S1} and R_{S2} , typically $50\ \Omega$) in series with an ideal switch (SW_1 and SW_2). The sampling capacitors, C_{S1} and C_{S2} , are typically $16\ \text{pF}$.

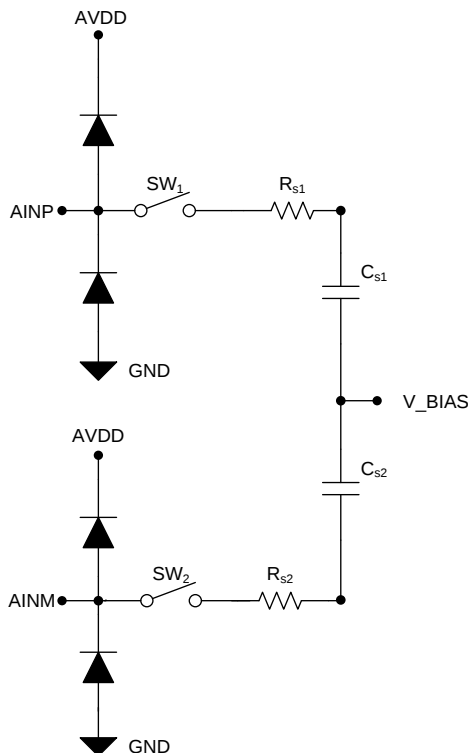


Figure 33. Equivalent Input Circuit for the Sampling Stage

During the acquisition process, both positive and negative inputs are individually sampled on C_{S1} and C_{S2} , respectively. During the conversion process, the device converts for the voltage difference between the two sampled values: $V_{AINP} - V_{AINM}$.

Each analog input pin has electrostatic discharge (ESD) protection diodes to AVDD and GND. Keep the analog inputs within the specified range to avoid turning the diodes on.

The full-scale analog input range (FSR) is $V_{FSR} = -AVDD$ to $AVDD$ and the common-mode input voltage is $AVDD / 2 \pm 0.1\ \text{V}$.

8.3.3 Reference

The device uses the analog supply voltage (AVDD) as the reference voltage for the analog to digital conversion. During the conversion process, the internal capacitors are switched to the AVDD pin as per the successive approximation algorithm. A voltage reference must be selected with low temperature drift, high output current drive and low output impedance. TI recommends a 3.3- μF (C_{AVDD}), low equivalent series resistance (ESR) ceramic capacitor between the AVDD and GND pins. This decoupling capacitor provides the instantaneous charge required by the internal circuit during the conversion process and maintains a stable dc voltage on the AVDD pin.

See the [Power Supply Recommendations](#) and [Layout Example](#) sections for component recommendations and layout guidelines.

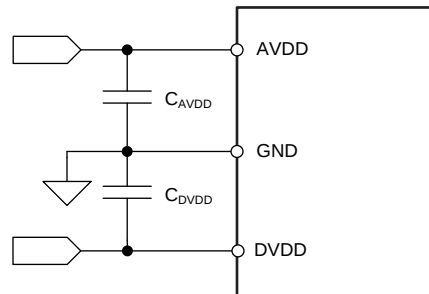


Figure 34. Reference for the Device

8.3.4 ADC Transfer Function

The device supports a unipolar fully-differential analog input signal. The output is in two's complement format. Figure 35 and Table 2 show the ideal transfer characteristics for the device.

The least significant bit for the device is given by:

$$1 \text{ LSB} = 2 \times V_{\text{REF}} / 2^N$$

where:

- V_{REF} = Voltage applied between the AVDD and GND pins
- $N = 14$

(1)

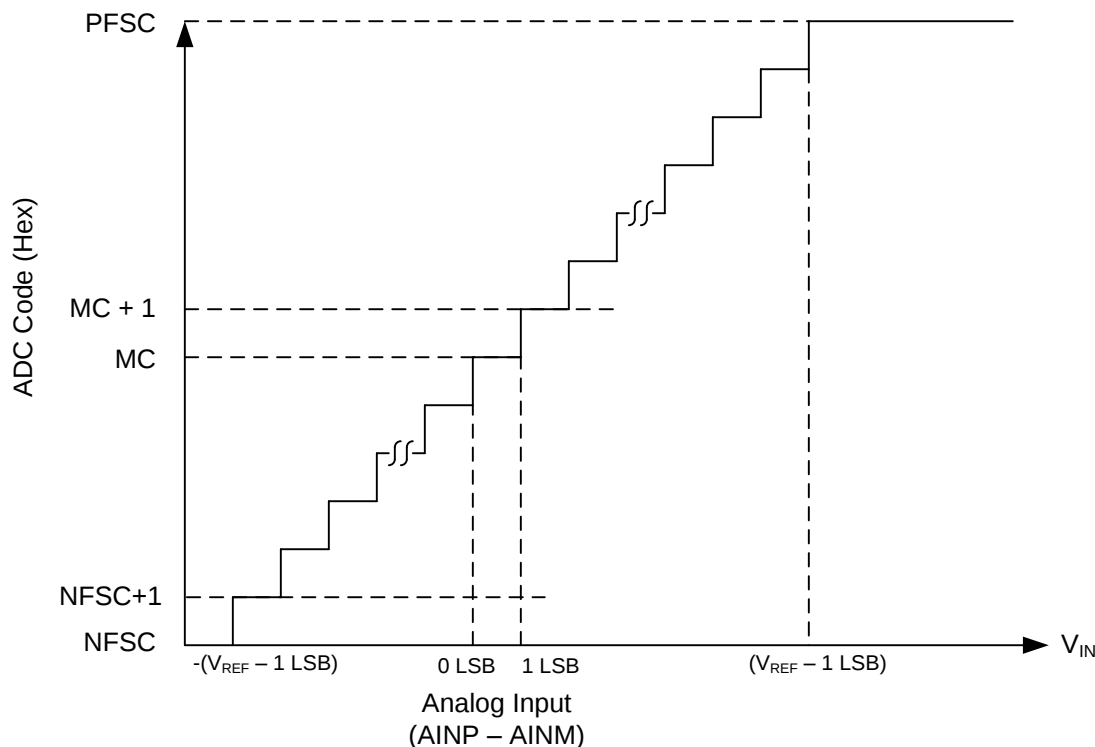


Figure 35. Ideal Transfer Characteristics

Table 2. Transfer Characteristics

INPUT VOLTAGE (AINP – AINM)	CODE	DESCRIPTION	IDEAL OUTPUT CODE (Hex)
$\leq -(V_{\text{REF}} - 1 \text{ LSB})$	NFSC	Negative full-scale code	2000
$-(V_{\text{REF}} - 1 \text{ LSB})$ to $-(V_{\text{REF}} - 2 \text{ LSB})$	NFSC + 1	—	2001
0 LSB to 1 LSB	MC	Mid code	0000
1 LSB to 2 LSB	MC + 1	—	0001
$\geq V_{\text{REF}} - 1 \text{ LSB}$	PFSC	Positive full-scale code	1FFF

8.4 Device Functional Modes

The device supports a simple, SPI-compatible interface to the external host. On power-up, the device is in the ACQ state. The $\overline{CS}$ signal defines one conversion and serial data transfer frame. A frame starts with a $\overline{CS}$ falling edge and ends with a $\overline{CS}$ rising edge. The SDO pin is tri-stated when $\overline{CS}$ is high. With $\overline{CS}$ low, the clock provided on the SCLK pin is used for conversion and data transfer. Output data are available on the SDO pin.

As shown in Figure 36, the device supports three functional states: acquisition (ACQ), conversion (CNV), and offset calibration (OFFCAL). The device status depends on the $\overline{CS}$ and SCLK signals provided by the host controller.

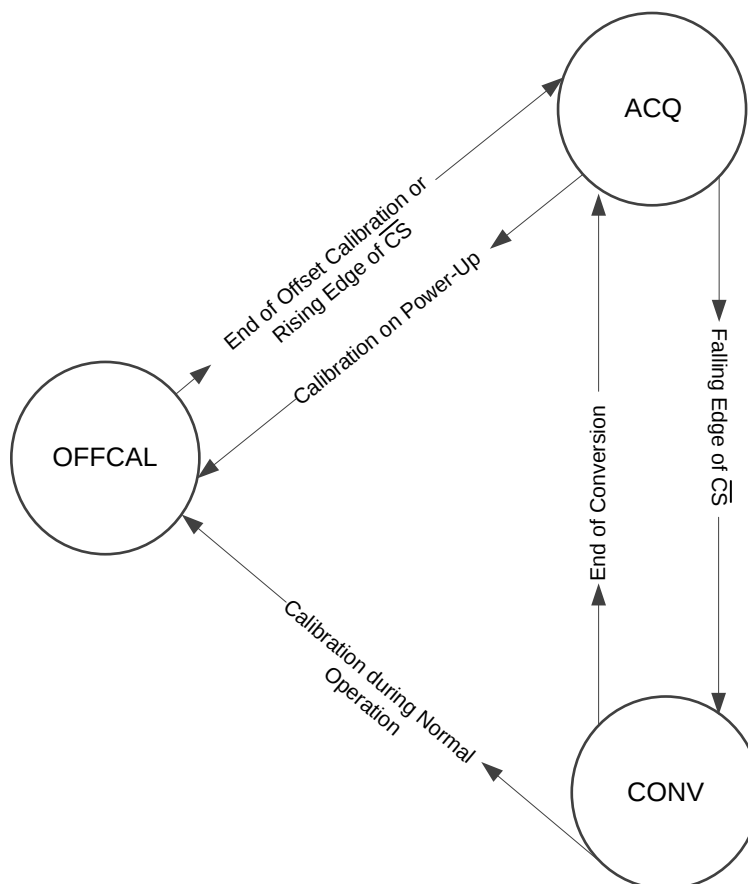


Figure 36. Functional State Diagram

8.4.1 ACQ State

In the ACQ state, switches SW_1 and SW_2 connected to the analog input pins close and the device acquires the analog input signal on C_{S1} and C_{S2} . The device enters ACQ state at power-up, at the end of every conversion, and after completing the offset calibration. A $\overline{CS}$ falling edge takes the device from the ACQ state to the CNV state.

The device consumes extremely low power from the AVDD and DVDD power supplies when in ACQ state.

Device Functional Modes (continued)

8.4.2 CNV State

In the CNV state, the device uses the external clock to convert the sampled analog input signal to an equivalent digital code as per the transfer function illustrated in [Figure 35](#). The conversion process requires a minimum of 18 SCLK falling edges to be provided within the frame. After the end of conversion process, the device automatically moves from the CNV state to the ACQ state. For acquisition of the next sample, a minimum time of t_{ACQ} must be provided.

[Figure 37](#) shows a detailed timing diagram for the serial interface. In the first serial transfer frame after power-up, the device provides the first data as all zeros. In any frame, the clocks provided on the SCLK pin are also used to transfer the output data for the previous conversion. A leading 0 is output on the SDO pin on the $\overline{CS}$ falling edge. The most significant bit (MSB) of the output data is launched on the SDO pin on the rising edge after the first SCLK falling edge. Subsequent output bits are launched on the subsequent rising edges provided on SCLK. When all 14 output bits are shifted out, the device outputs 0's on the subsequent SCLK rising edges. The device enters the ACQ state after 18 clocks and a minimum time of t_{ACQ} must be provided for acquiring the next sample. If the device is provided with less than 18 SCLK falling edges in the present serial transfer frame, the device provides an invalid conversion result in the next serial transfer frame.

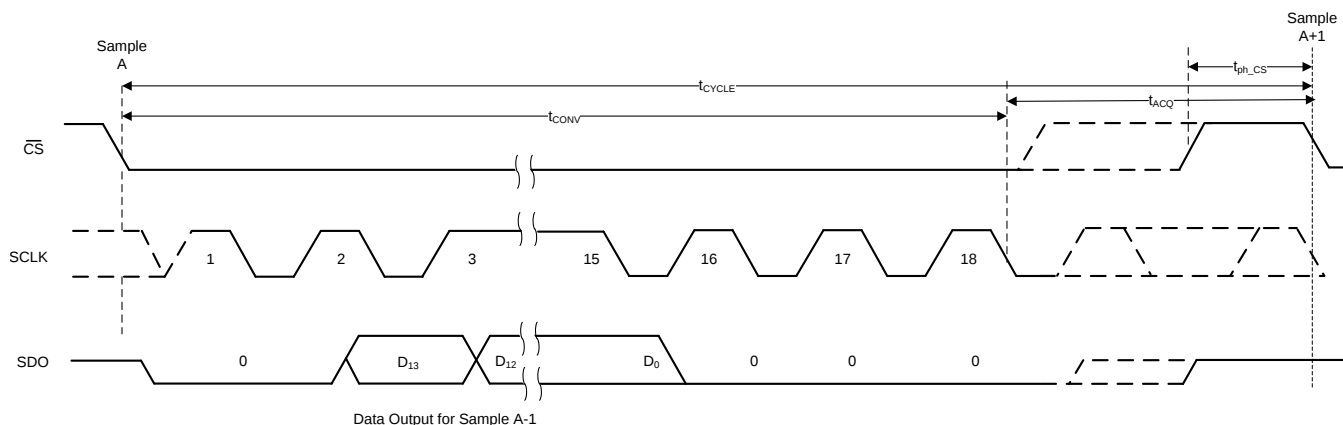


Figure 37. Serial Interface Timing Diagram

Device Functional Modes (continued)

8.4.3 OFFCAL State

In the offset calibration (OFFCAL) state, the sampling capacitors are disconnected from the analog input pins (AINP and AINM) and the device calibrates and corrects for any internal offset errors. The offset calibration is effective for all subsequent conversions until the device is powered off. An offset calibration cycle is recommended at power-up and whenever there is a significant change in the operating conditions for the device (such as in the AVDD voltage and operating temperature).

The host controller must provide a serial transfer frame as described in [Figure 38](#) or in [Figure 39](#) to enter the OFFCAL state.

8.4.3.1 Offset Calibration on Power-Up

On power-up, the host must provide 24 SCLKs in the first serial transfer to enter the OFFCAL state. The device provides 0's on SDO during offset calibration. For acquisition of the next sample, a minimum time of t_{ACQ} must be provided.

If the host controller starts the offset calibration process but then pulls the $\overline{CS}$ pin high before providing 24 SCLKs, then the offset calibration process is aborted and the device enters the ACQ state. [Figure 38](#) and [Table 3](#) provide the timing for offset calibration on power-up.

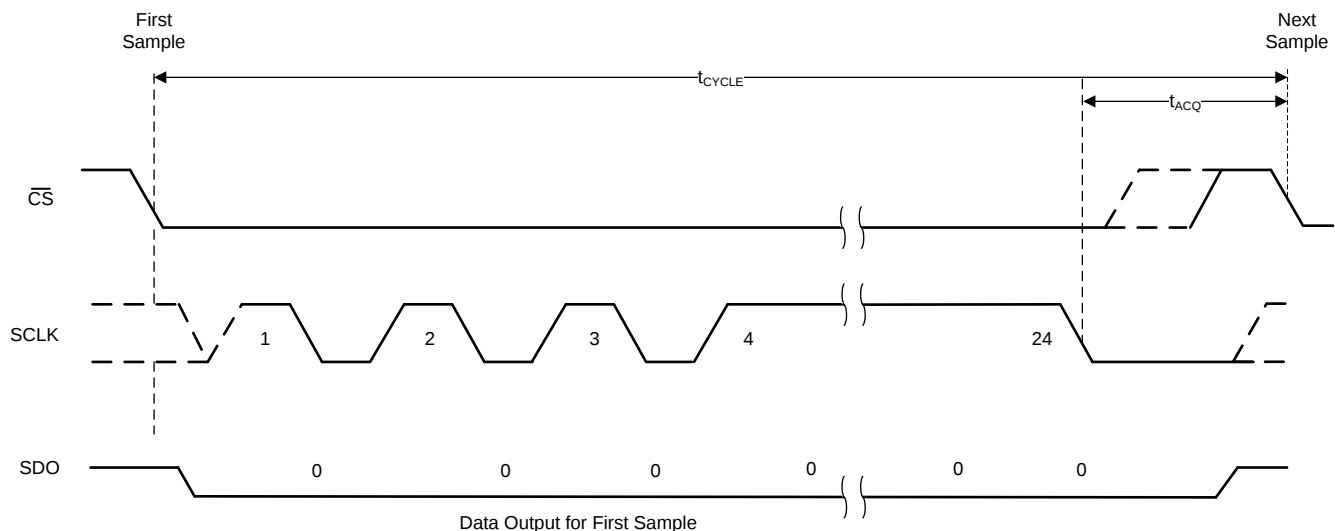


Figure 38. Timing for Offset Calibration on Power-Up

Table 3. Timing Specifications for Offset Calibration on Power-Up⁽¹⁾

		MIN	TYP	MAX	UNIT
t_{cycle}	Cycle time for offset calibration on power-up	$24 \times t_{CLK} + t_{ACQ}$			ns
t_{ACQ}	Acquisition time	95			ns
f_{SCLK}	Frequency of SCLK	60			MHz

(1) In addition to the timing specifications of [Figure 38](#) and [Table 3](#), the timing specifications described in [Figure 2](#) and the [Timing Requirements](#) table are also applicable for offset calibration on power-up.

8.4.3.2 Offset Calibration During Normal Operation

During normal operation, the host must provide 64 SCLKs in the serial transfer frame to enter the OFFCAL state. The device provides the conversion result for the previous sample during the first 18 SCLKs and 0's on SDO for the rest of the SCLKs in the serial transfer frame. For acquisition of the next sample, a minimum time of t_{ACQ} must be provided.

If the host controller provides more than 18 SCLKs but pulls the $\overline{CS}$ high before providing 64 SCLKs, then the offset calibration process is aborted and the device enters the ACQ state. Figure 39 and Table 4 provide the timing for offset calibration during normal operation.

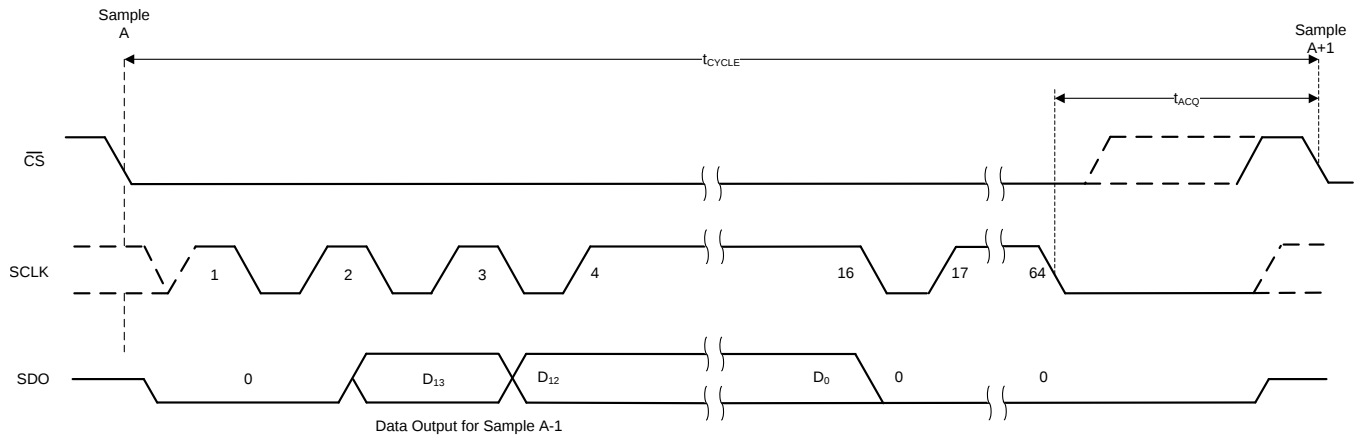


Figure 39. Timing for Offset Calibration During Normal Operation

Table 4. Timing Specifications for Offset Calibration During Normal Operation⁽¹⁾

		MIN	TYP	MAX	UNIT
t_{cycle}	Cycle time for offset calibration on power-up	$64 \times t_{CLK} + t_{ACQ}$			ns
t_{ACQ}	Acquisition time	95			ns
f_{SCLK}	Frequency of SCLK	60			MHz

- (1) In addition to the timing specifications of Figure 39 and Table 4, the timing specifications described in Figure 2 and the [Timing Requirements](#) table are also applicable for offset calibration during normal operation.

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The two primary supporting circuits required to maximize the performance of a high-precision, successive approximation register (SAR) analog-to-digital converter (ADC) are the input driver and the reference driver circuits. This section details some general principles for designing the input driver circuit, reference driver circuit, and provides typical application circuits designed for the device.

9.2 Typical Applications

9.2.1 2-Channel, Simultaneous Sampling Data Acquisition Using the ADS7057

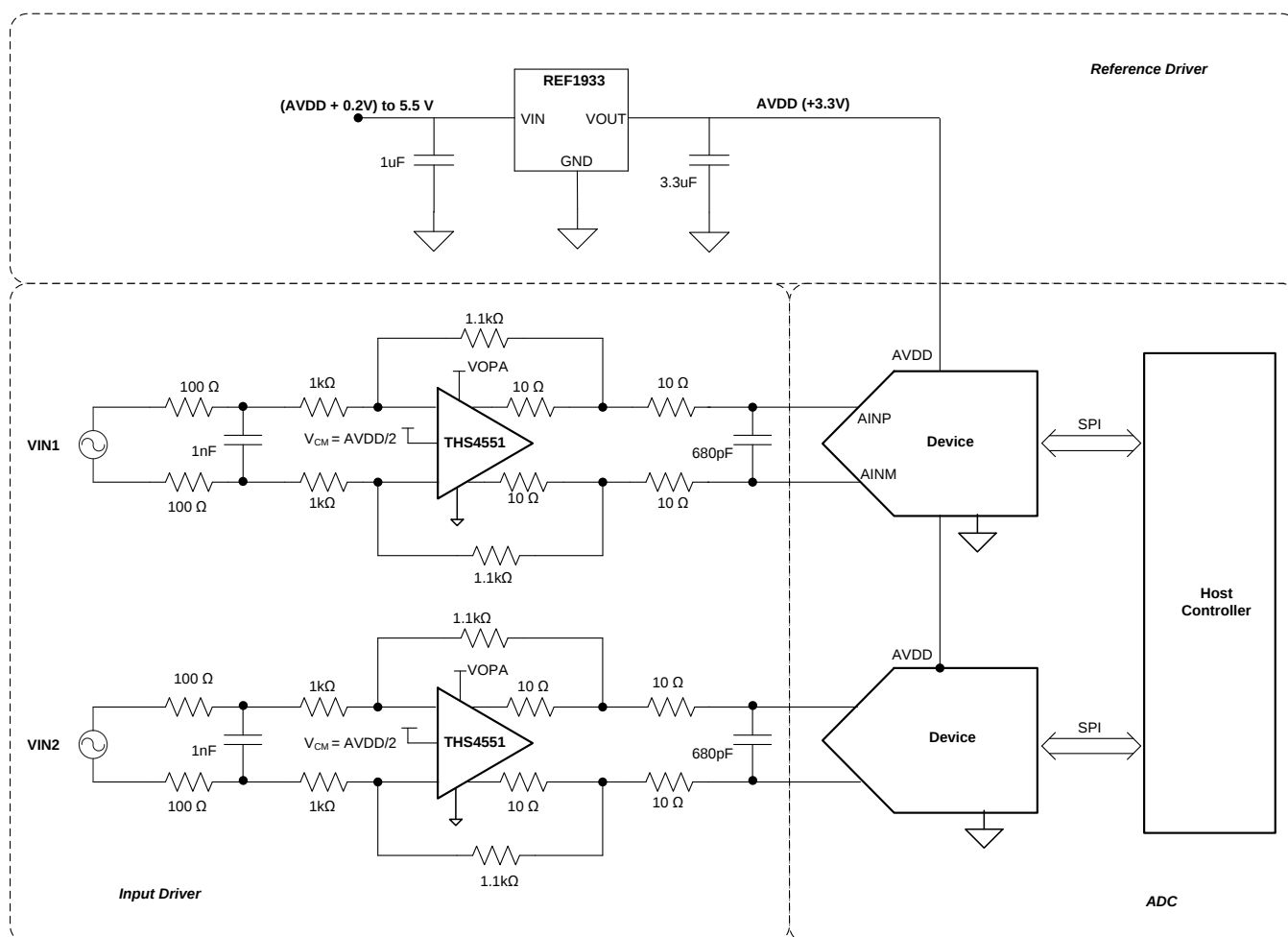


Figure 40. 2-Channel, Simultaneous-Sampling Data Acquisition (DAQ) Circuit Using the ADS7057

Typical Applications (continued)

9.2.1.1 Design Requirements

The goal of the circuit shown in Figure 40 is to design a two-channel, simultaneous-sampling data acquisition (DAQ) circuit based on the ADS7057 with an SNR greater than 79 dB and a THD less than –85 dB for input frequencies from 2 kHz to 50 kHz at a throughput of 2.5 MSPS. This simultaneous-sampling scheme is typically used in motor sine and cosine (sin-cos) encoders, resolvers, fish finders, sonar, and I-Q demodulation.

9.2.1.2 Detailed Design Procedure

The input driver circuit for a high-precision ADC mainly consists of two parts: a driving amplifier and charge kickback filter. Careful design of the front-end circuit is critical to meet the linearity and noise performance of a high-precision ADC.

9.2.1.2.1 Low Distortion Charge Kickback Filter Design

Figure 41 shows the input circuit of a typical SAR ADC. During the acquisition phase, the SW switch closes and connects the sampling capacitor (C_{SH}) to the input driver circuit. This action introduces a transient on the input pins of the SAR ADC. An ideal amplifier with 0 Ω of output impedance and infinite current drive can settle this transient in zero time. For a real amplifier with non-zero output impedance and finite drive strength, this switched capacitor load can create stability issues.

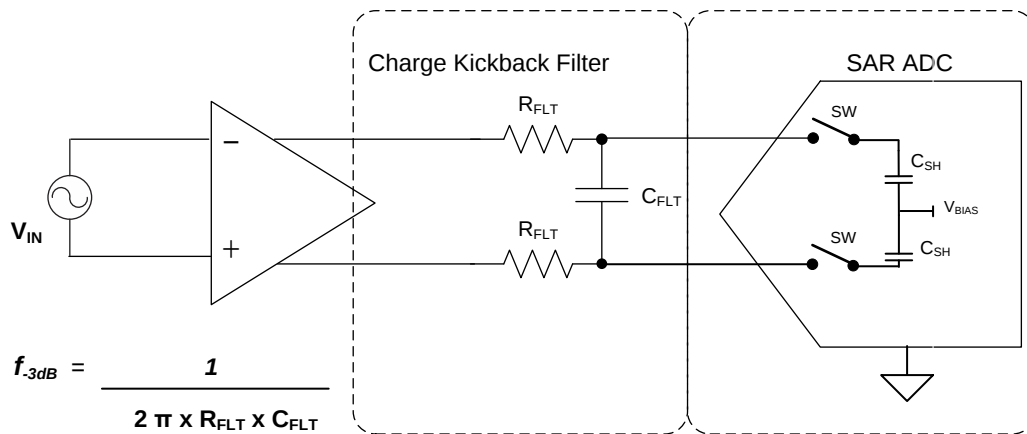


Figure 41. Input Sample-and-Hold Circuit for a Typical SAR ADC

For ac signals, the filter bandwidth must be kept low to band-limit the noise fed into the ADC input, thereby increasing the signal-to-noise ratio (SNR) of the system. Besides filtering the noise from the front-end drive circuitry, the RC filter also helps attenuate the sampling charge injection from the switched-capacitor input stage of the ADC. A filter capacitor, C_{FLT} , is connected across the ADC inputs. This capacitor helps reduce the sampling charge injection and provides a charge bucket to quickly charge the internal sample-and-hold capacitors during the acquisition process. As a rule of thumb, the value of this capacitor is at least 20 times the specified value of the ADC sampling capacitance. For this device, the input sampling capacitance is equal to 16 pF. Thus, the value of C_{FLT} is greater than 320 pF. Select a COG- or NPO-type capacitor because these capacitor types have a high-Q, low-temperature coefficient, and stable electrical characteristics under varying voltages, frequency, and time.

Driving capacitive loads can degrade the phase margin of the input amplifiers, thus making the amplifier marginally unstable. To avoid amplifier stability issues, series isolation resistors (R_{FLT}) are used at the output of the amplifiers. A higher value of R_{FLT} is helpful from the amplifier stability perspective, but adds distortion as a result of interactions with the nonlinear input impedance of the ADC. Distortion increases with source impedance, input signal frequency, and input signal amplitude. Therefore, the selection of R_{FLT} requires balancing the stability and distortion of the design.

Typical Applications (continued)

9.2.1.2.2 Input Amplifier Selection

The input amplifier bandwidth is typically much higher than the cutoff frequency of the charge kickback filter. Thus, TI strongly recommends performing a SPICE simulation to confirm that the amplifier has more than 40° phase margin with the selected filter. Simulation is critical because even with high-bandwidth amplifiers, some amplifiers can require more bandwidth than others to drive similar filters. To learn more about the SAR ADC input driver design, see the [TI Precision Labs training video series](#).

The [THS4551](#) is selected for its high bandwidth (135 MHz), low total harmonic distortion of –90 dBc at 100 kHz, and ultra-low noise of (3.2 nV/√Hz). The THS4551 is powered up from the power supply (VDD = 5 V and VSS = GND).

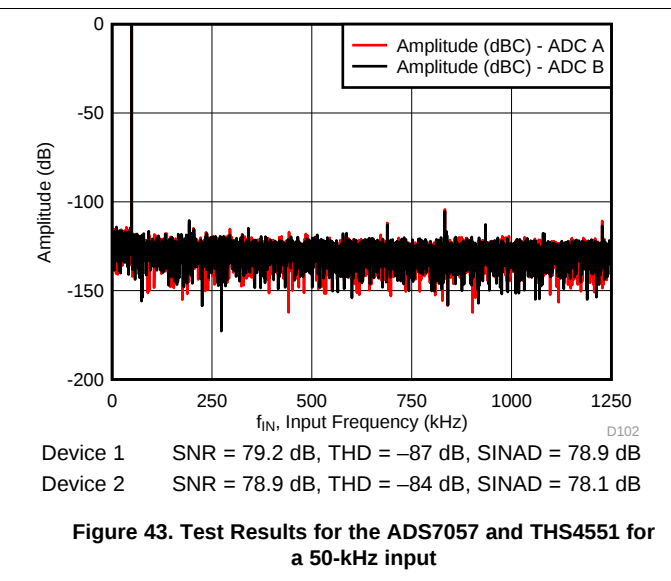
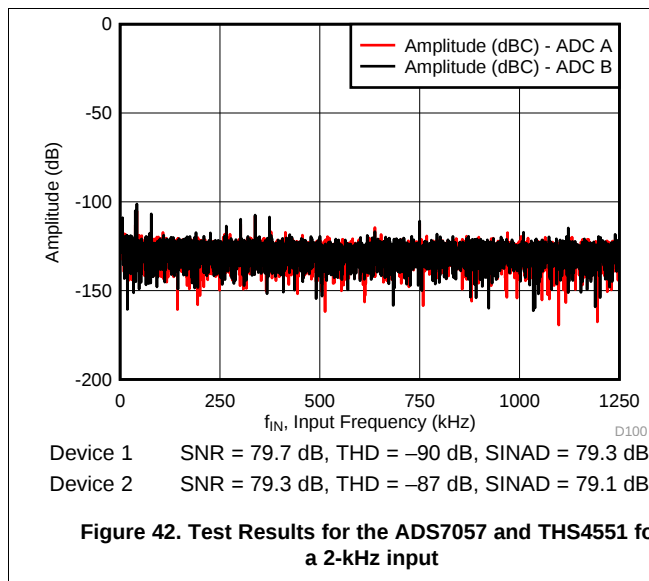
9.2.1.2.3 Reference Circuit

The ADS70xx uses the analog supply voltage (AVDD) as the reference voltage for the analog-to-digital conversion. During the conversion process, the internal capacitors are switched to the level of the AVDD pin as per the successive approximation algorithm. A voltage reference must be selected with low temperature drift, high output current drive, and low output impedance. For this application, the [REF1933](#) was selected as the voltage reference and analog power supply for the ADC. The [REF1933](#) has excellent temperature drift performance (25 ppm/°C), good initial accuracy (0.1%), high output drive capability (25 mA), and low quiescent current (360 µA). The [REF1933](#) also provides a bias voltage output of half the reference voltage ($V_{REF} / 2$) that can be used as the common-mode input for the amplifier.

TI recommends a 3.3-µF (C_{AVDD}), low equivalent series resistance (ESR) ceramic capacitor between the AVDD and GND pins. This decoupling capacitor provides the instantaneous charge required by the internal circuit during the conversion process and maintains a stable dc voltage on the AVDD pin.

9.2.1.3 Application Curves

[Figure 42](#) and [Figure 43](#) provide the measurement results for the circuit described in [Figure 40](#).



Typical Applications (continued)

9.2.2 Improving Precision of Single-Ended Signal Source Measurements Using the ADS7057

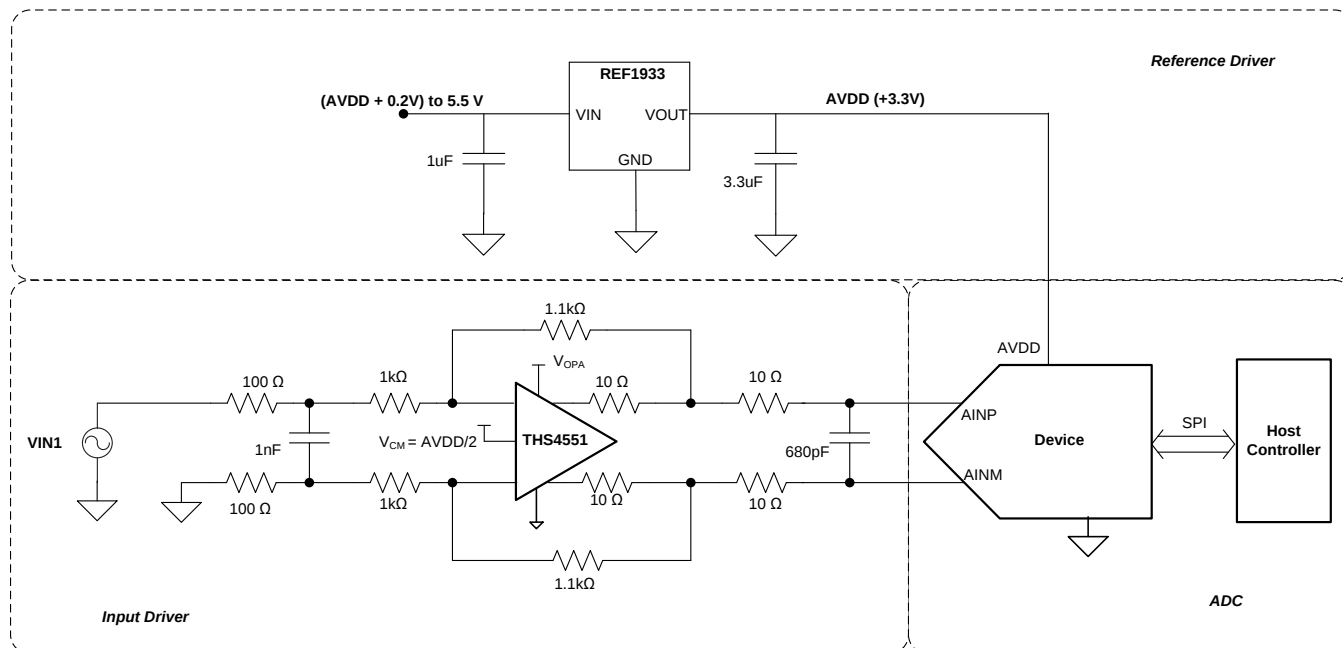


Figure 44. Interfacing Single-Ended Signals with the ADS7057 Using a Single-Ended to Differential Front-End

9.2.2.1 Design Requirements

Some applications have sensor or signal inputs that are single ended. In order to increase the dynamic range, linearity, and precision of the system, such single-ended signals are often required to be interfaced with a differential input ADC. The goal of the design shown in Figure 44 is to interface a single-ended input source with the ADS7057 using a single-ended to differential front-end amplifier to achieve an SNR greater than 79 dB and a THD less than –85 dB for input frequencies up to 10 kHz at a throughput of 2.5 MSPS.

9.2.2.2 Detailed Design Procedure

To achieve a SNR greater than 79 dB, the operational amplifier must have high bandwidth in order to settle the input signal within the acquisition time of the ADC. The operational amplifier must have low noise to keep the total system noise below 20% of the input-referred noise of the ADC. For the application circuit shown in Figure 44, the THS4551 is selected for its high bandwidth (135 MHz), low total harmonic distortion of –90 dBc at 100 kHz, and ultra-low noise of (3.2 nV/√Hz). The THS4551 is powered up from the power supply (VDD = 5 V and VSS = GND).

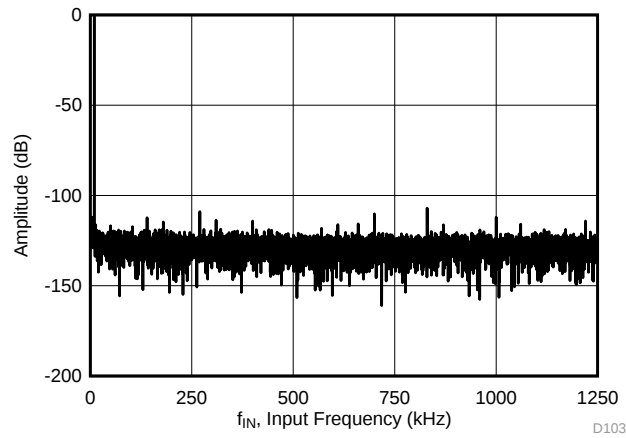
The THS4551 can be used in a single-ended to differential configuration as shown in Figure 44 without any performance degradation. This configuration enables single-ended input signals to be interfaced with differential input SAR ADCs (such as the ADS7057) to achieve higher system-level precision.

For this application, the REF1933 was selected as the voltage reference and analog power supply for the ADC. The REF1933 has excellent temperature drift performance (25 ppm/°C), good initial accuracy (0.1%), high output drive capability (25 mA), and low quiescent current (360 μA). The REF1933 also provides a bias voltage output of half the reference voltage ($V_{REF} / 2$) that can be used as the common-mode input for the amplifier.

Typical Applications (continued)

9.2.2.3 Application Curve

Figure 45 shows the FFT plot for the ADS7057 with a 2-kHz, single-ended input signal used for the circuit in Figure 44.



SNR = 79.9 dB, THD = -90 dB, SINAD = 79.4 dB

Figure 45. Test Results for the ADS7057 With a 2-kHz, Single-Ended Input

10 Power Supply Recommendations

10.1 AVDD and DVDD Supply Recommendations

The device has two separate power supplies: AVDD and DVDD.

AVDD powers the analog blocks and is also used as the reference voltage for the analog-to-digital conversion. Use a low-noise, low-dropout regulator (LDO) or a discrete reference to supply AVDD (see the [Reference](#) and [Application Information](#) sections). Always set the AVDD supply to be greater than or equal to the maximum input signal to avoid code saturation. Decouple the AVDD pin to the GND pin with a 3.3-μF ceramic decoupling capacitor.

DVDD is used for the interface circuits. Decouple the DVDD pin to the GND pin with a 1-μF ceramic decoupling capacitor. 图 46 shows the decoupling recommendations.

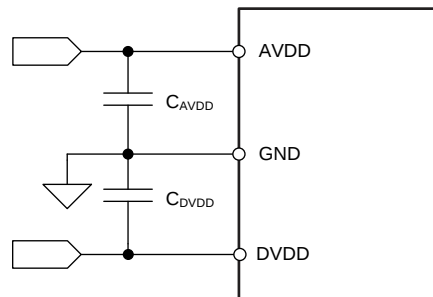


图 46. Power-Supply Decoupling

10.2 Optimizing Power Consumed by the Device

In order to best optimize the power consumed by the device, use the following design considerations:

- Keep the analog supply voltage (AVDD) in the specified operating range and equal to the maximum analog input voltage.
- Keep the digital supply voltage (DVDD) in the specified operating range and at the lowest value supported by the host controller.
- Reduce the load capacitance on the SDO output.
- Run the device at the optimum throughput. Power consumption reduces proportionally with the throughput.

10.2.1 Estimating Digital Power Consumption

The current consumption from the DVDD supply depends on the DVDD voltage, the load capacitance on the SDO pin ($C_{\text{LOAD-SDO}}$), and the output code, and can be calculated as:

$$I_{\text{DVDD}} = C_{\text{LOAD-SDO}} \times V \times f$$

where:

- $C_{\text{LOAD-SDO}}$ = Load capacitance on the SDO pin
 - V = DVDD supply voltage
 - f = Frequency of transitions on the SDO output
- (2)

The number of transitions on the SDO output depends on the output code, and thus changes with the analog input. The maximum value of f occurs when data output on the SDO change on every SCLK (that is, for output codes of 2AAAh or 1555h). With an output code of 2AAAh or 1555h, $f = 17.5$ MHz and when $C_{\text{LOAD-SDO}} = 20$ pF and DVDD = 1.8 V, $I_{\text{DVDD}} = 630$ μA.

11 Layout

11.1 Layout Guidelines

图 47 shows a typical connection diagram for the ADS7057.

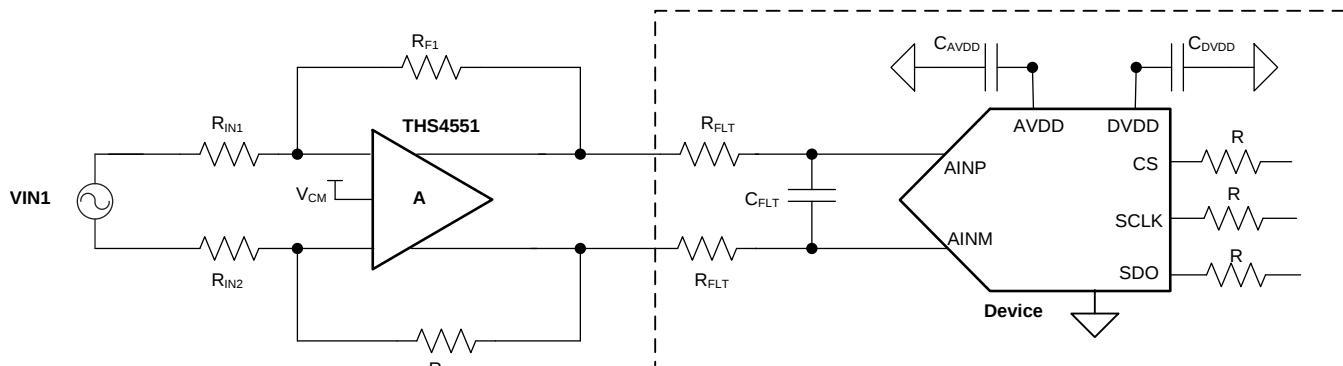


图 47. Typical Connection Diagram

图 48 depicts a board layout example for the device for the typical connection diagram in 图 47. The key considerations for layout are:

- Use a solid ground plane underneath the device and partition the PCB into analog and digital sections
- Avoid crossing digital lines with the analog signal path and keep the analog input signals and the reference input signals away from noise sources.
- The power sources to the device must be clean and well-bypassed. Use C_{AVDD} decoupling capacitors in close proximity to the analog (AVDD) power-supply pin.
- Use a C_{DVDD} decoupling capacitor close to the digital (DVDD) power-supply pin.
- Avoid placing vias between the AVDD and DVDD pins and the bypass capacitors.
- Connect the ground pin to the ground plane using a short, low-impedance path.
- Place the charge kickback filter components close to the device.

Among ceramic surface-mount capacitors, COG (NPO) ceramic capacitors are recommended because these components provide the most stable electrical properties over voltage, frequency, and temperature changes.

11.2 Layout Example

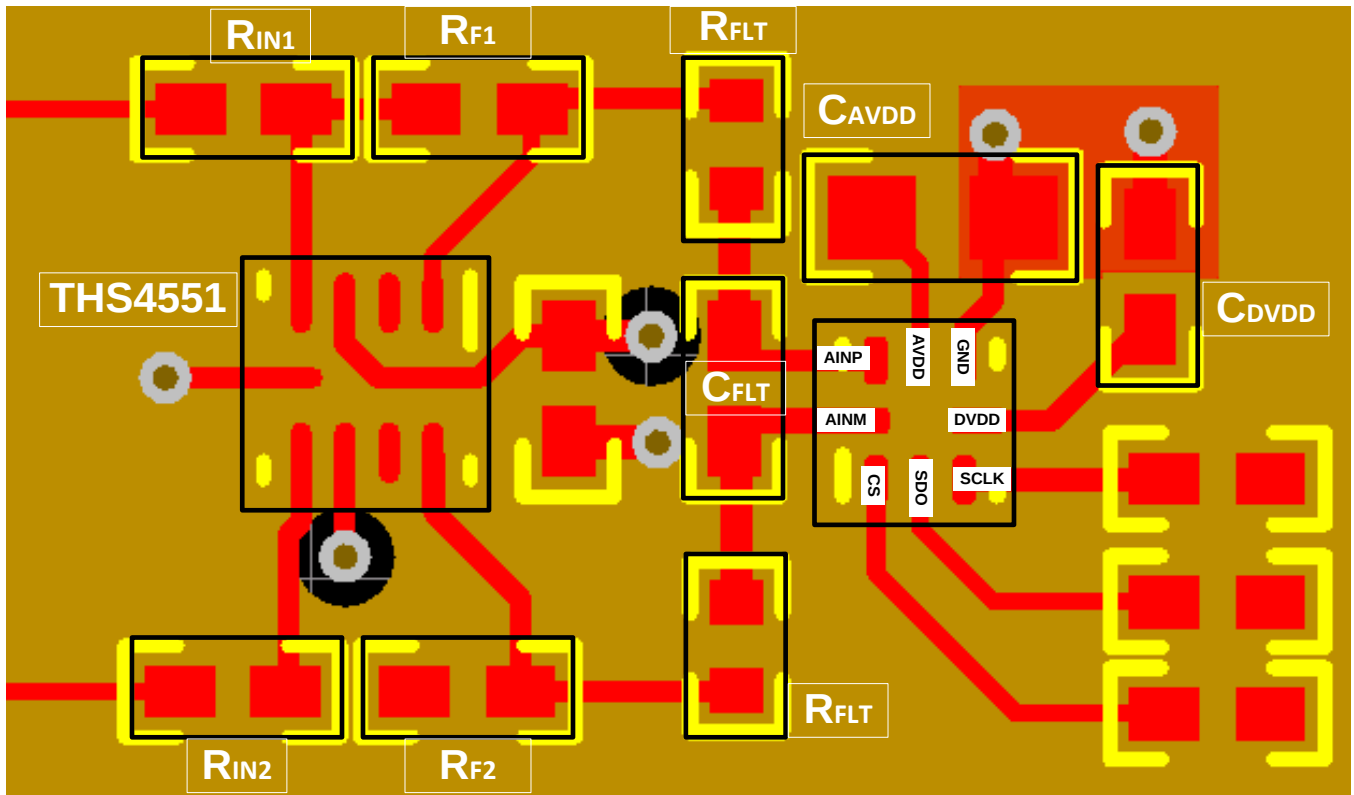


图 48. Example Layout

12 器件和文档支持

12.1 器件支持

12.1.1 开发支持

[TI 高精度实验室培训视频系列](#)

12.2 文档支持

12.2.1 相关文档

请参阅如下相关文档：

输入驱动器放大器（单端输入）：

- [《OPAx836 极低功耗、轨至轨输出、负轨输入、电压反馈运算放大器》](#)
- [THS403x 100MHz 低噪声高速放大器](#)
- [《OPAx365 50MHz、零交叉、低失真、高 CMRR、RRI/O、单电源运算放大器》](#)

输入驱动器放大器（全差分输入）：

- [THS4551 低噪声 150MHz 全差分精密放大器](#)
- [《OPAx836 极低功耗、轨至轨输出、负轨输入、电压反馈运算放大器》](#)

基准驱动器：

- [《REF19xx 低漂移、低功率、双路输出、 \$V_{REF}\$ 和 \$V_{REF}/2\$ 电压基准》](#)
- [《具有集成 ADC 驱动器缓冲器的 REF61xx 高精度电压基准》](#)

类似器件：

- [《ADS7042 超低功耗、超小尺寸、12 位、1MSPS、SAR ADC》](#)
- [《ADS7049-Q1 小型低功耗 12 位、2MSPS SAR ADC》](#)

参考设计：

- [TI 设计：采用 73dB SNR、7.5MSPS 时间交织 SAR ADC 且适用于成像应用的模拟前端参考设计](#)
- [针对双极信号采用运算放大器和 FDA 的单端到差分](#)

12.3 接收文档更新通知

要接收文档更新通知，请导航至 TI.com 上的器件产品文件夹。单击右上角的 [通知我](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

12.4 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [《使用条款》](#)。

TI E2E™ 在线社区 [TI 的工程师对工程师 \(E2E\) 社区](#)。此社区的创建目的在于促进工程师之间的协作。在 e2e.ti.com 中，您可以咨询问题、分享知识、拓展思路并与同行工程师一道帮助解决问题。

设计支持 [TI 参考设计支持](#) 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

12.5 商标

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

12.6 静电放电警告



ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

12.7 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知和修订此文档。如欲获取此产品说明书的浏览器版本，请参阅左侧的导航。

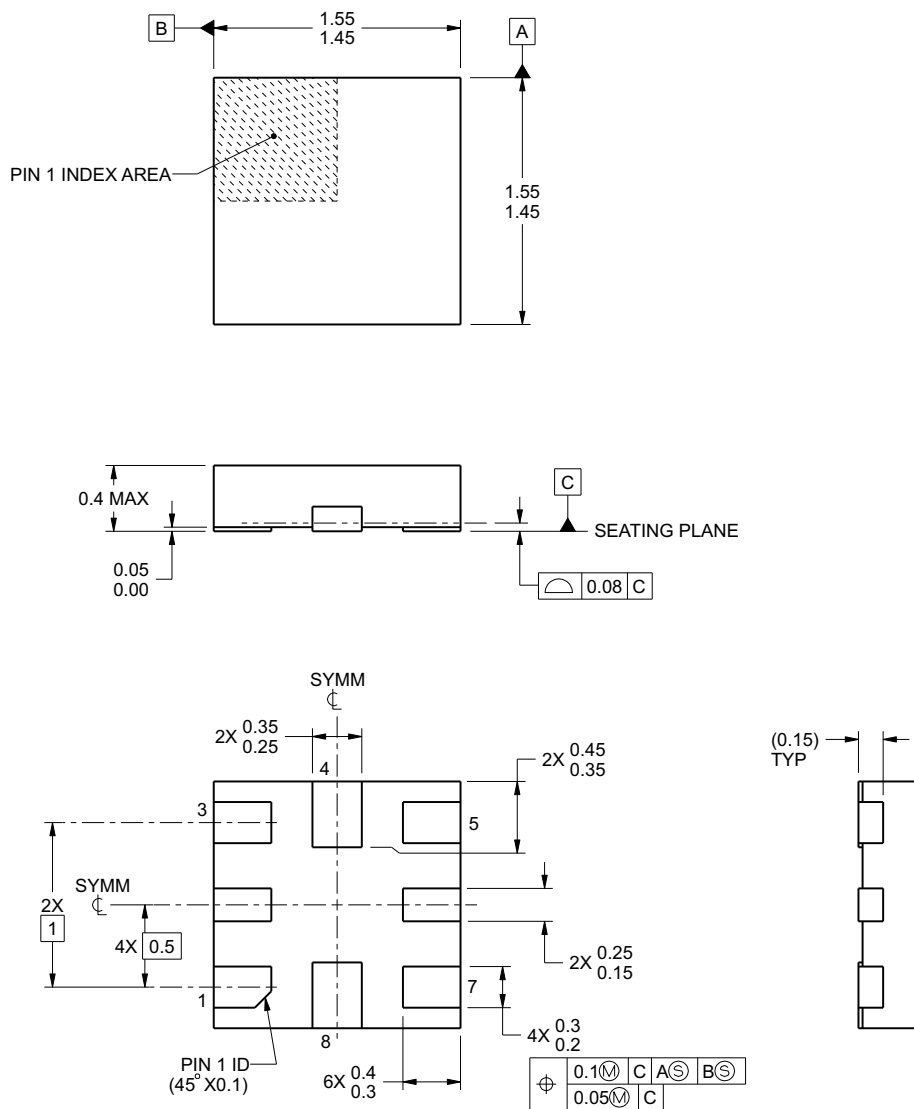


RUG0008A

PACKAGE OUTLINE

X2QFN - 0.4 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4222060/A 05/14/2015

NOTES:

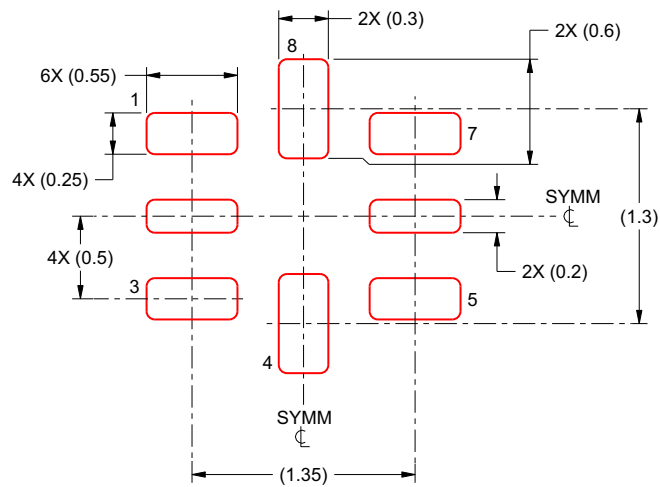
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE STENCIL DESIGN

RUG0008A

X2QFN - 0.4 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
 BASED ON 0.1 mm THICKNESS
 SCALE:25X

4222060/A 05/14/2015

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
ADS7057IRUGR	ACTIVE	X2QFN	RUG	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	9P	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ADS7057IRUGR	X2QFN	RUG	8	3000	180.0	8.4	1.6	1.6	0.66	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS

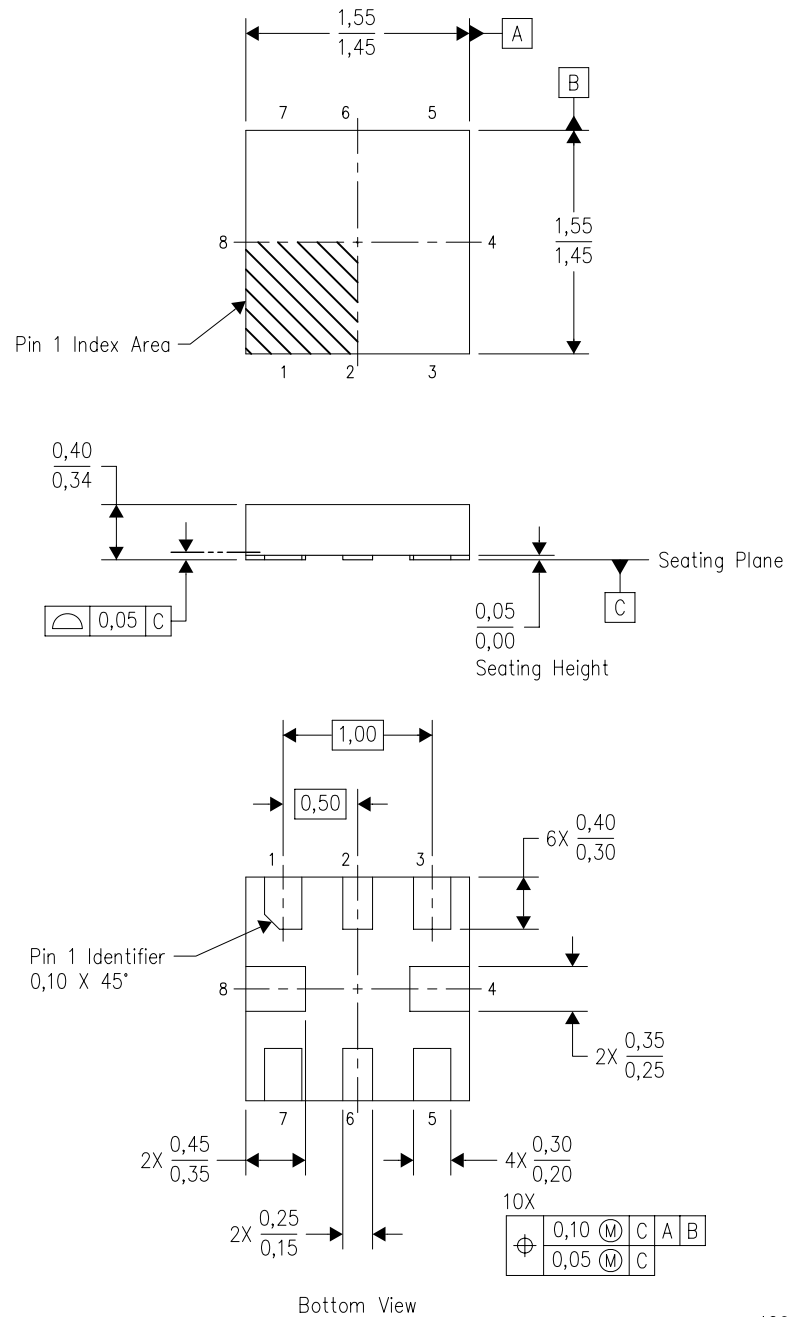


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ADS7057IRUGR	X2QFN	RUG	8	3000	183.0	183.0	20.0

RUG (S-PQFP-N8)

PLASTIC QUAD FLATPACK

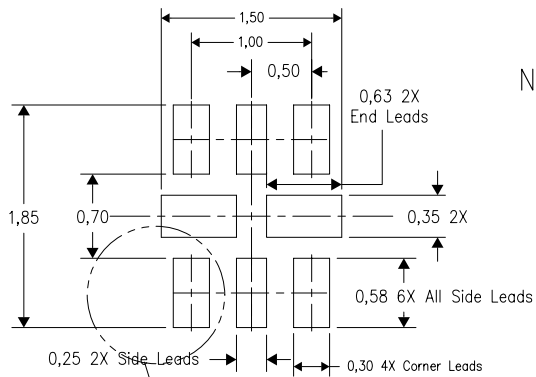


4208528-2/B 04/2008

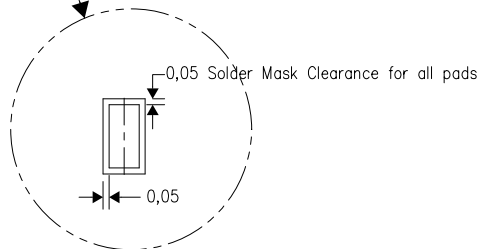
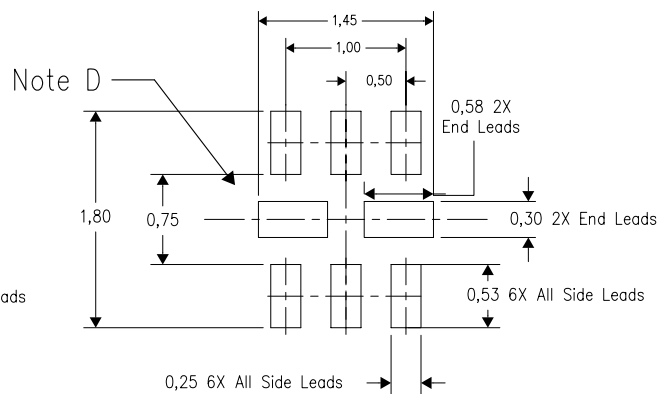
- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - QFN (Quad Flatpack No-Lead) package configuration.
 - This package complies to JEDEC MO-288 variation X2ECD.

RUG (R-PQFP-N8)

Example Board Layout



Example Stencil Design
(Note E)



4210299-2/A 06/09

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
 - E. Maximum stencil thickness 0,127 mm (5 mils). All linear dimensions are in millimeters.
 - F. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
 - G. Side aperture dimensions over-print land for acceptable area ratio > 0.66. Customer may reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.

重要声明

德州仪器 (TI) 公司有权按照最新发布的 JESD46 对其半导体产品和服务进行纠正、增强、改进和其他修改，并不再按最新发布的 JESD48 提供任何产品和服务。买方在下订单前应获取最新的相关信息，并验证这些信息是否完整且是最新的。

TI 公布的半导体产品销售条款 (<http://www.ti.com/sc/docs/stdterms.htm>) 适用于 TI 已认证和批准上市的已封装集成电路产品的销售。另有其他条款可能适用于其他类型 TI 产品及服务的使用或销售。

复制 TI 数据表上 TI 信息的重要部分时，不得变更该等信息，且必须随附所有相关保证、条件、限制和通知，否则不得复制。TI 对该等复制文件不承担任何责任。第三方信息可能受到其它限制条件的制约。在转售 TI 产品或服务时，如果存在对产品或服务参数的虚假陈述，则会失去相关 TI 产品或服务的明示或暗示保证，且构成不公平的、欺诈性商业行为。TI 对此类虚假陈述不承担任何责任。

买方和在系统中整合 TI 产品的其他开发人员（总称“设计人员”）理解并同意，设计人员在设计应用时应自行实施独立的分析、评价和判断，且应全权负责并确保应用的安全性，及设计人员的应用（包括应用中使用的 TI 产品）应符合所有适用的法律法规及其他相关要求。设计人员就自己设计的应用声明，其具备制订和实施下列保障措施所需的一切必要专业知识，能够 (1) 预见故障的危险后果，(2) 监视故障及其后果，以及 (3) 降低可能导致危险的故障几率并采取适当措施。设计人员同意，在使用或分发包含 TI 产品的任何应用前，将彻底测试该等应用和该等应用所用 TI 产品的功能而设计。

TI 提供技术、应用或其他设计建议、质量特点、可靠性数据或其他服务或信息，包括但不限于与评估模块有关的参考设计和材料（总称“TI 资源”），旨在帮助设计人员开发整合了 TI 产品的应用，如果设计人员（个人，或如果是代表公司，则为设计人员的公司）以任何方式下载、访问或使用任何特定的 TI 资源，即表示其同意仅为该等目标，按照本通知的条款使用任何特定 TI 资源。

TI 所提供的 TI 资源，并未扩大或以其他方式修改 TI 对 TI 产品的公开适用的质保及质保免责声明；也未导致 TI 承担任何额外的义务或责任。TI 有权对其 TI 资源进行纠正、增强、改进和其他修改。除特定 TI 资源的公开文档中明确列出的测试外，TI 未进行任何其他测试。

设计人员只有在开发包含该等 TI 资源所列 TI 产品的应用时，才被授权使用、复制和修改任何相关单项 TI 资源。但并未依据禁止反言原则或其他法理授予您任何 TI 知识产权的任何其他明示或默示的许可，也未授予您 TI 或第三方的任何技术或知识产权的许可，该等产权包括但不限于任何专利权、版权、屏蔽作品权或与应用 TI 产品或服务的任何整合、机器制作、流程相关的其他知识产权。涉及或参考了第三方产品或服务的信息不构成使用此类产品或服务的许可或与其相关的保证或认可。使用 TI 资源可能需要您向第三方获得对该等第三方专利或其他知识产权的许可。

TI 资源系“按原样”提供。TI 兹免除对资源及其使用作出所有其他明确或默示的保证或陈述，包括但不限于对准确性或完整性、产权保证、无屡发故障保证，以及适销性、适合特定用途和不侵犯任何第三方知识产权的任何默认保证。TI 不负任何责任，包括但不限于因组合产品所致或与之有关的申索，也不为或对设计人员进行辩护或赔偿，即使该等产品组合已列于 TI 资源或其他地方。对因 TI 资源或其使用引起或与之有关的任何实际的、直接的、特殊的、附带的、间接的、惩罚性的、偶发的、从属或惩戒性损害赔偿，不管 TI 是否获悉可能会产生上述损害赔偿，TI 概不负责。

除 TI 已明确指出特定产品已达到特定行业标准（例如 ISO/TS 16949 和 ISO 26262）的要求外，TI 不对未达到任何该等行业标准要求而承担任何责任。

如果 TI 明确宣称产品有助于功能安全或符合行业功能安全标准，则该等产品旨在帮助客户设计和创作自己的符合相关功能安全标准和要求的的应用。在应用内使用产品的行为本身不会配有安全特性。设计人员必须确保遵守适用于其应用的相关安全要求和标准而设计。设计人员不可将任何 TI 产品用于关乎性命的医疗设备，除非已由各方获得授权的管理层人员签署专门的合同对此类应用专门作出规定。关乎性命的医疗设备是指出现故障会导致严重身体伤害或死亡的医疗设备（例如生命保障设备、心脏起搏器、心脏除颤器、人工心脏泵、神经刺激器以及植入设备）。此类设备包括但不限于，美国食品药品监督管理局认定为 III 类设备的设备，以及在美国以外的其他国家或地区认定为同等类别设备的所有医疗设备。

TI 可能明确指定某些产品具备某些特定资格（例如 Q100、军用级或增强型产品）。设计人员同意，其具备一切必要专业知识，可以为自己的应用选择适合的产品，并且正确选择产品的风险由设计人员承担。设计人员单方面负责遵守与该等选择有关的所有法律或监管要求。

设计人员同意向 TI 及其代表全额赔偿因其不遵守本通知条款和条件而引起的任何损害、费用、损失和/或责任。

邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122
Copyright © 2018 德州仪器半导体技术（上海）有限公司