ADC3244E Dual-channel, 14-bit, 125-MSPS analog-to-digital converter

1 Features

- Dual channel
- 14-bit resolution
- Single supply: 1.8 V
- Serial LVDS interface (SLVDS)
- Flexible input clock buffer with divide-by-1, -2, -4
- SNR = 72.4 dBFS, SFDR = 87 dBc at f_{IN} = 70 MHz
- Ultra-low power consumption:
  - 116 mW/Ch at 125 MSPS
- Channel isolation: 105 dB
- Internal dither and chopper
- Support for multichip synchronization
- Pin-to-pin compatible with 12-bit version
- Package: VQFN-48 (7 mm × 7 mm)
- Extended temperature range: –50°C to +105°C

2 Applications

- Multi-carrier, multi-mode cellular base stations
- Radar and smart antenna arrays
- Munitions guidance
- Motor control feedback
- Network and vector analyzers
- Communications test equipment
- Nondestructive testing
- Microwave receivers
- Software-defined radios (SDRs)
- Quadrature and diversity radio receivers
- Handheld radio and instrumentation

3 Description

The ADC3244E is a high-linearity, ultra-low power, dual-channel, 14-bit, 25-MSPS to 125-MSPS analog-to-digital converter (ADC). The device is designed specifically to support demanding, high input frequency signals with large dynamic range requirements. An input clock divider allows more flexibility for system clock architecture design, and the SYSREF input enables complete system synchronization.

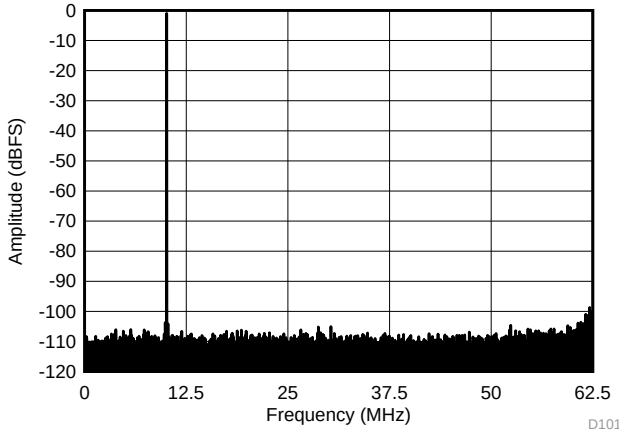
The ADC3244E supports serial, low-voltage, differential signaling (LVDS) in order to reduce the number of interface lines, thus allowing for high system integration density. The serial LVDS interface is two-wire, where the data from each ADC are serialized and output over two LVDS pairs. An internal phase-locked loop (PLL) multiplies the incoming ADC sampling clock to derive the bit clock that is used to serialize the 14-bit output data from each channel. In addition to the serial data streams, the frame and bit clocks are also transmitted as LVDS outputs.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
ADC3244E	VQFN (48)	7.00 mm × 7.00 mm

(1) For all available packages, see the package option addendum at the end of the datasheet.

Performance at f_S = 125 MSPS, f_{IN} = 10 MHz



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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
February 2019	*	Initial release.

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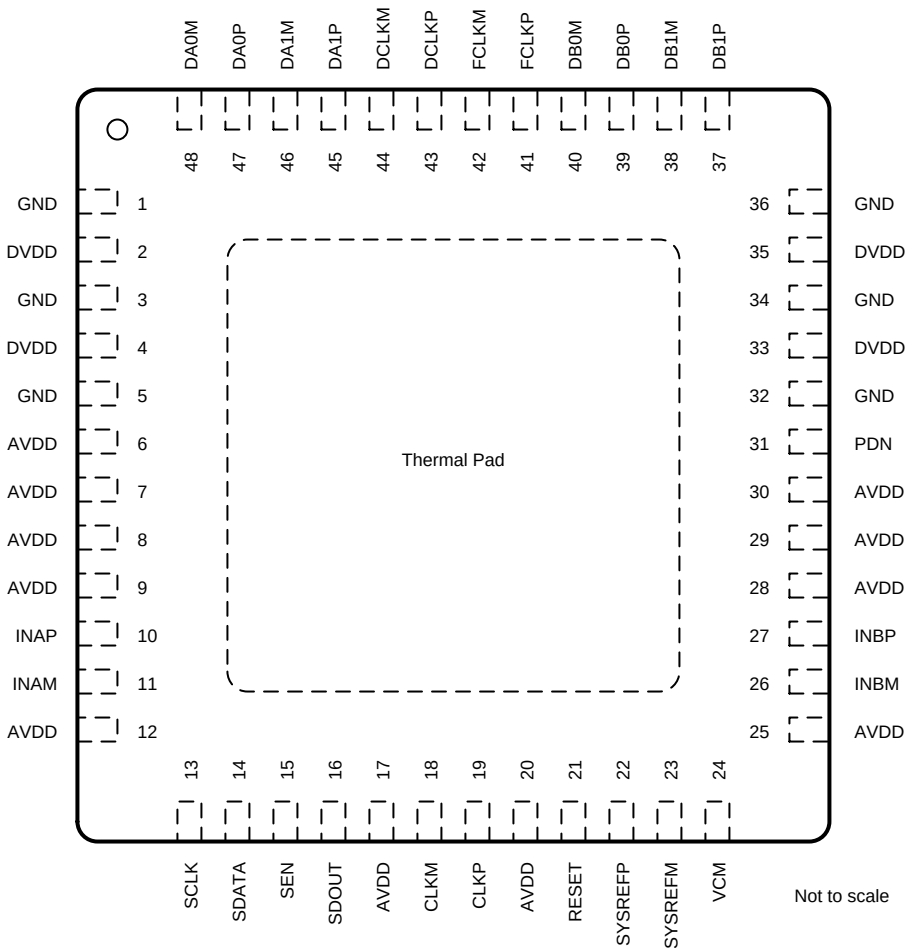
5 Device Comparison Table

INTERFACE	RESOLUTION (Bits)	25 MSPS	50 MSPS	80 MSPS	125 MSPS	160 MSPS
Serial LVDS	12	ADC3221	ADC3222	ADC3223	ADC3224	—
	14	ADC3241	ADC3242	ADC3243	ADC3244	—
		—	—	—	ADC3244E (1)	—
JESD204B	12	—	ADC32J22	ADC32J23	ADC32J24	ADC32J25
	14	—	ADC32J42	ADC32J43	ADC32J44	ADC32J45

(1) The ADC3244E is specified at extended temperature range of –50°C to +105°C. Other devices in the table are specified at standard industrial temperature range of –40°C to +85°C.

6 Pin Configuration and Functions

RGZ Package
48-Pin VQFN
Top View



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
AVDD	6-9, 12, 17, 20, 25, 28-30	I	Analog 1.8-V power supply
CLKM	18	I	Negative differential clock input for the ADC
CLKP	19	I	Positive differential clock input for the ADC
DA0M	48	O	Negative serial LVDS output for channel A0
DA0P	47	O	Positive serial LVDS output for channel A0
DA1M	46	O	Negative serial LVDS output for channel A1
DA1P	45	O	Positive serial LVDS output for channel A1
DB0M	40	O	Negative serial LVDS output for channel B0
DB0P	39	O	Positive serial LVDS output for channel B0
DB1M	38	O	Negative serial LVDS output for channel B1
DB1P	37	O	Positive serial LVDS output for channel B1
DCLKM	44	O	Negative bit clock output
DCLKP	43	O	Positive bit clock output
DVDD	2, 4, 33, 35	I	Digital 1.8-V power supply
FCLKM	42	O	Negative frame clock output
FCLKP	41	O	Positive frame clock output
GND	1, 3, 5, 32, 34, 36	I	Ground, 0 V
INAM	11	I	Negative differential analog input for channel A
INAP	10	I	Positive differential analog input for channel A
INBM	26	I	Negative differential analog input for channel B
INBP	27	I	Positive differential analog input for channel B
PDN	31	I	Power-down control. This pin can be configured using the SPI. This pin has an internal 150-kΩ pulldown resistor.
RESET	21	I	Hardware reset; active high. This pin has an internal 150-kΩ pulldown resistor.
SCLK	13	I	Serial interface clock input. This pin has an internal 150-kΩ pulldown resistor.
SDATA	14	I	Serial interface data input. This pin has an internal 150-kΩ pulldown resistor.
SDOUT	16	O	Serial interface data output
SEN	15	I	Serial interface enable; active low. This pin has an internal 150-kΩ pullup resistor to AVDD.
SYSREFM	23	I	Negative external SYSREF input
SYSREFP	22	I	Positive external SYSREF input
VCM	24	O	Common-mode voltage for analog inputs
Thermal Pad		I	Thermal pad. Connect to ground.

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7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1]

			MIN	MAX	UNIT
	Analog supply voltage, AVDD		–0.3	2.1	V
	Digital supply voltage, DVDD		–0.3	2.1	V
	Voltage applied to input pins	INAP, INBP, INAM, INBM	–0.3	min (1.9, AVDD + 0.3)	V
		CLKP, CLKM	–0.3	AVDD + 0.3	
		SYSREFP, SYSREFM	–0.3	AVDD + 0.3	
		SCLK, SEN, SDATA, RESET, PDN	–0.3	3.9	
T_J	Operating junction temperature			125	ºC
T_{stg}	Storage temperature		–65	150	ºC

(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.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±2000	V

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

7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)[1]

			MIN	NOM	MAX	UNIT
SUPPLIES						
AVDD	Analog supply voltage		1.7	1.8	1.9	V
DVDD	Digital supply voltage		1.7	1.8	1.9	V
ANALOG INPUT						
V_{ID}	Differential input voltage	For input frequencies < 450 MHz		2		V_{PP}
		For input frequencies < 600 MHz		1		
V_{IC}	Input common-mode voltage			VCM ± 0.025		V
CLOCK INPUT						
	Input clock frequency[2]	Sampling clock frequency	10		125	MSPS
	Input clock amplitude (differential)	Sine wave, ac-coupled	0.2	1.5		V_{PP}
		LVPECL, ac-coupled		1.6		
		LVDS, ac-coupled		0.7		
	Input clock duty cycle		35%	50%	65%	
	Input clock common-mode voltage			0.95		V
DIGITAL OUTPUTS						
C_{LOAD}	Maximum external load capacitance from each output pin to GND			3.3		pF
R_{LOAD}	Differential load resistance placed externally			100		Ω
TEMPERATURE						
T_A	Operating free-air temperature		–50		105	°C

(1) After power-up, to reset the device for the first time, only use the RESET pin; see the *Register Initialization* section.
(2) With the clock divider enabled by default for divide-by-1. Maximum sampling clock frequency for the divide-by-4 option is 500 MSPS.

7.4 Thermal Information

THERMAL METRIC[1]		ADC3244E RGZ (VQFN) 48 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	25.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	18.9	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	3.0	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.2	°C/W
ψ_{JB}	Junction-to-board characterization parameter	3	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	0.5	°C/W

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

7.5 Electrical Characteristics: General

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = DVDD = 1.8 V, and –1-dBFS differential input (unless otherwise noted); minimum and maximum values at full temperature range of –50°C to +105°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
	ADC clock frequency				125	MSPS
	1.8-V analog supply current			65	106	mA
	1.8-V digital supply current			64	95	mA
	Total power dissipation			233	325	mW
	Global power-down dissipation			5	17	mW
	Standby power-down dissipation			78	103	mW
RESOLUTION						
	Resolution		14			Bits
ANALOG INPUT						
	Differential input full-scale			2.0		V_{PP}
R_{IN}	Input resistance	Differential at dc		6.6		kΩ
C_{IN}	Input capacitance	Differential at dc		3.7		pF
$V_{OC(VCM)}$	VCM common-mode voltage output			0.95		V
	VCM output current capability			10		mA
	Input common-mode current	Per analog input pin		1.5		µA/MSPS
	Analog input bandwidth (3 dB)	50-Ω differential source driving 50-Ω termination across INP and INM		540		MHz
DC ACCURACY						
E_O	Offset error		–25		25	mV
α_{EO}	Temperature coefficient of offset error			±0.024		°C
$E_{G(REF)}$	Gain error as a result of internal reference inaccuracy alone		–2		2	%FS
$E_{G(CHAN)}$	Gain error of channel alone			–2		%FS
$\alpha_{(EGCHAN)}$	Temperature coefficient of $E_{G(CHAN)}$			±0.008		Δ%FS/°C
CHANNEL-TO-CHANNEL ISOLATION						
	Crosstalk[1]	f_{IN} = 10 MHz		105		dB
		f_{IN} = 100 MHz		105		
		f_{IN} = 200 MHz		105		
		f_{IN} = 230 MHz		105		
		f_{IN} = 300 MHz		105		

(1) Crosstalk is measured with a –1-dBFS input signal on one channel and no input on the other channel.

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7.6 Electrical Characteristics: AC Performance

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = DVDD = 1.8 V, and –1-dBFS differential input (unless otherwise noted); minimum and maximum values at full temperature range of –50°C to +105°C

PARAMETER		TEST CONDITIONS	f_S = 125 MSPS						UNIT
			DITHER ON			DITHER OFF			
			MIN	TYP	MAX	MIN	TYP	MAX	
DYNAMIC AC CHARACTERISTICS									
SNR	Signal-to-noise ratio (from 1-MHz offset)	f_{IN} = 10 MHz		72.9			73.3		dBFS
		f_{IN} = 70 MHz	71	72.6			73		
		f_{IN} = 100 MHz		72.4			72.8		
		f_{IN} = 170 MHz		71.7			72.2		
		f_{IN} = 230 MHz		71			71.6		
	Signal-to-noise ratio (full Nyquist band)	f_{IN} = 10 MHz		72.5			72.9		
		f_{IN} = 70 MHz		72.2			72.6		
		f_{IN} = 100 MHz		72.1			72.5		
		f_{IN} = 170 MHz		71.4			71.9		
		f_{IN} = 230 MHz		70.7			71.3		
NSD (1)	Noise spectral density (averaged across Nyquist zone)	f_{IN} = 10 MHz		–150.8			–151.1		dBFS/Hz
		f_{IN} = 70 MHz		–150.5	–148.9		–150.9		
		f_{IN} = 100 MHz		–150.3			–150.7		
		f_{IN} = 170 MHz		–149.6			–150.1		
		f_{IN} = 230 MHz		–148.9			–149.5		
SINAD (1)	Signal-to-noise and distortion ratio	f_{IN} = 10 MHz		72.8			73		dBFS
		f_{IN} = 70 MHz	69.6	72.6			72.9		
		f_{IN} = 100 MHz		72.3			72.5		
		f_{IN} = 170 MHz		71.5			71.9		
		f_{IN} = 230 MHz		70.7			71.1		
ENOB (1)	Effective number of bits	f_{IN} = 10 MHz		11.8			11.8		Bits
		f_{IN} = 70 MHz	11.3	11.8			11.8		
		f_{IN} = 100 MHz		11.7			11.8		
		f_{IN} = 170 MHz		11.6			11.6		
		f_{IN} = 230 MHz		11.5			11.5		
SFDR	Spurious-free dynamic range	f_{IN} = 10 MHz		93			86		dBc
		f_{IN} = 70 MHz	82	94			89		
		f_{IN} = 100 MHz		89			85		
		f_{IN} = 170 MHz		85			85		
		f_{IN} = 230 MHz		83			82		

(1) Reported from a 1-MHz offset.

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Electrical Characteristics: AC Performance (continued)

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = DVDD = 1.8 V, and –1-dBFS differential input (unless otherwise noted); minimum and maximum values at full temperature range of –50°C to +105°C

PARAMETER		TEST CONDITIONS	f_S = 125 MSPS						UNIT
			DITHER ON			DITHER OFF			
			MIN	TYP	MAX	MIN	TYP	MAX	
HD2	Second-order harmonic distortion	f_{IN} = 10 MHz		95			96		dBc
		f_{IN} = 70 MHz	82	96			95		
		f_{IN} = 100 MHz		91			90		
		f_{IN} = 170 MHz		85			85		
		f_{IN} = 230 MHz		83			83		
HD3	Third-order harmonic distortion	f_{IN} = 10 MHz		94			86		dBc
		f_{IN} = 70 MHz	83	94			89		
		f_{IN} = 100 MHz		91			85		
		f_{IN} = 170 MHz		97			89		
		f_{IN} = 230 MHz		87			85		
Non HD2, HD3	Spurious-free dynamic range (excluding HD2, HD3)	f_{IN} = 10 MHz		100			95		dBc
		f_{IN} = 70 MHz	86	99			95		
		f_{IN} = 100 MHz		99			95		
		f_{IN} = 170 MHz		100			91		
		f_{IN} = 230 MHz		96			92		
THD	Total harmonic distortion	f_{IN} = 10 MHz		91			85		dBc
		f_{IN} = 70 MHz	76	91			86		
		f_{IN} = 100 MHz		87			83		
		f_{IN} = 170 MHz		84			82		
		f_{IN} = 230 MHz		81			80		
IMD3	Two-tone, third-order intermodulation distortion	f_{IN1} = 45 MHz, f_{IN2} = 50 MHz		–97			–95		dBFS
		f_{IN1} = 185 MHz, f_{IN2} = 190 MHz		–91			–90		

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7.7 Digital Characteristics

dc specifications refer to the condition where the digital outputs are not switching, but are permanently at a valid logic level of 0 or 1, AVDD = DVDD = 1.8 V, and –1-dBFS differential input (unless otherwise noted)

)PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
DIGITAL INPUTS (RESET, SCLK, SDATA, SEN, PDN)							
V_{IH}	High-level input voltage		All digital inputs support 1.8-V and 3.3-V CMOS logic levels	1.3			V
V_{IL}	Low-level input voltage		All digital inputs support 1.8-V and 3.3-V CMOS logic levels			0.4	V
I_{IH}	High-level input current	RESET, SDATA, SCLK, PDN	V_{HIGH} = 1.8 V		10		µA
		SEN (1)	V_{HIGH} = 1.8 V		0		
I_{IL}	Low-level input current	RESET, SDATA, SCLK, PDN	V_{LOW} = 0 V		0		µA
		SEN	V_{LOW} = 0 V		10		
DIGITAL INPUTS (SYSREFP, SYSREFM)							
V_{IH}	High-level input voltage				1.3		V
V_{IL}	Low-level input voltage				0.5		V
	Common-mode voltage for SYSREF				0.9		V
DIGITAL OUTPUTS, CMOS INTERFACE (SDOUT)							
V_{OH}	High-level output voltage			DVDD – 0.1	DVDD		V
V_{OL}	Low-level output voltage				0	0.1	V
DIGITAL OUTPUTS, LVDS INTERFACE							
V_{ODH}	High-level output differential voltage		With an external 100-Ω termination	280	410	460	mV
V_{ODL}	Low-level output differential voltage		With an external 100-Ω termination	–460	–410	–280	mV
V_{OCM}	Output common-mode voltage				1.05		V

(1) SEN has an internal 150-kΩ pull-up resistor to AVDD. Because the pull-up resistor is weak, SEN can also be driven by 1.8-V or 3.3-V CMOS buffers.

7.8 Timing Requirements: General

typical values at T_A = 25°C, AVDD = DVDD = 1.8 V, and –1-dBFS differential input (unless otherwise noted); minimum and maximum values at full temperature range of –50°C to +105°C

			MIN	TYP	MAX	UNIT
t_A	Aperture delay		1.24	1.44	1.64	ns
	Aperture delay matching between two channels of the same device			±70		ps
	Variation of aperture delay between two devices at the same temperature and supply voltage			±150		ps
t_J	Aperture jitter			130		f_S rms
	Wake-up time	Time to valid data after exiting standby power-down mode		35	65	µs
		Time to valid data after exiting global power-down mode (in this mode, both channels power down)		85	140	
	ADC latency (1)	2-wire mode (default)		9		Clock cycles
		1-wire mode		8		
t_{SU_SYSREF}	SYSREF reference setup time	Setup time for SYSREF referenced to input clock rising edge	1000			ps
t_{H_SYSREF}	SYSREF reference hold time	Hold time for SYSREF referenced to input clock rising edge	100			

(1) Overall latency = ADC latency + t_{PDI}.

7.9 Timing Requirements: LVDS Output

typical values at 25°C, AVDD = DVDD = 1.8 V, –1-dBFS differential input, 7x serialization, C_{LOAD} = 3.3 pF[(1)], and R_{LOAD} = 100 Ω[(2)] (unless otherwise noted); minimum and maximum values at full temperature range of –50°C to +105°C[(3)(4)]

			MIN	TYP	MAX	UNIT
t_{SU}	Data setup time: data valid to zero-crossing of differential output clock (CLKOUTP – CLKOUTM)[(5)]		0.36	0.42		ns
t_{HO}	Data hold time: zero-crossing of differential output clock (CLKOUTP – CLKOUTM) to data becoming invalid[(5)]		0.36	0.47		ns
	LVDS bit clock duty cycle: duty cycle of differential clock (CLKOUTP – CLKOUTM)			49%		
t_{PDI}	Clock propagation delay: input clock falling edge cross-over to frame clock rising edge cross-over 10 MSPS < sampling frequency < 125 MSPS	1-wire mode	2.7	4.5	6.5	ns
		2-wire mode		$0.44 \times t_S + t_{DELAY}$		
t_{DELAY}	Delay time		3	4.5	5.9	ns
t_{FALL}, t_{RISE}	Data fall time, data rise time: rise time measured from –100 mV to 100 mV, *10 MSPS ≤ Sampling frequency ≤ 125 MSPS*			0.11		ns
$t_{CLKRISE}$, $t_{CLKFALL}$	Output clock rise time, output clock fall time: rise time measured from –100 mV to 100 mV, *10 MSPS ≤ Sampling frequency ≤ 125 MSPS*			0.11		ns

(1) C_{LOAD} is the effective external single-ended load capacitance between each output pin and ground
(2) R_{LOAD} is the differential load resistance between the LVDS output pair.
(3) Measurements are done with a transmission line of a 100-Ω characteristic impedance between the device and load. Setup and hold time specifications take into account the effect of jitter on the output data and clock.
(4) Timing parameters are specified by design and characterization and are not tested in production.
(5) Data valid refers to a logic high of +100 mV and a logic low of –100 mV.

Table 1. LVDS Timings at Lower Sampling Frequencies: 7x Serialization (2-Wire Mode)

SAMPLING FREQUENCY (MSPS)	SETUP TIME (t_{SU}, ns)			HOLD TIME (t_{HO}, ns)		
	MIN	TYP	MAX	MIN	TYP	MAX
25	2.27	2.6		2.41	2.6	
40	1.44	1.6		1.51	1.7	
50	1.2	1.32		1.24	1.4	
60	0.95	1.04		0.97	1.09	
80	0.68	0.75		0.72	0.81	
100	0.5	0.57		0.53	0.62	

Table 2. LVDS Timings at Lower Sampling Frequencies: 14x Serialization (1-Wire Mode)

SAMPLING FREQUENCY (MSPS)	SETUP TIME (t_{SU}, ns)			HOLD TIME (t_{HO}, ns)		
	MIN	TYP	MAX	MIN	TYP	MAX
25	1.1	1.24		1.19	1.34	
40	0.66	0.72		0.74	0.82	
50	0.48	0.55		0.54	0.64	
60	0.35	0.41		0.42	0.51	
80	0.17	0.24		0.3	0.38	

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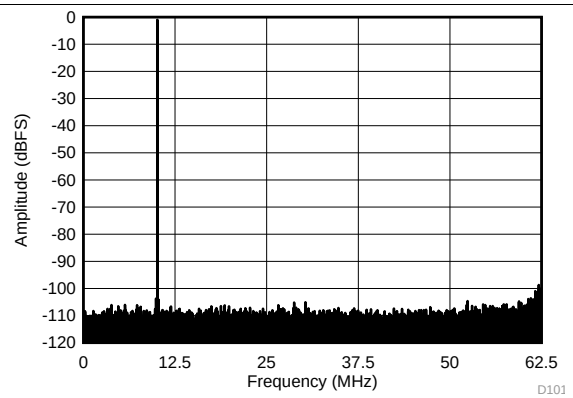
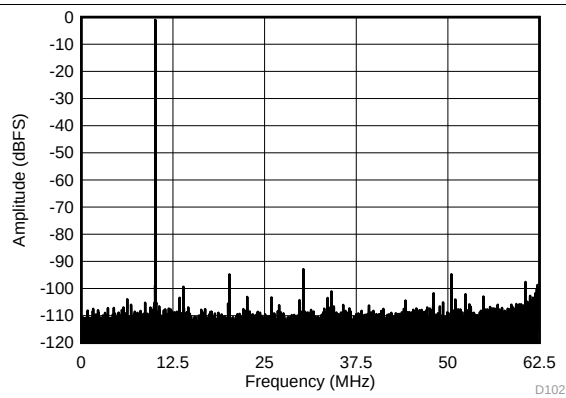
7.10 Typical Characteristics

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when chopper is enabled (unless otherwise noted)



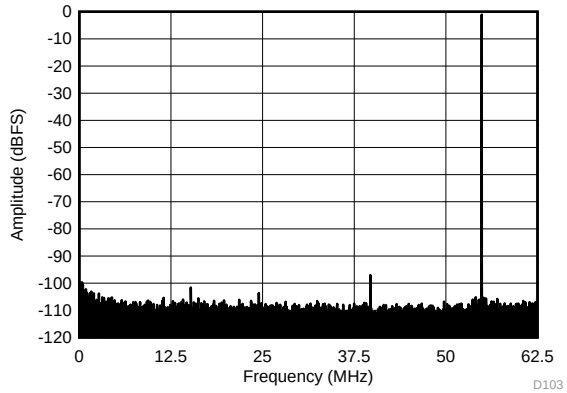
SFDR = 102.6 dBc, SNR = 72.9 dBFS, SINAD = 72.8 dBFS, THD = 99.8 dBc, HD2 = –108.6 dBc, HD3 = –104.0 dBc

Figure 1. FFT for 10-MHz Input Signal (Chopper On, Dither On)



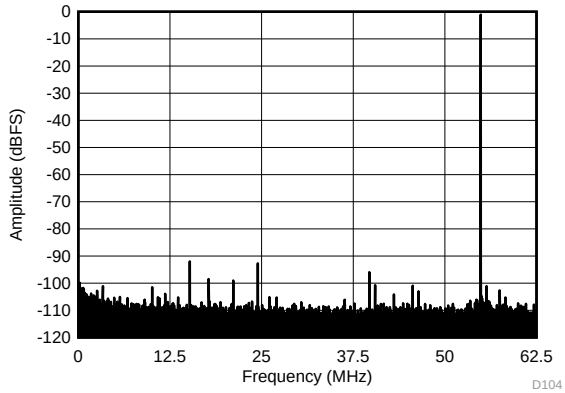
SFDR = 91.8 dBc, SNR = 73.5 dBFS, SINAD = 73.4 dBFS, THD = 87.3 dBc, HD2 = –93.8 dBc, HD3 = –91.8 dBc

Figure 2. FFT for 10-MHz Input Signal (Chopper On, Dither Off)



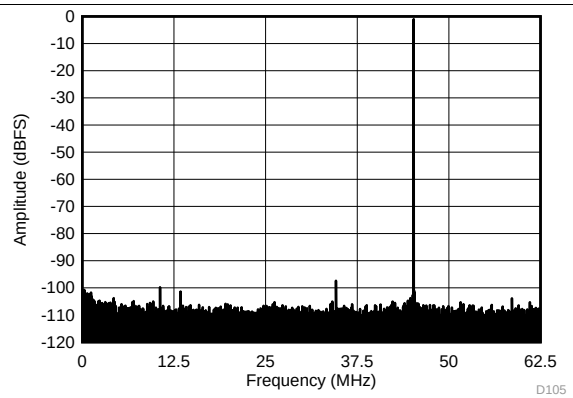
SFDR = 95.9 dBc, SNR = 72.7 dBFS, SINAD = 72.7 dBFS, THD = 93.6 dBc, HD2 = –100.6 dBc, HD3 = –95.9 dBc

Figure 3. FFT for 70-MHz Input Signal (Dither On)



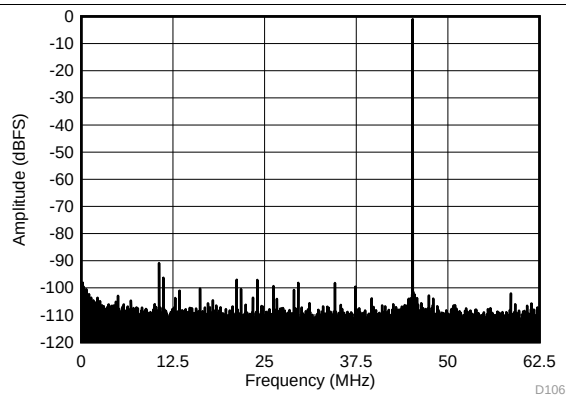
SFDR = 90.9 dBc, SNR = 73.3 dBFS, SINAD = 73.1 dBFS, THD = 87 dBc, HD2 = –90.9 dBc, HD3 = –94.9 dBc

Figure 4. FFT for 70-MHz Input Signal (Dither Off)



SFDR = 96.4 dBc, SNR = 72.1 dBFS, SINAD = 72.0 dBFS, THD = 92.6 dBc, HD2 = –96.4 dBc, HD3 = –98.8 dBc

Figure 5. FFT for 170-MHz Input Signal (Dither On)

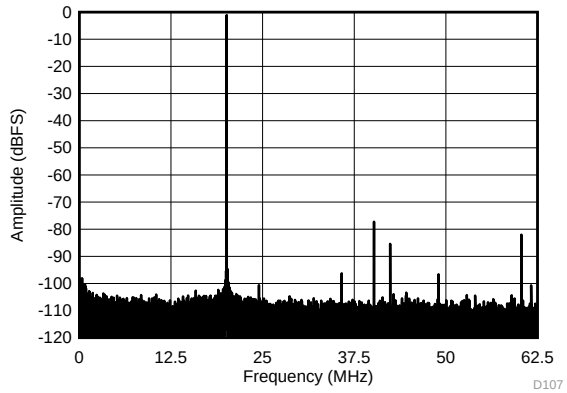


SFDR = 89.9 dBc, SNR = 72.8 dBFS, SINAD = 72.6 dBFS, THD = 87.1 dBc, HD2 = –97.2 dBc, HD3 = –89.9 dBc

Figure 6. FFT for 170-MHz Input Signal (Dither Off)

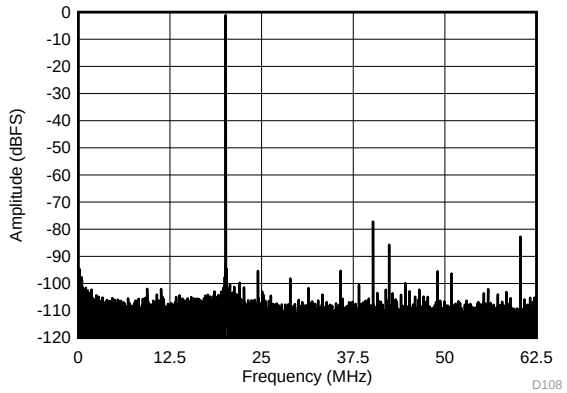
Typical Characteristics (continued)

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when chopper is enabled (unless otherwise noted)



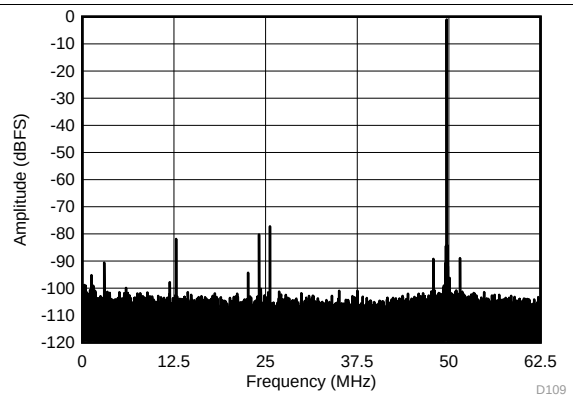
SFDR = 76.1 dBc, SNR = 70.8 dBFS, SINAD = 69.8 dBFS, THD = 74.8 dBc, HD2 = –76.1 dBc, HD3 = –80.9 dBc

Figure 7. FFT for 270-MHz Input Signal (Dither On)



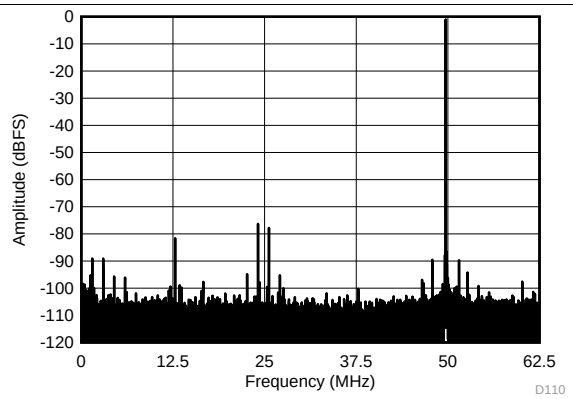
SFDR = 76.1 dBc, SNR = 71.2 dBFS, SINAD = 70.2 dBFS, THD = 74.9 dBc, HD2 = –76.1 dBc, HD3 = –81.6 dBc

Figure 8. FFT for 270-MHz Input Signal (Dither Off)



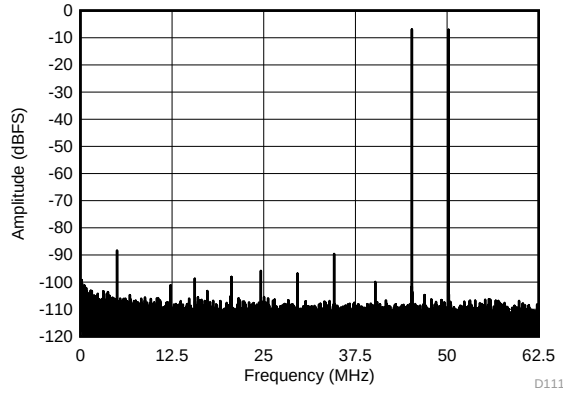
SFDR = 76.2 dBc, SNR = 68.3 dBFS, SINAD = 67.5 dBFS, THD = 74.3 dBc, HD2 = –76.2 dBc, HD3 = –79.2 dBc

Figure 9. FFT for 450-MHz Input Signal (Dither On)



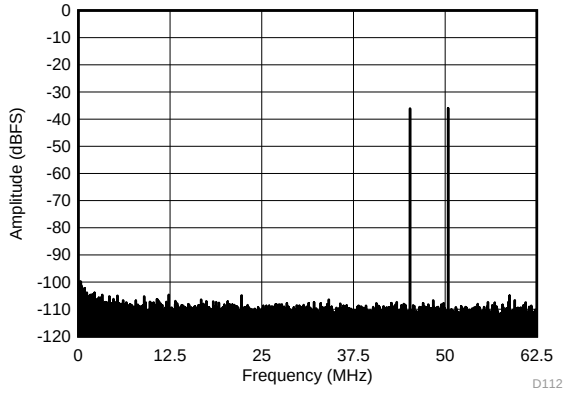
SFDR = 75.3 dBc, SNR = 69.1 dBFS, SINAD = 67.8 dBFS, THD = 72.7 dBc, HD2 = –76.7 dBc, HD3 = –75.3 dBc

Figure 10. FFT for 450-MHz Input Signal (Dither Off)



f_{IN1} = 46 MHz, f_{IN2} = 50 MHz, IMD3 = 88.3 dBFS, each tone at –7 dBFS

Figure 11. FFT for Two-Tone Input Signal



f_{IN1} = 46 MHz, f_{IN2} = 50 MHz, IMD3 = 90.8 dBFS, each tone at –36 dBFS

Figure 12. FFT for Two-Tone Input Signal

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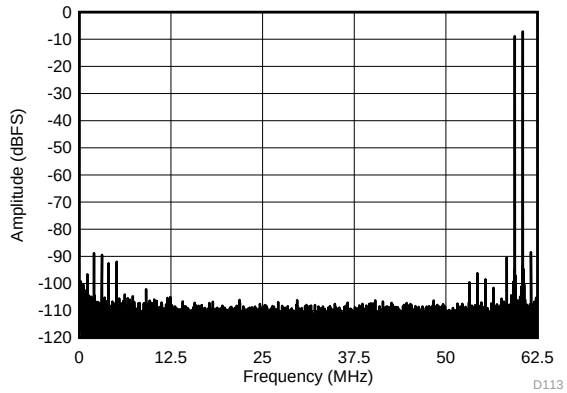
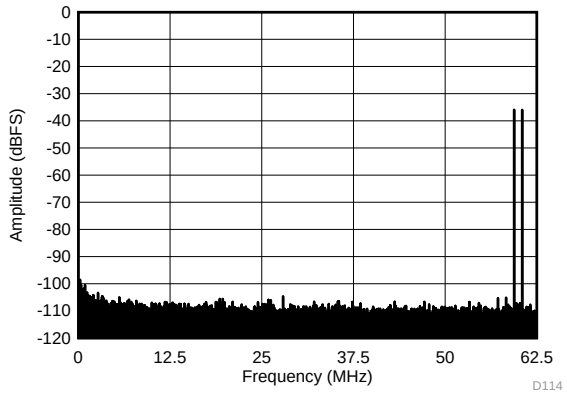
Typical Characteristics (continued)

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when chopper is enabled (unless otherwise noted)



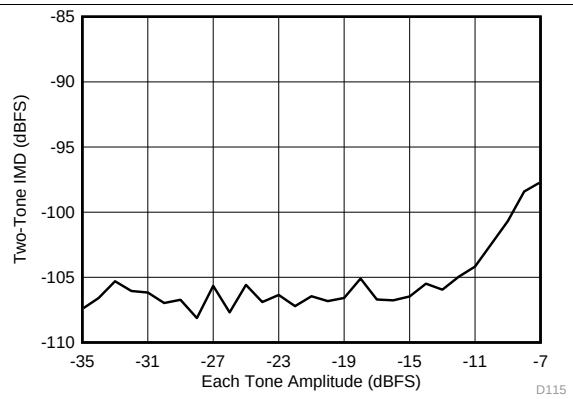
f_{IN1} = 185 MHz, f_{IN2} = 190 MHz, IMD3 = 86.4 dBFS, each tone at –7 dBFS

Figure 13. FFT for Two-Tone Input Signal



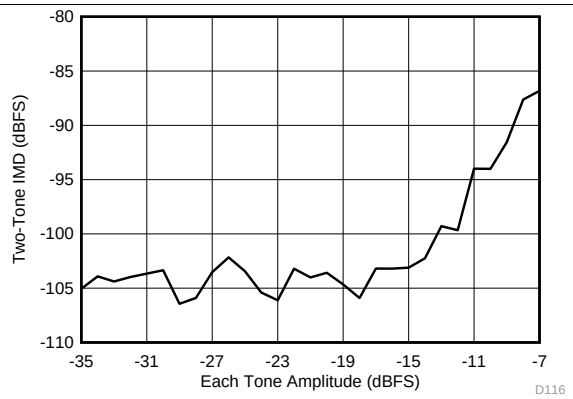
f_{IN1} = 185 MHz, f_{IN2} = 190 MHz, IMD3 = 87.28 dBFS, each tone at –36 dBFS

Figure 14. FFT for Two-Tone Input Signal



f_{IN1} = 46 MHz, f_{IN2} = 50 MHz

Figure 15. Intermodulation Distortion vs Input Amplitude



f_{IN1} = 185 MHz, f_{IN2} = 190 MHz

Figure 16. Intermodulation Distortion vs Input Amplitude

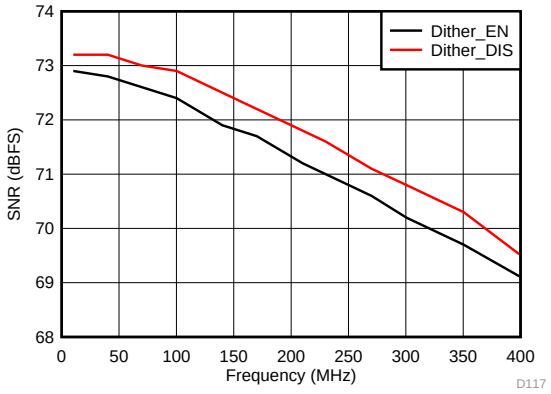


Figure 17. Signal-to-Noise Ratio vs Input Frequency

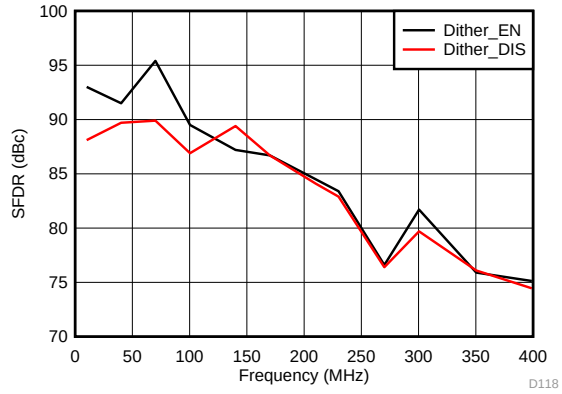
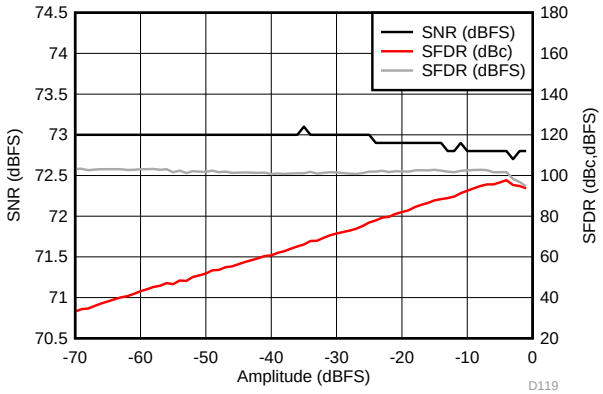


Figure 18. Spurious-Free Dynamic Range vs Input Frequency

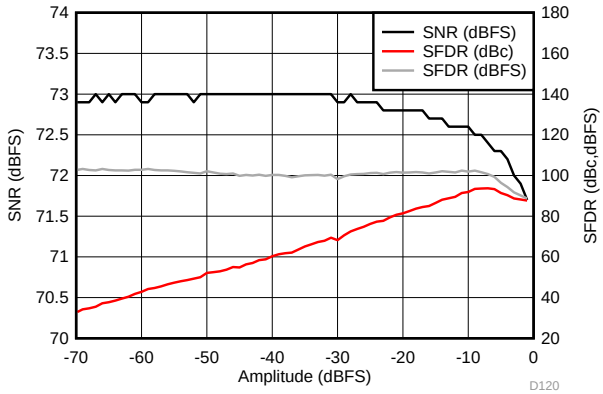
Typical Characteristics (continued)

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when chopper is enabled (unless otherwise noted)



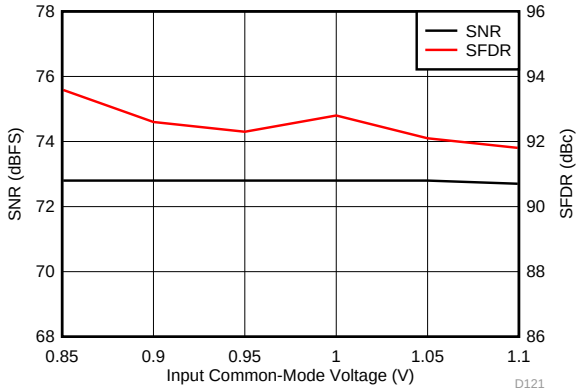
f_{IN} = 30 MHz

Figure 19. Performance vs Input Amplitude



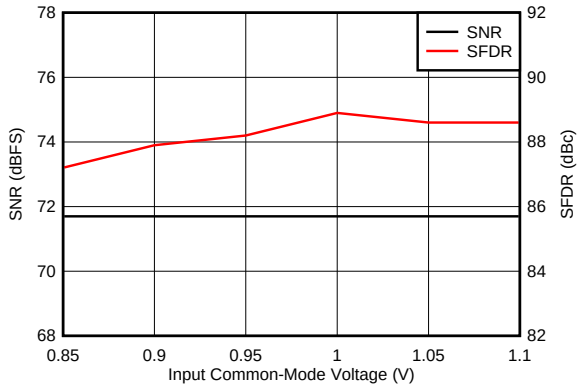
f_{IN} = 170 MHz

Figure 20. Performance vs Input Amplitude



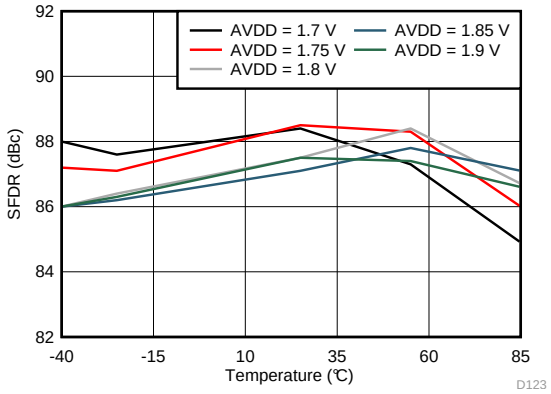
f_{IN} = 30 MHz

Figure 21. Performance vs Input Common-Mode Voltage



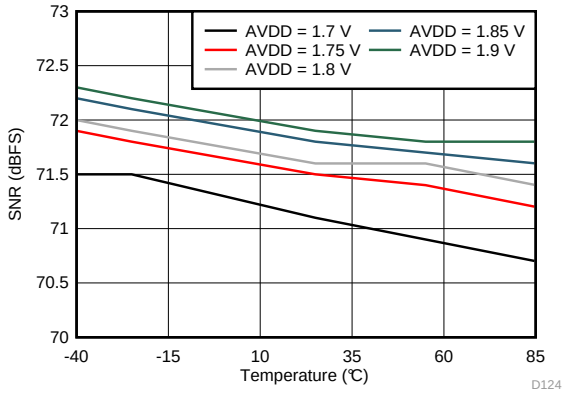
f_{IN} = 170 MHz

Figure 22. Performance vs Input Common-Mode Voltage



f_{IN} = 170 MHz

Figure 23. Spurious-Free Dynamic Range vs AVDD Supply and Temperature



f_{IN} = 170 MHz

Figure 24. Signal-to-Noise Ratio vs AVDD Supply and Temperature

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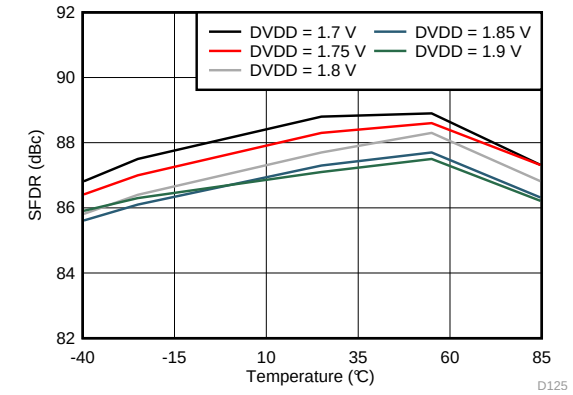
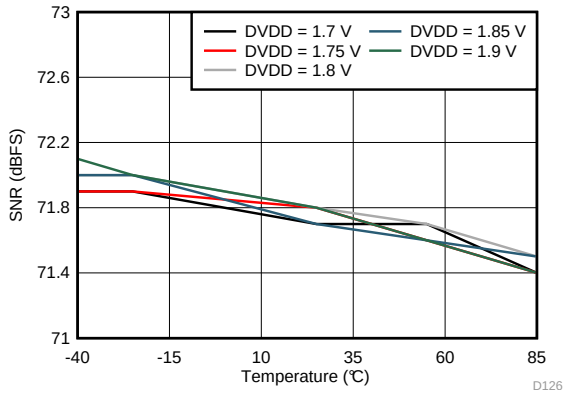
Typical Characteristics (continued)

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when chopper is enabled (unless otherwise noted)



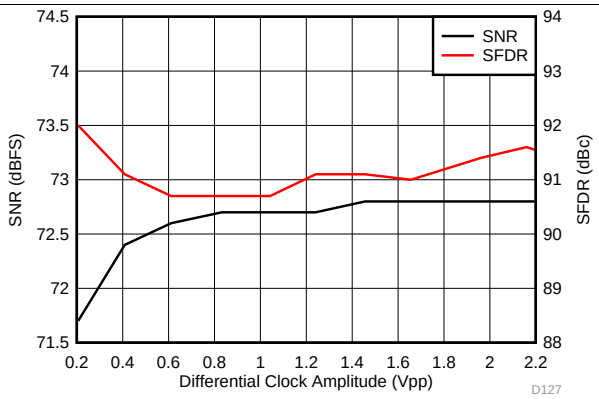
f_{IN} = 170 MHz

Figure 25. Spurious-Free Dynamic Range vs DVDD Supply and Temperature



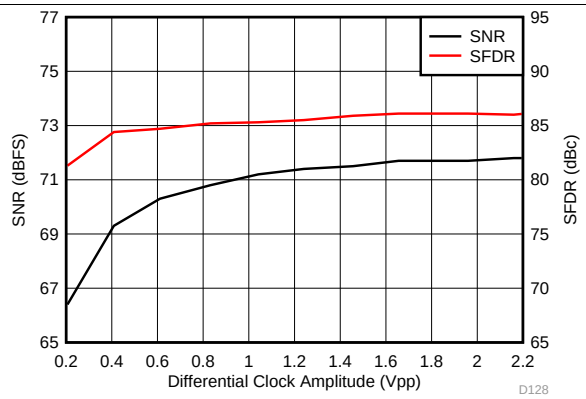
f_{IN} = 170 MHz

Figure 26. Signal-to-Noise Ratio vs DVDD Supply and Temperature



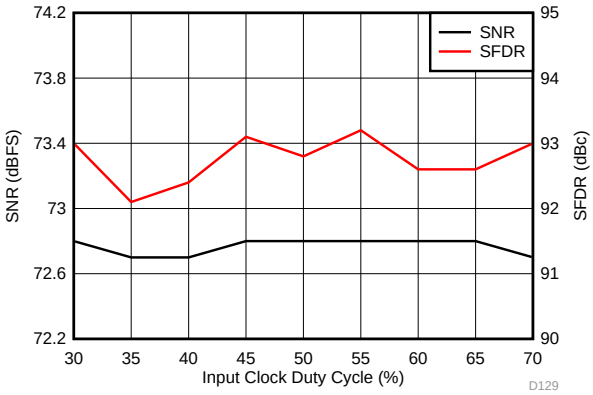
f_{IN} = 40 MHz

Figure 27. Performance vs Clock Amplitude



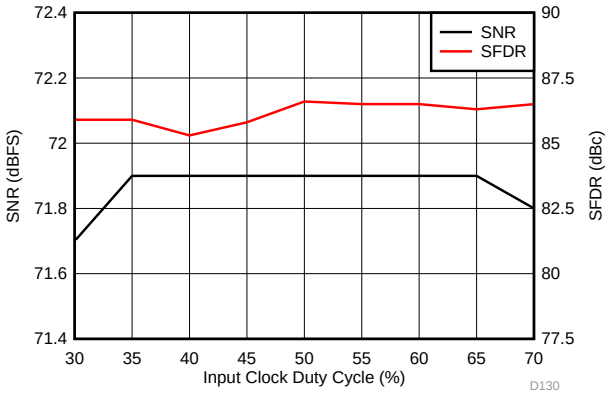
f_{IN} = 150 MHz

Figure 28. Performance vs Clock Amplitude



f_{IN} = 30 MHz

Figure 29. Performance vs Clock Duty Cycle

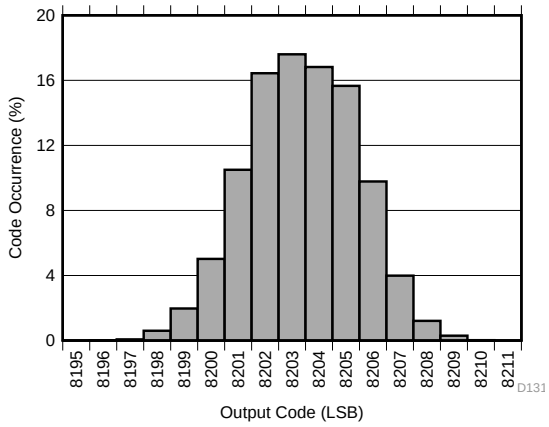


f_{IN} = 150 MHz

Figure 30. Performance vs Clock Duty Cycle

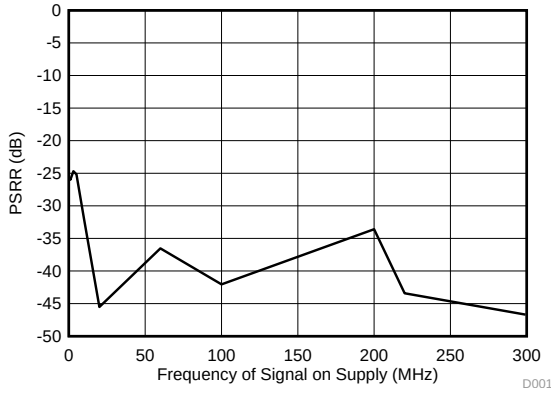
Typical Characteristics (continued)

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when chopper is enabled (unless otherwise noted)



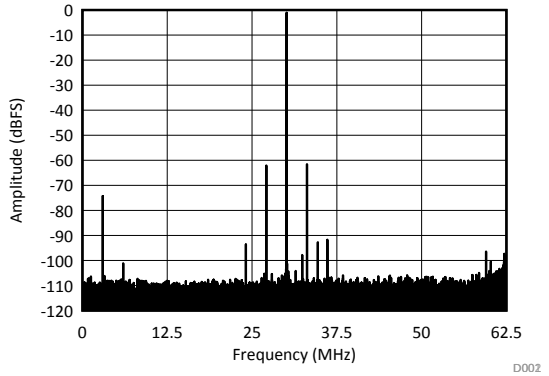
RMS Noise = 1.4 LSBs

Figure 31. Idle Channel Histogram



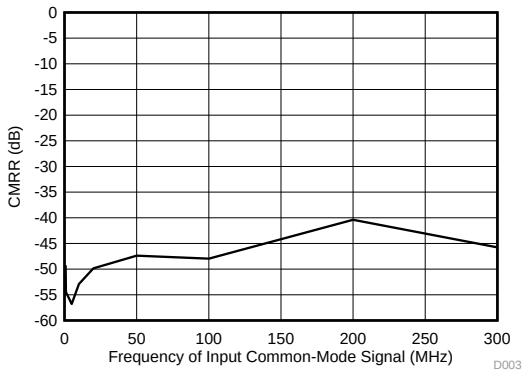
f_{IN} = 30 MHz, A_{IN} = –1 dBFS,
test signal amplitude = 50 mV_{PP}

Figure 32. Power-Supply Rejection Ratio vs Test Signal Frequency



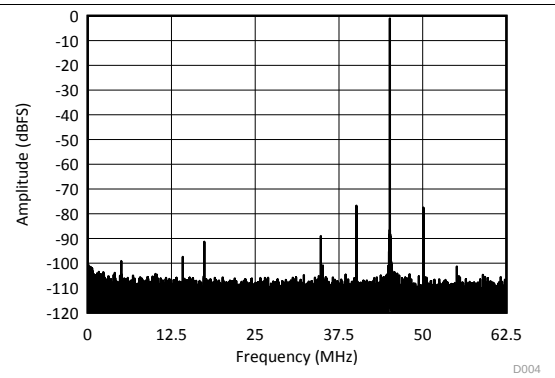
f_{IN} = 30.1 MHz, f_{PSRR} = 3 MHz, A_{PSRR} = 50 mV_{PP},
SNR = 58.51 dBFS, SINAD = 58.51 dBFS, SFDR = 60.53 dBc,
THD = –90.71 dBc, SFDR = 60.53 dBc (non 23)

Figure 33. Power-Supply Rejection Ratio Spectrum



f_{IN} = 30 MHz, A_{IN} = –1 dBFS,
test signal amplitude = 50 mV_{PP}

Figure 34. Common-Mode Rejection Ratio vs Test Signal Frequency



f_{IN} = 170.1 MHz, f_{CMRR} = 5 MHz, A_{CMRR} = 50 mV_{PP},
SNR = 69.72 dBFS, SINAD = 69.66 dBFS, SFDR = 75.66 dBc,
THD = –86.98 dBc, SFDR = 75.66 dBc (non 23)

Figure 35. Common-Mode Rejection Ratio Spectrum

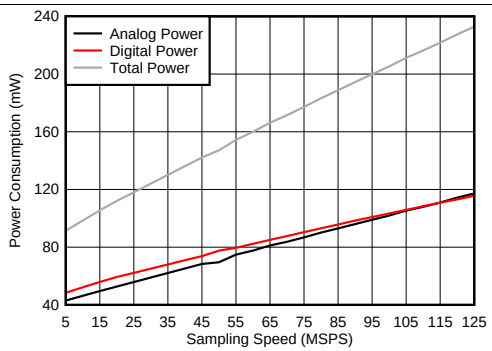


Figure 36. Power vs Sampling Frequency (1-Wire Mode)

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7.11 Typical Characteristics: Contour

typical values at T_A = 25°C, ADC sampling rate = 125 MSPS, 50% clock duty cycle, AVDD = 1.8 V, DVDD = 1.8 V, –1-dBFS differential input, 2-V_{PP} full-scale, 32k-point FFT, chopper disabled, and SNR reported with a 1-MHz offset from dc when chopper is disabled and from f_S / 2 when is chopper enabled (unless otherwise noted)

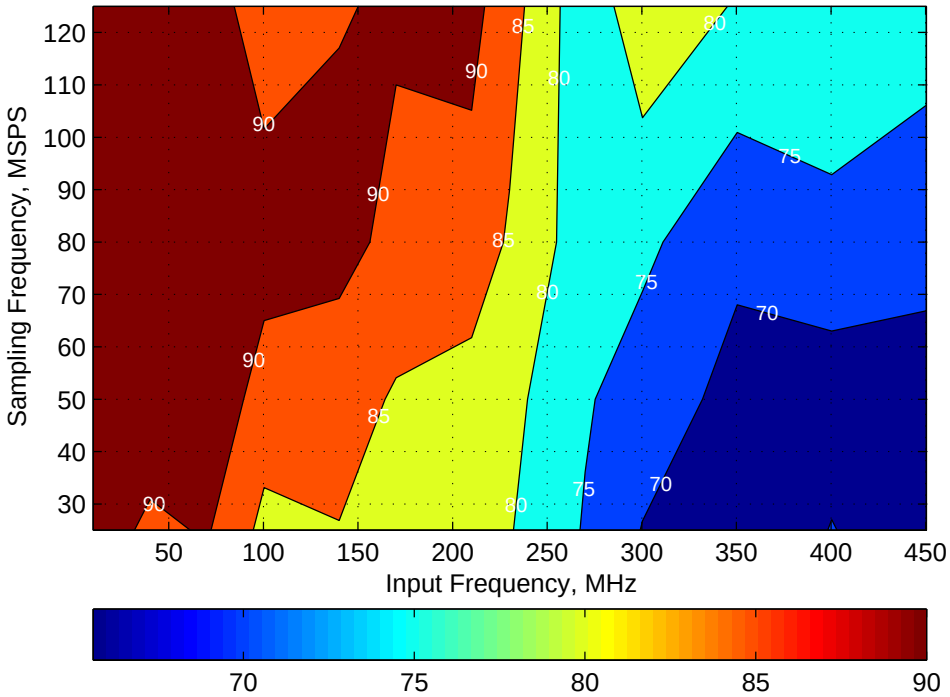


Figure 37. Spurious-Free Dynamic Range (SFDR)

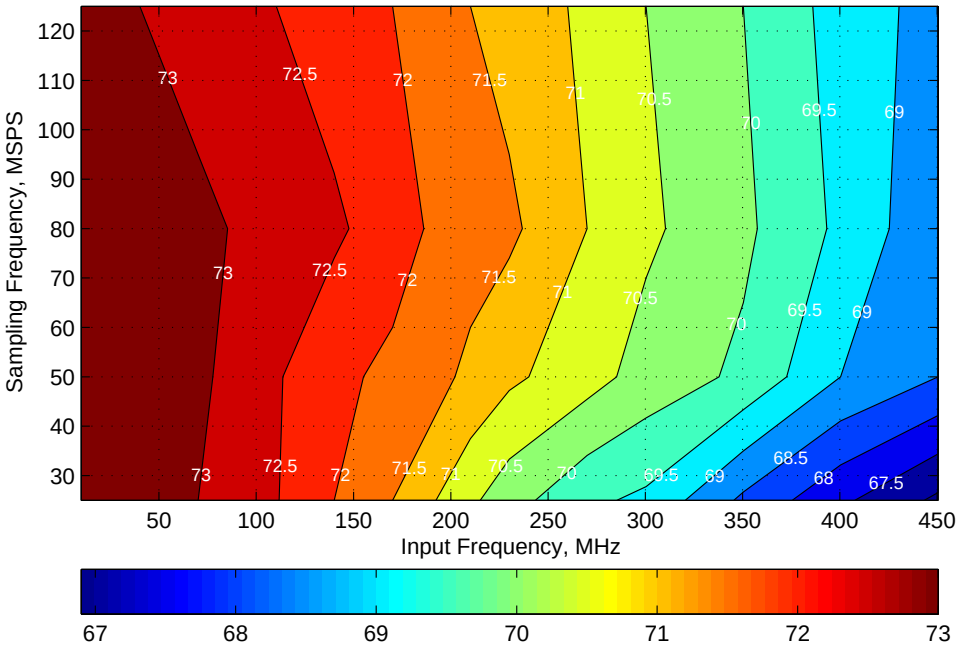
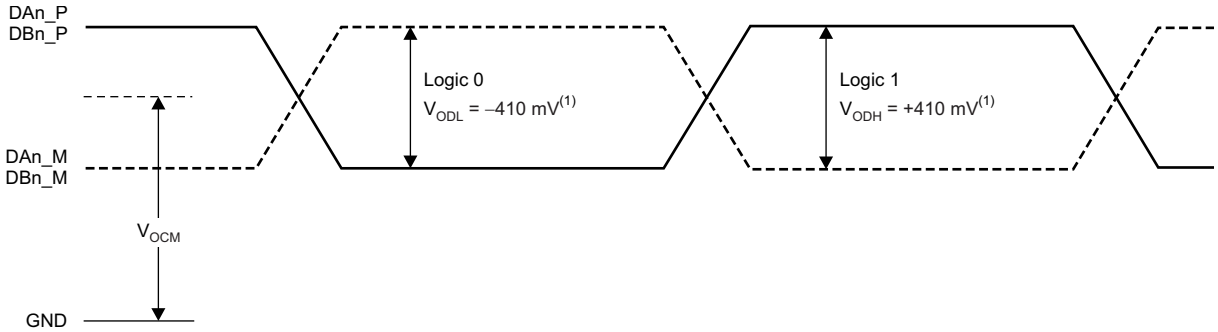


Figure 38. Signal-to-Noise Ratio (SNR)

8 Parameter Measurement Information

8.1 Timing Diagrams



(1) With an external 100-Ω termination.

Figure 39. Serial LVDS Output Voltage Levels

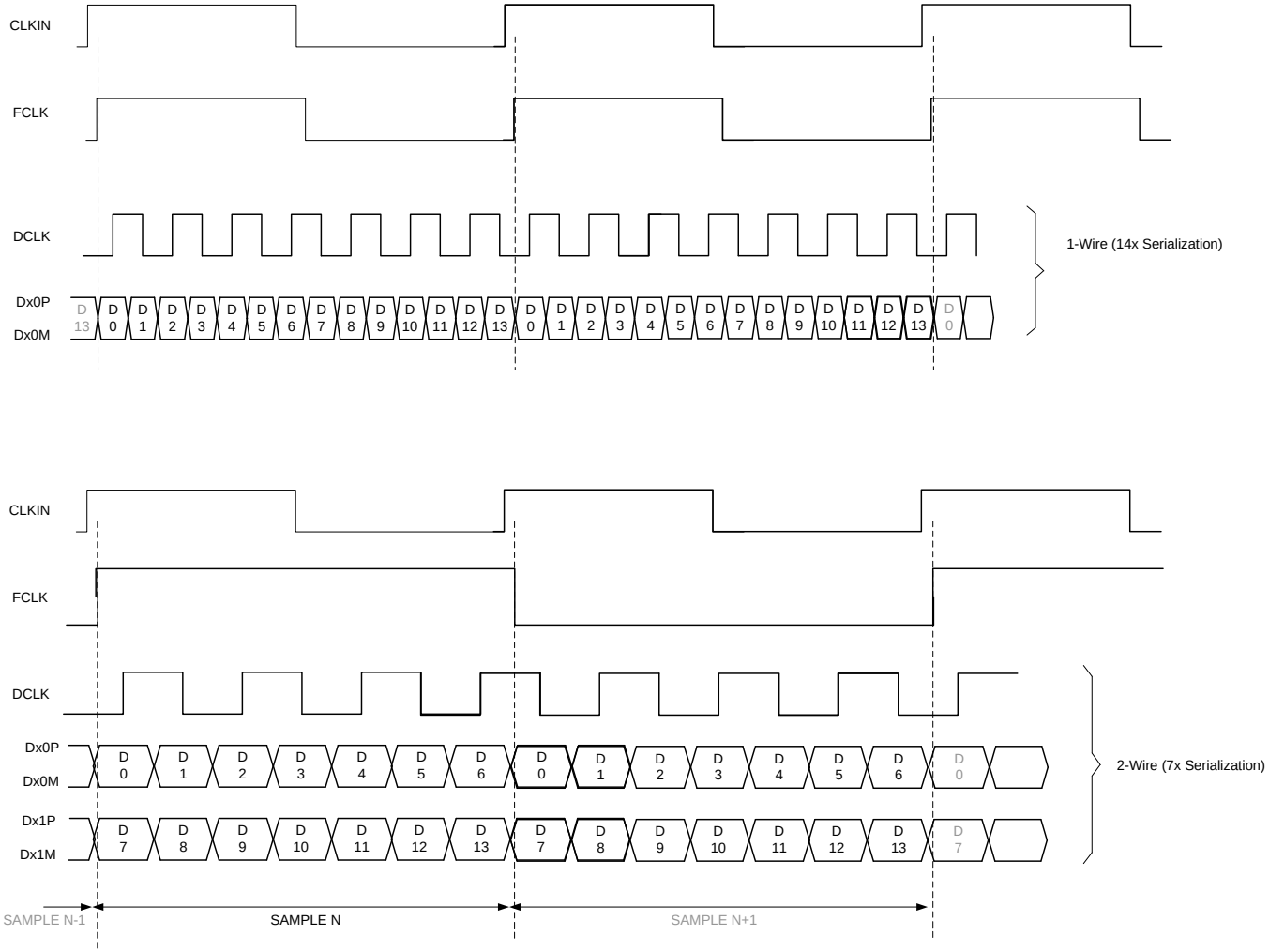


Figure 40. Output Timing Diagram

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Timing Diagrams (continued)

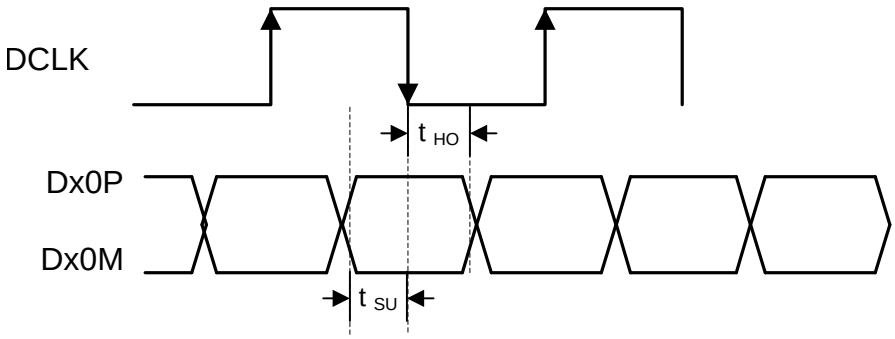
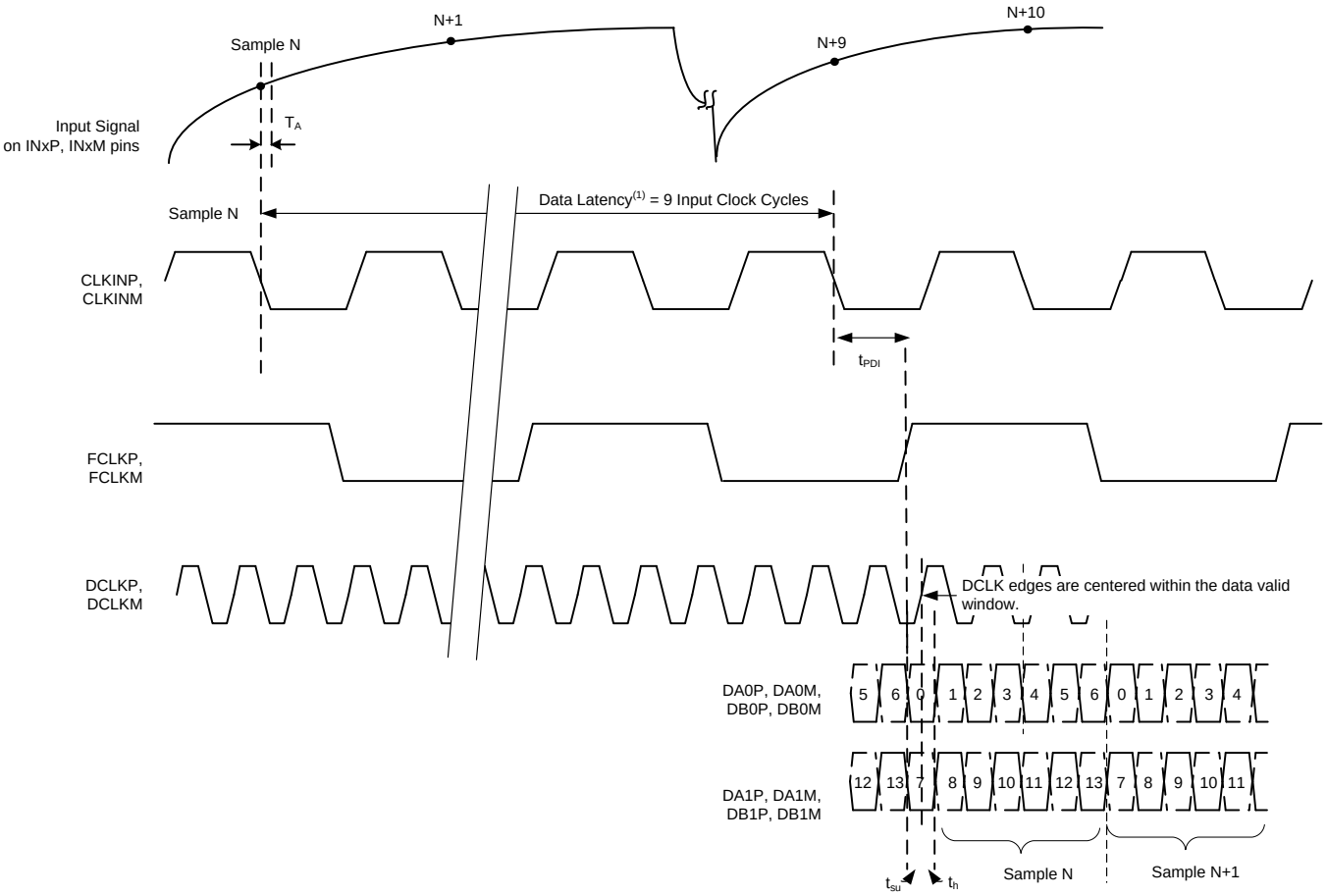


Figure 41. Setup and Hold Time



(1) Overall latency = data latency + t_{PDI}.

Figure 42. Latency Diagram

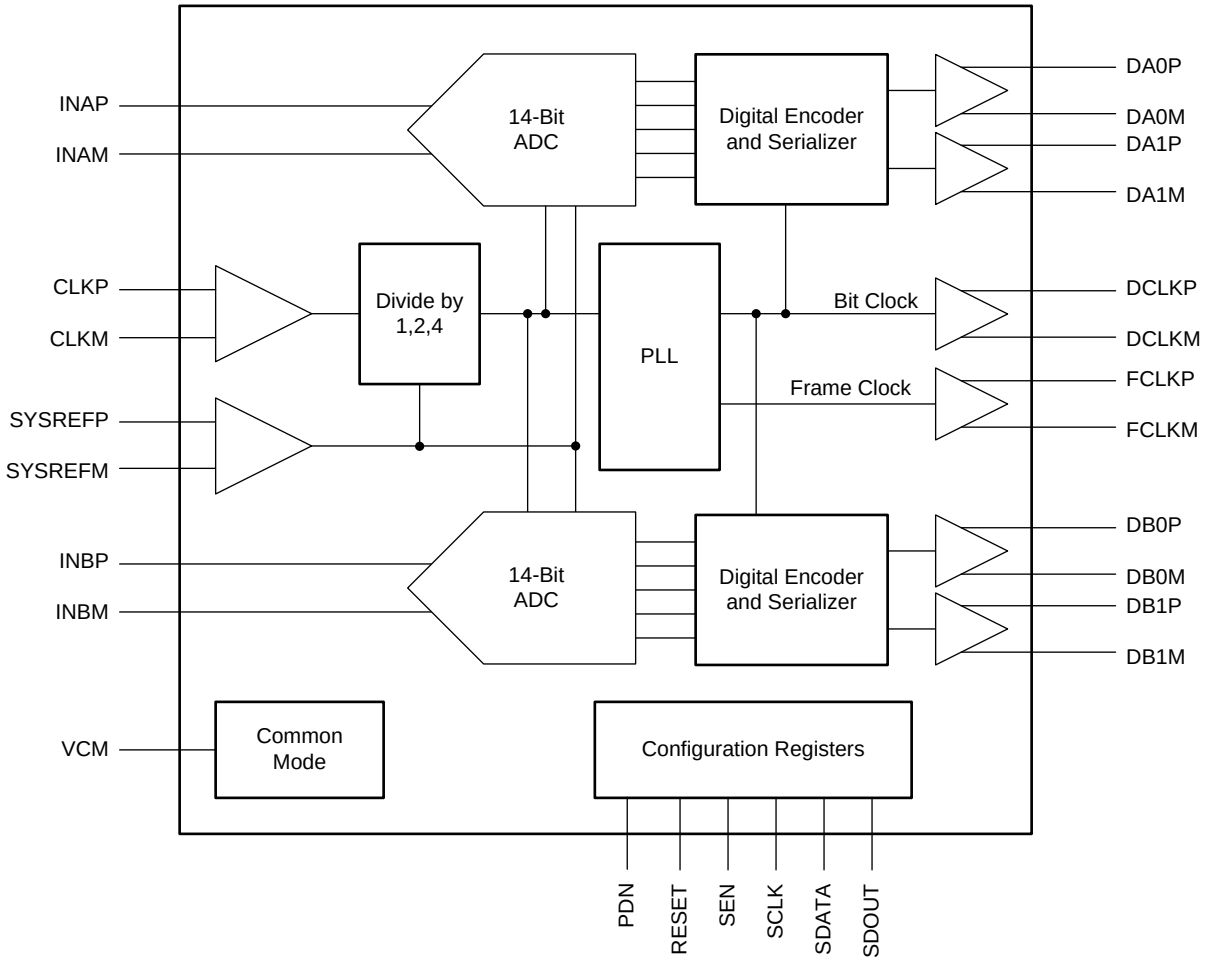
9 Detailed Description

9.1 Overview

The ADC3244E is a high-performance, 14-bit, 125-MSPS, dual channel analog-to-digital converter (ADC) with ultra-low power consumption. The ADC3244E supports the extended ambient temperature range of –50°C to +105°C, making this device a great choice for extreme temperature conditions while delivering excellent noise and linearity performance.

The LVDS output interface reduces number of connections between the ADC and receiving device, such as an FPGA, which results in power saving and higher system integration. The device supports an input dynamic range of 2 V_{PP}, and is equipped with digital features such as chopper function and dither algorithm. The chopper function helps in shifting the ADC 1/f noise spectrum to the Nyquist frequency, while preserving the signal spectrum, thus making this device useful for dc-coupling applications. The internal dither algorithms help clean higher-order harmonic spurs from the ADC output spectrum. See the *Chopper Functionality* and *Internal Dither Algorithm* sections for more details on chopper and dither functions, respectively.

9.2 Functional Block Diagram



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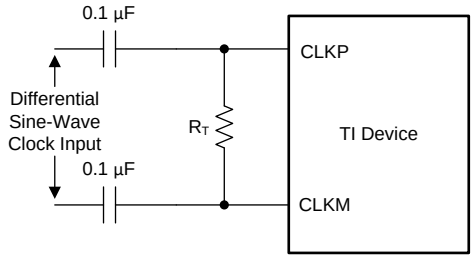
9.3 Feature Description

9.3.1 Analog Inputs

The ADC3244E analog signal inputs are designed to be driven differentially. Each input pin (INP, INM) must swing symmetrically between (VCM + 0.5 V) and (VCM – 0.5 V), resulting in a 2-V_{PP} (default) differential input swing. The input sampling circuit has a 3-dB bandwidth that extends up to 540 MHz (50-Ω source driving 50-Ω termination between INP and INM).

9.3.2 Clock Input

The device clock inputs can be driven differentially (sine, LVPECL, or LVDS) or single-ended (LVCMOS), with little or no difference in performance between them. The common-mode voltage of the clock inputs is set to 0.95 V using internal 5-kΩ resistors. The self-bias clock inputs of the ADC3244E are driven by the transformer-coupled, sine-wave clock source or by the ac-coupled, LVPECL and LVDS clock sources, as shown in Figure 43, Figure 44, and Figure 45. See Figure 46 for details regarding the internal clock buffer.



NOTE: R_T = termination resistor, if necessary.

Figure 43. Differential Sine-Wave Clock Driving Circuit

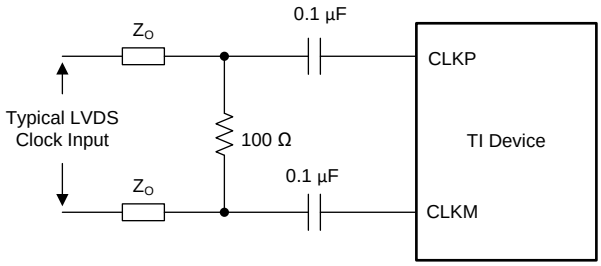


Figure 44. LVDS Clock Driving Circuit

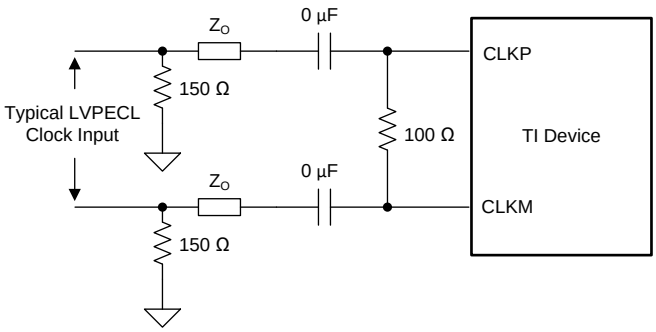
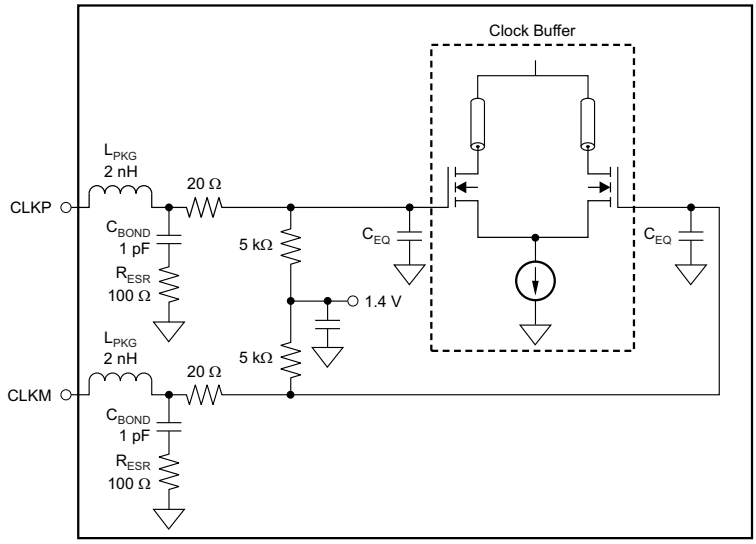


Figure 45. LVPECL Clock Driving Circuit



NOTE: C_{EQ} is 1 pF to 3 pF and is the equivalent input capacitance of the clock buffer.

Figure 46. Internal Clock Buffer

A single-ended CMOS clock can be ac-coupled to the CLKP input, with CLKM connected to ground with a 0.1-µF capacitor, as shown in Figure 47. However, for best performance the clock inputs must be driven differentially, thereby reducing susceptibility to common-mode noise. For high input frequency sampling, TI recommends using a clock source with very low jitter. Band-pass filtering of the clock source can help reduce the effects of jitter. There is no change in performance with a non-50% duty cycle clock input.

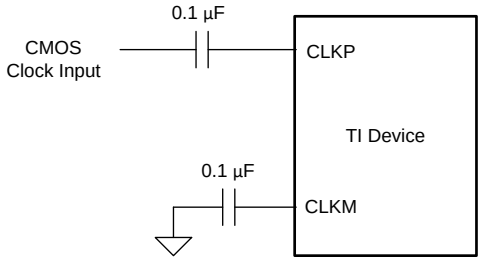


Figure 47. Single-Ended Clock Driving Circuit

9.3.2.1 SNR and Clock Jitter

The signal-to-noise ratio of the ADC is limited by three different factors, as shown in Equation 1. Quantization noise (typically 86 dB for a 14-bit ADC) and thermal noise limit SNR at low input frequencies while the clock jitter sets SNR for higher input frequencies.

$$SNR_{ADC}[dBc] = -20 \cdot \log \sqrt{\left(10^{-\frac{SNR_{Quantization_Noise}}{20}}\right)^2 + \left(10^{-\frac{SNR_{Thermal_Noise}}{20}}\right)^2 + \left(10^{-\frac{SNR_{Jitter}}{20}}\right)^2} \quad (1)$$

The SNR limitation resulting from sample clock jitter can be calculated with Equation 2.

$$SNR_{Jitter}[dBc] = -20 \cdot \log\left(2\pi \cdot f_{in} \cdot t_{Jitter}\right) \quad (2)$$

The total clock jitter (t_{Jitter}) has two components: the internal aperture jitter (130 fs for the device) that is set by the noise of the clock input buffer and the external clock. t_{Jitter} can be calculated with Equation 3.

$$t_{Jitter} = \sqrt{\left(t_{Jitter,Ext.Clock_Input}\right)^2 + \left(t_{Aperture_ADC}\right)^2} \quad (3)$$

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External clock jitter can be minimized by using high-quality clock sources and jitter cleaners as well as bandpass filters at the clock input while a faster clock slew rate improves the ADC aperture jitter. The ADC3244E has a typical thermal noise of 73.5 dBFS and internal aperture jitter of 130 fs. Figure 48 shows SNR (from 1 MHz offset leaving the 1/f flicker noise) for different jitter of clock driver.

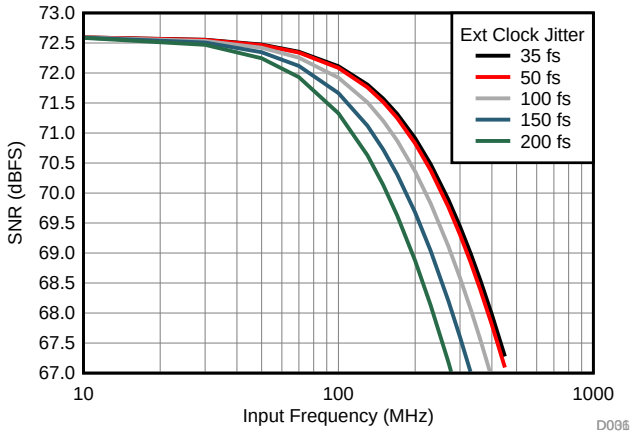

Figure 48. SNR vs Frequency for Different Clock Jitter

9.3.3 Digital Output Interface

The devices offer two different output format options, thus making interfacing to a field-programmable gate array (FPGA) or an application-specific integrated circuit (ASIC) easy. Each option can be easily programmed using the serial interface, as shown in Table 3. The output interface options are:

- One-wire, 1x frame clock, 14x serialization with the DDR bit clock and
- Two-wire, 0.5x frame clock, 7x serialization with the DDR bit clock.

Table 3. Interface Rates

INTERFACE OPTIONS	SERIALIZATION	RECOMMENDED SAMPLING FREQUENCY (MSPS)		BIT CLOCK FREQUENCY (MHz)	FRAME CLOCK FREQUENCY (MHz)	SERIAL DATA RATE (Mbps)
		MINIMUM	MAXIMUM			
1-wire	14x	15 (1)	—	105	15	210
		—	80	560	80	1120
2-wire (default after reset)	7x	20 (1)	—	70	10	140
		—	125	437.5	62.5	875

(1) Use the LOW SPEED ENABLE register bits for low speed operation; see Table 22.

9.3.3.1 One-Wire Interface: 14x Serialization

In this interface option, the device outputs the data of each ADC serially on a single LVDS pair (one-wire). The data are available at the rising and falling edges of the bit clock (DDR bit clock). The ADC outputs a new word at the rising edge of every frame clock, starting with the MSB. The data rate is 14x sample frequency (14x serialization).

9.3.3.2 Two-Wire Interface: 7x Serialization

The two-wire interface is recommended for sampling frequencies above 65 MSPS. The output data rate is 7x sample frequency because seven data bits are output every clock cycle on each differential pair. Each ADC sample is sent over the two wires with the seven MSBs on Dx1P, Dx1M and the seven LSBs on Dx0P, Dx0M, as shown in Figure 49. Note that in two-wire mode, the frame clock (FCLK) frequency is half of sampling clock (CLKIN) frequency.

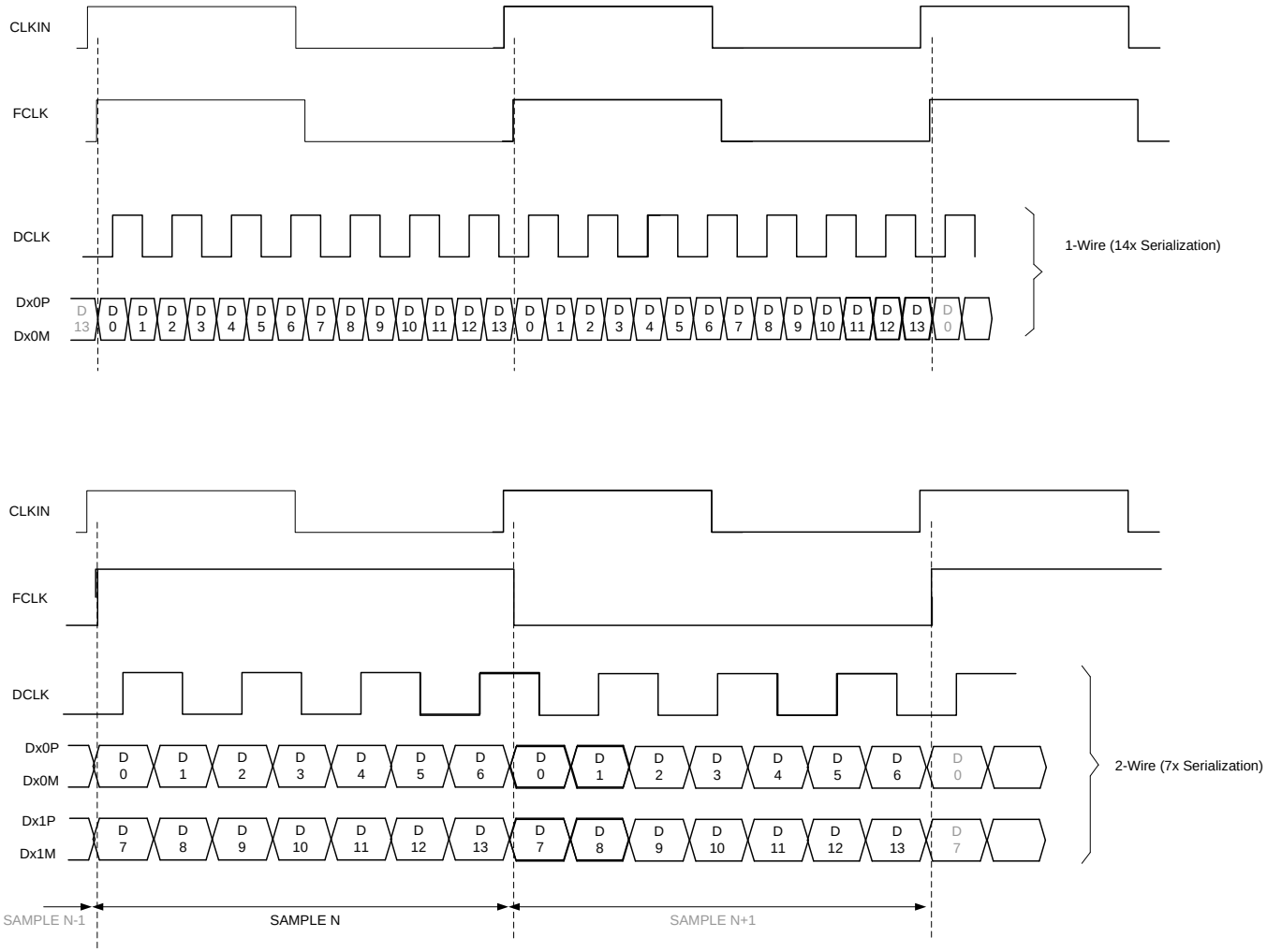

Figure 49. Output Timing Diagram

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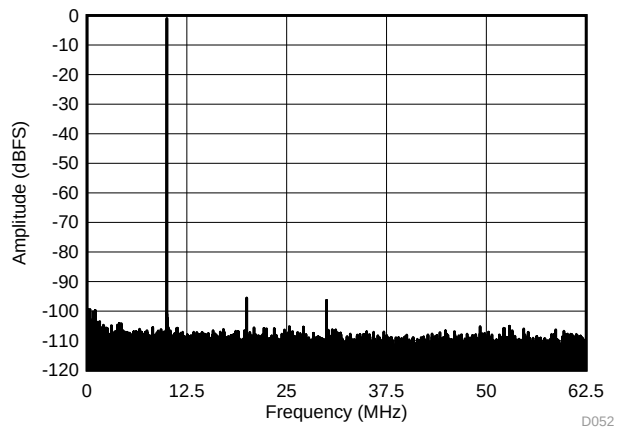
9.4 Device Functional Modes

9.4.1 Input Clock Divider

The devices are equipped with an internal divider on the clock input. The clock divider allows operation with a faster input clock, thus simplifying the system clock distribution design. The clock divider can be bypassed for operation with a 125-MHz clock while the divide-by-2 option supports a maximum input clock of 250 MHz and the divide-by-4 option provides a maximum input clock frequency of 500 MHz.

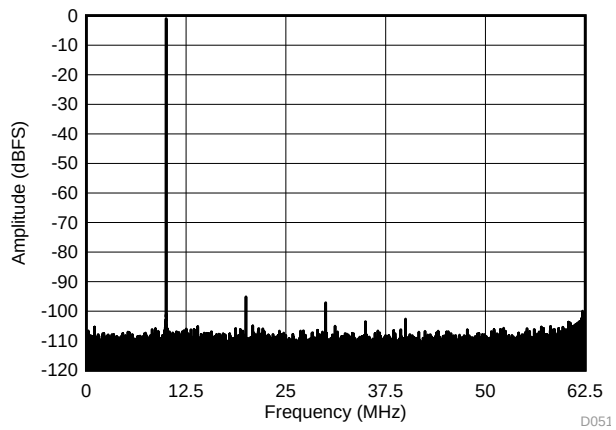
9.4.2 Chopper Functionality

The devices are equipped with an internal chopper front-end. Enabling the chopper function swaps the ADC noise spectrum by shifting the 1/f noise from dc to f_S / 2. Figure 50 shows the noise spectrum with the chopper off and Figure 51 shows the noise spectrum with the chopper on. This function is especially useful in applications requiring good ac performance at low input frequencies or in dc-coupled applications. The chopper can be enabled via SPI register writes and is recommended for input frequencies below 30 MHz. The chopper function creates a spur at f_S / 2 that must be filtered out digitally.



f_{IN} = 10 MHz, f_S = 125 MHz

Figure 50. ADC Output Spectrum With Chopper Off



f_{IN} = 10 MHz, f_S = 125 MHz

Figure 51. ADC Output Spectrum With Chopper On

9.4.3 Power-Down Control

The power-down functions of the ADC3244E can be controlled either through the parallel control pin (PDN) or through an SPI register setting (see register 15h). The PDN pin can also be configured using the SPI to a global power-down or standby functionality, as shown in Table 4.

Table 4. Power-Down Modes

FUNCTION	POWER CONSUMPTION (mW)	WAKE-UP TIME (µs)
Global power-down	5	85
Standby	81	35

9.4.3.1 Improving Wake-Up Time From Global Power-Down

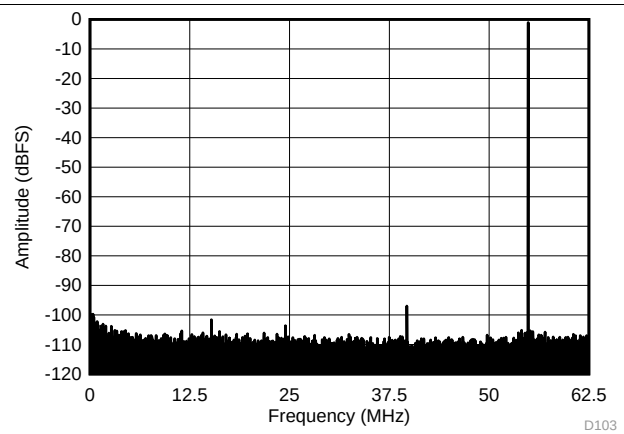
The device has an internal low-pass filter in the sampling clock path. This low-pass filter helps improve the aperture jitter of the device. However, in applications where input frequencies are < 200 MHz, noise from the aperture jitter does not dominate the overall SNR of the device. In such applications, the wake-up time from a global power-down can be reduced by bypassing the low-pass filter using the DIS CLK FILT register bit (write 80h to register address 70Ah). As shown in Table 5, setting the DIS CLK FILT bit improves the wake-up time from a global power-down from 85 µs to 55 µs.

Table 5. Wake-Up Time From Global Power-Down

DIS CLK FILT REGISTER BIT	GLOBAL PDN REGISTER BIT	WAKE-UP TIME		
		TYP	MAX	UNIT
0	0→1→0	85	140	µs
1	0→1→0	55	81	µs

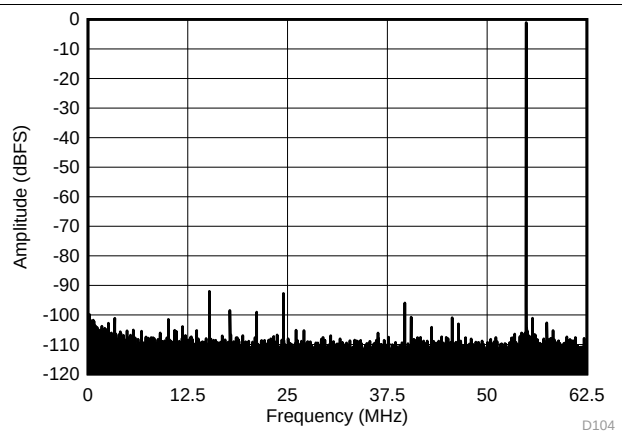
9.4.4 Internal Dither Algorithm

The ADC3244E uses an internal dither algorithm to achieve high SFDR and a clean spectrum. However, the dither algorithm marginally degrades SNR, creating a trade-off between SNR and SFDR. If desired, the dither algorithm can be turned off by using the DIS DITH CHx registers bits. Figure 52 and Figure 53 show the effect of using dither algorithms.



SFDR = 95.9 dBc, SNR = 72.7 dBFS, SINAD = 72.7 dBFS, THD = 93.6 dBc, HD2 = –100.6 dBc, HD3 = –95.9 dBc

Figure 52. FFT with Dither On



SFDR = 90.9 dBc, SNR = 73.3 dBFS, SINAD = 73.1 dBFS, THD = 87 dBc, HD2 = –90.9 dBc, HD3 = –94.9 dBc

Figure 53. FFT with Dither Off

9.5 Programming

The ADC3244E can be configured using a serial programming interface, as described in this section.

9.5.1 Serial Interface

The device has a set of internal registers that can be accessed by the serial interface formed by the SEN (serial interface enable), SCLK (serial interface clock), SDATA (serial interface data), and SDOUT (serial interface data output) pins. Serially shifting bits into the device is enabled when SEN is low. Serial data SDATA are latched at every SCLK rising edge when SEN is active (low). The serial data are loaded into the register at every 24th SCLK rising edge when SEN is low. When the word length exceeds a multiple of 24 bits, the excess bits are ignored. Data can be loaded in multiples of 24-bit words within a single active SEN pulse. The interface can function with SCLK frequencies from 20 MHz down to very low speeds (of a few hertz) and also with a non-50% SCLK duty cycle.

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Programming (continued)

9.5.1.1 Register Initialization

After power-up, the internal registers **must be** initialized to their default values through a hardware reset by applying a high pulse on the RESET pin (of durations greater than 10 ns), as shown in Figure 54. If required, the serial interface registers can be cleared during operation either:

1. Through a hardware reset, or
2. By applying a software reset. When using the serial interface, set the RESET bit (D0 in register address 06h) high. This setting initializes the internal registers to the default values and then self-resets the RESET bit low. In this case, the RESET pin is kept low.

9.5.1.1.1 Serial Register Write

The device internal register can be programmed with these steps:

1. Drive the SEN pin low,
2. Set the R/W bit to 0 (bit A15 of the 16-bit address),
3. Set bit A14 in the address field to 1,
4. Initiate a serial interface cycle by specifying the address of the register (A13 to A0) whose content must be written, and
5. Write the 8-bit data that are latched in on the SCLK rising edge.

Figure 54 and Table 6 show the timing requirements for the serial register write operation.

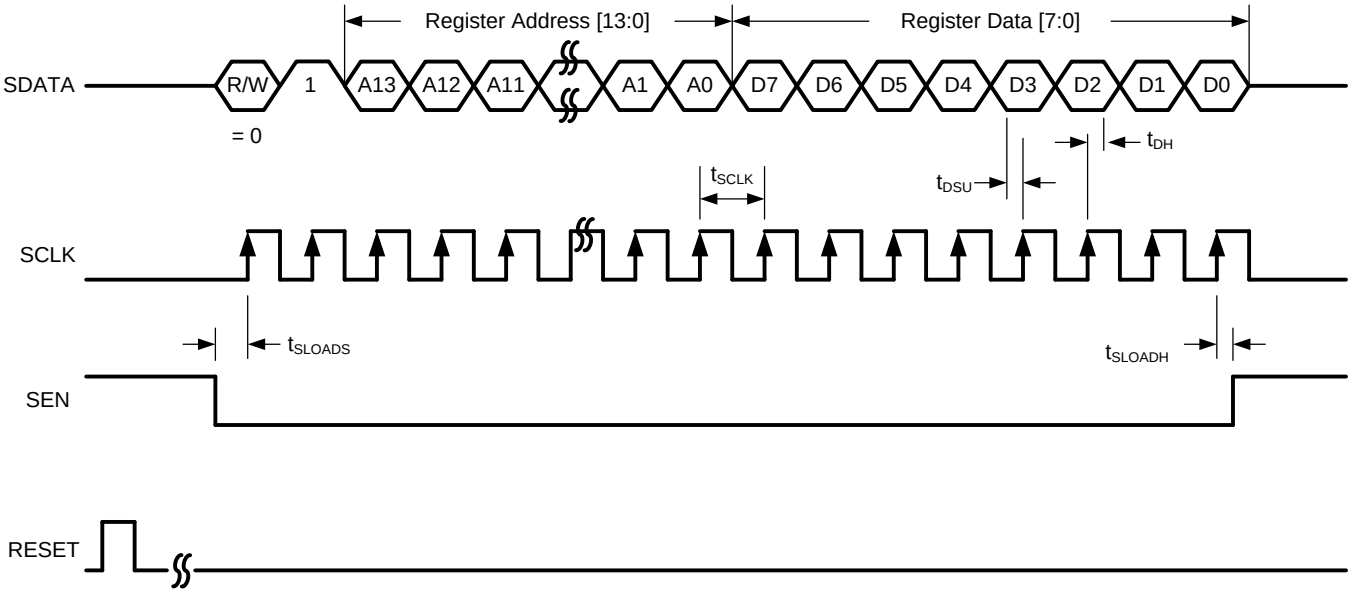

Figure 54. Serial Register Write Timing Diagram

Table 6. Serial Interface Timing(1)

		MIN	TYP	MAX	UNIT
f_{SCLK}	SCLK frequency (equal to 1 / t_{SCLK})	> dc		20	MHz
t_{SLOADS}	SEN to SCLK setup time	25			ns
t_{SLOADH}	SCLK to SEN hold time	25			ns
t_{DSU}	SDIO setup time	25			ns
t_{DH}	SDIO hold time	25			ns

(1) Full temperature range is from –50°C to +105°C, and AVDD = DVDD = 1.8 V.

9.5.1.1.2 Serial Register Readout

The device includes a mode where the contents of the internal registers can be read back using the SDOUT pin. This readback mode can be useful as a diagnostic check to verify the serial interface communication between the external controller and the ADC. Given below is the procedure to read contents of serial registers:

1. Drive the SEN pin low.
2. Set the R/W bit (A15) to 1. This setting disables any further writes to the registers.
3. Set bit A14 in the address field to 1.
4. Initiate a serial interface cycle specifying the address of the register (A13 to A0) whose content must be read.
5. The device outputs the contents (D7 to D0) of the selected register on the SDOUT pin.
6. The external controller can latch the contents at the SCLK rising edge.
7. To enable register writes, reset the R/W register bit to 0.

When READOUT is disabled, the SDOUT pin is in a high-impedance mode. If serial readout is not used, the SDOUT pin must float. Figure 55 shows a timing diagram of the serial register read operation. Data appear on the SDOUT pin at the SCLK falling edge with an approximate delay (t_{SD_DELAY}) of 20 ns, as shown in Figure 56.

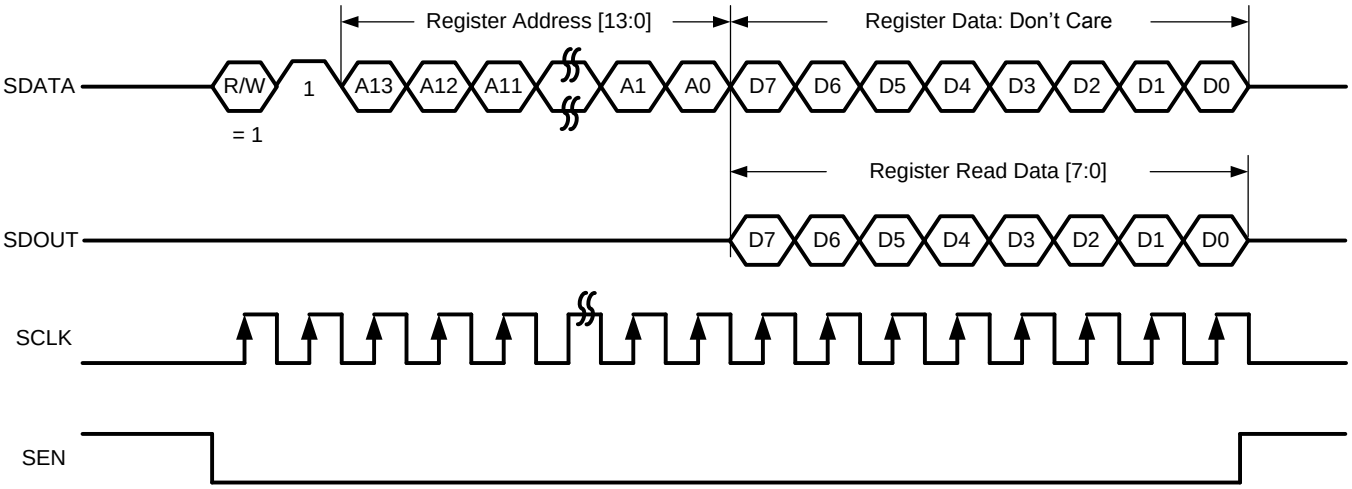

Figure 55. Serial Register Read Timing Diagram

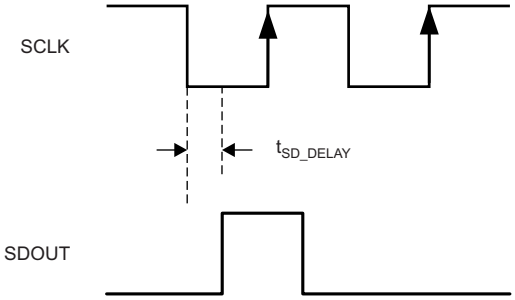

Figure 56. SDOUT Timing Diagram

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9.5.2 Register Initialization

After power-up, the internal registers must be initialized to their default values through a hardware reset by applying a high pulse on the RESET pin, as shown in Figure 57 and Table 7.

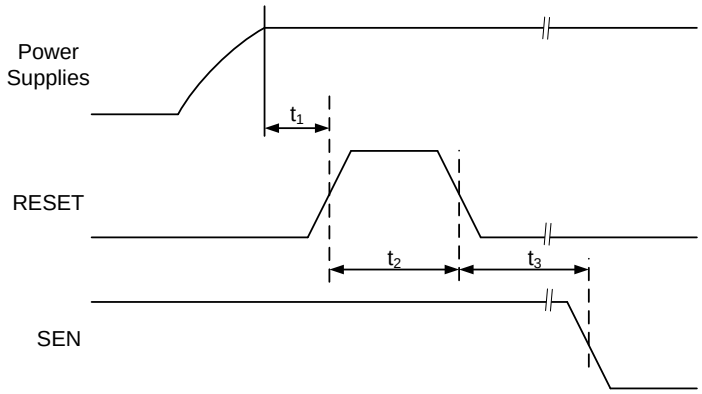

Figure 57. Initialization of Serial Registers after Power-Up

Table 7. Power-Up Timing

		MIN	TYP	MAX	UNIT
t_1	Power-on delay: delay from power up to active high RESET pulse	1			ms
t_2	Reset pulse duration: active high RESET pulse duration	10		1000	ns
t_3	Register write delay: delay from RESET disable to SEN active	100			ns

If required, the serial interface registers can be cleared during operation either:

1. Through hardware reset, or
2. By applying a software reset. When using the serial interface, set the RESET bit (D0 in register address 06h) high. This setting initializes the internal registers to the default values and then self-resets the RESET bit low. In this case, the RESET pin is kept low.

9.6 Register Maps

Table 8. Register Map Summary

REGISTER ADDRESS	REGISTER DATA							
A[13:0] (Hex)	D7	D6	D5	D4	D3	D2	D1	D0
01	0	0	DIS DITH CHA		DIS DITH CHB		0	0
03	0	0	0	0	0	0	0	ODD EVEN
04	0	0	0	0	0	0	0	FLIP WIRE
05	0	0	0	0	0	0	0	1W-2W
06	0	0	0	0	0	0	TEST PATTERN EN	RESET
07	0	0	0	0	0	0	0	OVR ON LSB
09	0	0	0	0	0	0	ALIGN TEST PATTERN	DATA FORMAT
0A	0	0	0	0	CHA TEST PATTERN			
0B	CHB TEST PATTERN			0	0	0	0	0
0E	CUSTOM PATTERN[13:6]							
0F	CUSTOM PATTERN[5:0]						0	0
13	0	0	0	0	0	0	LOW SPEED ENABLE	
15	0	CHA PDN	CHB PDN	0	STANDBY	GLOBAL PDN	0	CONFIG PDN PIN
25	LVDS SWING							
27	CLK DIV		0	0	0	0	0	0
41D	0	0	0	0	0	0	HIGH IF MODE0	0
422	0	0	0	0	0	0	DIS CHOP CHA	0
434	0	0	DIS DITH CHA	0	DIS DITH CHA	0	0	0
439	0	0	0	0	SP1 CHA	0	0	0
51D	0	0	0	0	0	0	HIGH IF MODE1	0
522	0	0	0	0	0	0	DIS CHOP CHB	0
534	0	0	DIS DITH CHB	0	DIS DITH CHB	0	0	0
539	0	0	0	0	SP1 CHB	0	0	0
608	HIGH IF MODE[3:2]		0	0	0	0	0	0
70A	DIS CLK FILT	0	0	0	0	0	0	PDN SYSREF

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9.6.1 Summary of Special Mode Registers

Table 9 lists the location, value, and functions of special mode registers in the device.

Table 9. Special Modes Summary

MODE	REGISTER SETTINGS	DESCRIPTION
Special modes	Registers 439h (bit 3) and 539h (bit 3)	Always set these bits high for best performance
Disable dither	Registers 1h (bits 5-2), 434h (bits 5 and 3), and 534h (bits 5 and 3)	Disable dither to improve SNR
Disable chopper	Registers 422h (bit 1) and 522h (bit 1)	Disable chopper to shift 1/f noise floor at dc
High IF modes	Registers 41Dh (bit 1), 51Dh (bit 1), and 608h (bits 7-6)	Improves HD3 for IF > 100 MHz

9.6.2 Serial Register Description

9.6.2.1 Register 01h

Figure 58. Register 01h

7	6	5	4	3	2	1	0
0	0	DIS DITH CHA		DIS DITH CHB		0	0
W-0h	W-0h	R/W-0h		R/W-0h		W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 10. Register 01h Description

Bit	Field	Type	Reset	Description
7-6	0	W	0h	Must write 0
5-4	DIS DITH CHA	R/W	0h	These bits enable or disable the on-chip dither. Control this bit with bits 5 and 3 of register 434h. 00 = Default 11 = Dither is disabled for channel A. In this mode, SNR typically improves by 0.5 dB at 70 MHz.
3-2	DIS DITH CHB	R/W	0h	These bits enable or disable the on-chip dither. Control this bit with bits 5 and 3 of register 434h. 00 = Default 11 = Dither is disabled for channel B. In this mode, SNR typically improves by 0.5 dB at 70 MHz.
1-0	0	W	0h	Must write 0

9.6.2.2 Register 03h

Figure 59. Register 03h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	ODD EVEN
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 11. Register 03h Description

Bit	Field	Type	Reset	Description
7-1	0	W	0h	Must write 0
0	ODD EVEN	R/W	0h	This bit selects the bit sequence on the output lanes (in 2-wire mode only). 0 = Bits 0, 1, and 2 appear on lane 0; bits 7, 8, and 9 appear on lane 1 1 = Bits 0, 2, and 4 appear on lane 0; bits 1, 3, and 5 appear on lane 1

9.6.2.3 Register 04h

Figure 60. Register 04h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	FLIP WIRE
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 12. Register 04h Description

Bit	Field	Type	Reset	Description
7-1	0	W	0h	Must write 0
0	FLIP WIRE	R/W	0h	This bit flips the data on the output wires. Valid only in two wire configuration. 0 = Default 1 = Data on output wires is flipped. Pin D0x becomes D1x, and vice versa.

9.6.2.4 Register 05h

Figure 61. Register 05h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1W-2W
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 13. Register 05h Description

Bit	Field	Type	Reset	Description
7-1	0	W	0h	Must write 0
0	1W-2W	R/W	0h	This bit transmits output data on either one or two wires. 0 = Output data are transmitted on two wires (Dx0P, Dx0M and Dx1P, Dx1M) 1 = Output data are transmitted on one wire (Dx0P, Dx0M). In this mode, the recommended f_S is less than 62.5 MSPS.

9.6.2.5 Register 06h

Figure 62. Register 06h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	TEST PATTERN EN	RESET
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 14. Register 06h Description

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0
1	TEST PATTERN EN	R/W	0h	This bit enables test pattern selection for the digital outputs. 0 = Normal output 1 = Test pattern output enabled
0	RESET	W	0h	This bit applies a software reset. This bit resets all internal registers to the default values and self-clears to 0.

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9.6.2.6 Register 07h

Figure 63. Register 07h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	OVR ON LSB
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 15. Register 07h Description

Bit	Field	Type	Reset	Description
7-1	0	W	0h	Must write 0
0	OVR ON LSB	R/W	0h	This bit provides the overrange (OVR) information on the LSB bits. 0 = Output data bit 0 functions as the LSB of the 14-bit data 1 = Output data bit 0 carries the OVR information.

9.6.2.7 Register 09h

Figure 64. Register 09h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	ALIGN TEST PATTERN	DATA FORMAT
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 16. Register 09h Description

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0
1	ALIGN TEST PATTERN	R/W	0h	This bit aligns the test patterns across the outputs of both channels. 0 = Test patterns of both channels are free running 1 = Test patterns of both channels are aligned
0	DATA FORMAT	R/W	0h	This bit programs the digital output data format. 0 = Twos complement 1 = Offset binary

9.6.2.8 Register 0Ah

Figure 65. Register 0Ah

7	6	5	4	3	2	1	0
0	0	0	0	CHA TEST PATTERN			
W-0h	W-0h	W-0h	W-0h	R/W-0h			

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 17. Register 0Ah Description

Bit	Field	Type	Reset	Description
7-4	0	W	0h	Must write 0
3-0	CHA TEST PATTERN	R/W	0h	These bits control the test pattern for channel A after the TEST PATTERN EN bit is set. 0000 = Normal operation 0001 = All 0's 0010 = All 1's 0011 = Toggle pattern: data alternate between 10101010101010 and 01010101010101 0100 = Digital ramp: data increment by 1 LSB every clock cycle from code 0 to 16383 0101 = Custom pattern: output data are the same as programmed by the CUSTOM PATTERN register bits 0110 = Deskew pattern: data are 2AAAh 1000 = PRBS pattern: data are a sequence of pseudo random numbers 1001 = 8-point sine-wave: data are a repetitive sequence of the following eight numbers that form a sine-wave: 0, 2399, 8192, 13984, 16383, 13984, 8192, 2399. Others = Do not use

9.6.2.9 Register 0Bh

Figure 66. Register 0Bh

7	6	5	4	3	2	1	0
CHB TEST PATTERN				0	0	0	0
R/W-0h				W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 18. Register 0Bh Description

Bit	Field	Type	Reset	Description
7-4	CHB TEST PATTERN	R/W	0h	These bits control the test pattern for channel B after the TEST PATTERN EN bit is set. 0000 = Normal operation 0001 = All 0's 0010 = All 1's 0011 = Toggle pattern: data alternate between 10101010101010 and 01010101010101 0100 = Digital ramp: data increment by 1 LSB every clock cycle from code 0 to 16383 0101 = Custom pattern: output data are the same as programmed by the CUSTOM PATTERN register bits 0110 = Deskew pattern: data are 2AAAh 1000 = PRBS pattern: data are a sequence of pseudo random numbers 1001 = 8-point sine-wave: data are a repetitive sequence of the following eight numbers that form a sine-wave: 0, 2399, 8192, 13984, 16383, 13984, 8192, 2399. Others = Do not use
3-0	0	W	0h	Must write 0

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9.6.2.10 Register 0Eh

Figure 67. Register 0Eh

7	6	5	4	3	2	1	0
CUSTOM PATTERN[13:6]							
R/W-0h							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 19. Register 0Eh Description

Bit	Field	Type	Reset	Description
7-0	CUSTOM PATTERN[13:6]	R/W	0h	These bits set the 14-bit custom pattern (bits 13-6) for all channels.

9.6.2.11 Register 0Fh

Figure 68. Register 0Fh

7	6	5	4	3	2	1	0
CUSTOM PATTERN[5:0]						0	0
R/W-0h						W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 20. Register 0Fh Description

Bit	Field	Type	Reset	Description
7-2	CUSTOM PATTERN[5:0]	R/W	0h	These bits set the 14-bit custom pattern (bits 5-0) for all channels.
1-0	0	W	0h	Must write 0

9.6.2.12 Register 13h (address = 13h)

Figure 69. Register 13h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	LOW SPEED ENABLE	
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	

LEGEND: R/W = Read/Write; W = Write only; -n = value after reset

Table 21. Register 13h Field Descriptions

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0.
1-0	LOW SPEED ENABLE	R/W	0h	Enables low speed operation in 1-wire and 2-wire mode. Depending upon sampling frequency, write this bit as per Table 22.

Table 22. LOW SPEED ENABLE Register Bit Settings Across f_S

f_S (MSPS)		REGISTER BIT LOW SPEED ENABLE	
MIN	MAX	1-WIRE MODE	2-WIRE MODE
25	125	00	00
20	25	00	10
15	20	10	Not supported

9.6.2.13 Register 15h

Figure 70. Register 15h

7	6	5	4	3	2	1	0
0	CHA PDN	CHB PDN	0	STANDBY	GLOBAL PDN	0	CONFIG PDN PIN
W-0h	R/W-0h	R/W-0h	W-0h	R/W-0h	R/W-0h	W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 23. Register 15h Description

Bit	Field	Type	Reset	Description
7	0	W	0h	Must write 0
6	CHA PDN	R/W	0h	0 = Normal operation 1 = Power-down channel A
5	CHB PDN	R/W	0h	0 = Normal operation 1 = Power-down channel B
4	0	W	0h	Must write 0
3	STANDBY	R/W	0h	The ADCs of both channels enter standby. 0 = Normal operation 1 = Standby
2	GLOBAL PDN	R/W	0h	0 = Normal operation 1 = Global power-down
1	0	W	0h	Must write 0
0	CONFIG PDN PIN	R/W	0h	This bit configures the PDN pin as either a global power-down or standby pin. 0 = Logic high voltage on the PDN pin sends the device into global power-down 1 = Logic high voltage on the PDN pin sends the device into standby

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9.6.2.14 Register 25h

Figure 71. Register 25h

7	6	5	4	3	2	1	0
LVDS SWING							
R/W-0h							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

Table 24. Register 25h Description

Bit	Field	Type	Reset	Description
7-0	LVDS SWING	R/W	0h	These bits control the swing of the LVDS outputs (including the data output, bit clock, and frame clock). For details see Table 25.

Table 25. LVDS Output Swing

BITS 7-4	BITS 3-0	LVDS OUTPUT SWING
0h	0h	Default (±425 mV)
Dh	9h	Swing reduces by 50 mV
Eh	Ah	Swing reduces by 100 mV
Fh	Dh	Swing reduces by 300 mV
Ch	Eh	Swing increases by 100 mV
Others	Others	Do not use

9.6.2.15 Register 27h

Figure 72. Register 27h

7	6	5	4	3	2	1	0
CLK DIV		0	0	0	0	0	0
R/W-0h		W-0h	W-0h	W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 26. Register 27h Description

Bit	Field	Type	Reset	Description
7-6	CLK DIV	R/W	0h	These bits set the internal clock divider for the input sampling clock. 00 = Divide-by-1 01 = Divide-by-1 10 = Divide-by-2 11 = Divide-by-4
5-0	0	W	0h	Must write 0

9.6.2.16 Register 41Dh

Figure 73. Register 41Dh

7	6	5	4	3	2	1	0
0	0	0	0	0	0	HIGH IF MODE0	0
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 27. Register 41Dh Description

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0
1	HIGH IF MODE0	R/W	0h	This bit improves HD3 for IF > 100 MHz. 0 = Normal operation For best HD3 at IF > 100 MHz, set HIGH IF MODE[3:0] to 1111.
0	0	W	0h	Must write 0

9.6.2.17 Register 422h

Figure 74. Register 422h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	DIS CHOP CHA	0
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 28. Register 422h Description

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0
1	DIS CHOP CHA	R/W	0h	Disable chopper. Set this bit to shift a 1/f noise floor at dc. 0 = 1/f noise floor is centered at f_S / 2 (default) 1 = Chopper mechanism is disabled; 1/f noise floor is centered at dc
0	0	W	0h	Must write 0

9.6.2.18 Register 434h

Figure 75. Register 434h

7	6	5	4	3	2	1	0
0	0	DIS DITH CHA	0	DIS DITH CHA	0	0	0
W-0h	W-0h	R/W-0h	W-0h	R/W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 29. Register 434h Description

Bit	Field	Type	Reset	Description
7-6	0	W	0h	Must write 0
5	DIS DITH CHA	R/W	0h	Set this bit with bits 5 and 4 of register 01h. 00 = Default 11 = Dither is disabled for channel A. In this mode, SNR typically improves by 0.5 dB at 70 MHz.
4	0	W	0h	Must write 0
3	DIS DITH CHA	R/W	0h	Set this bit with bits 5 and 4 of register 01h. 00 = Default 11 = Dither is disabled for channel A. In this mode, SNR typically improves by 0.5 dB at 70 MHz.
2-0	0	W	0h	Must write 0

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9.6.2.19 Register 439h

Figure 76. Register 439h

7	6	5	4	3	2	1	0
0	0	0	0	SP1 CHA	0	0	0
W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 30. Register 439h Description

Bit	Field	Type	Reset	Description
7-4	0	W	0h	Must write 0
3	SP1 CHA	R/W	0h	Special mode for best performance on channel A. Always write 1 after reset.
2-0	0	W	0h	Must write 0

9.6.2.20 Register 51Dh

Figure 77. Register 51Dh

7	6	5	4	3	2	1	0
0	0	0	0	0	0	HIGH IF MODE1	0
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 31. Register 51Dh Description

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0
1	HIGH IF MODE1	R/W	0h	This bit improves HD3 for IF > 100 MHz. 0 = Normal operation For best HD3 at IF > 100 MHz, set HIGH IF MODE[3:0] to 1111.
0	0	W	0h	Must write 0

9.6.2.21 Register 522h

Figure 78. Register 522h

7	6	5	4	3	2	1	0
0	0	0	0	0	0	DIS CHOP CHB	0
W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 32. Register 522h Description

Bit	Field	Type	Reset	Description
7-2	0	W	0h	Must write 0
1	DIS CHOP CHB	R/W	0h	Disable chopper. Set this bit to shift a 1/f noise floor at dc. 0 = 1/f noise floor is centered at f_S / 2 (default) 1 = Chopper mechanism is disabled; 1/f noise floor is centered at dc
0	0	W	0h	Must write 0

9.6.2.22 Register 534h

Figure 79. Register 534h

7	6	5	4	3	2	1	0
0	0	DIS DITH CHA	0	DIS DITH CHA	0	0	0
W-0h	W-0h	R/W-0h	W-0h	R/W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 33. Register 534h Description

Bit	Field	Type	Reset	Description
7-6	0	W	0h	Must write 0
5	DIS DITH CHA	R/W	0h	Set this bit with bits 3 and 2 of register 01h. 00 = Default 11 = Dither is disabled for channel B. In this mode, SNR typically improves by 0.5 dB at 70 MHz.
4	0	W	0h	Must write 0
3	DIS DITH CHA	R/W	0h	Set this bit with bits 3 and 2 of register 01h. 00 = Default 11 = Dither is disabled for channel B. In this mode, SNR typically improves by 0.5 dB at 70 MHz.
2-0	0	W	0h	Must write 0

9.6.2.23 Register 539h

Figure 80. Register 539h

7	6	5	4	3	2	1	0
0	0	0	0	SP1 CHB	0	0	0
W-0h	W-0h	W-0h	W-0h	R/W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 34. Register 539h Description

Bit	Field	Type	Reset	Description
7-4	0	W	0h	Must write 0
3	SP1 CHB	R/W	0h	Special mode for best performance on channel B. Always write 1 after reset.
0	0	W	0h	Must write 0

9.6.2.24 Register 608h

Figure 81. Register 608h

7	6	5	4	3	2	1	0
HIGH IF MODE[3:2]		0	0	0	0	0	0
R/W-0h		W-0h	W-0h	W-0h	W-0h	W-0h	W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 35. Register 608h Description

Bit	Field	Type	Reset	Description
7-6	HIGH IF MODE[3:2]	R/W	0h	This bit improves HD3 for IF > 100 MHz. 0 = Normal operation For best HD3 at IF > 100 MHz, set HIGH IF MODE[3:0] to 1111.
5-0	0	W	0h	Must write 0

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9.6.2.25 Register 70Ah

Figure 82. Register 70Ah

7	6	5	4	3	2	1	0
DIS CLK FILT	0	0	0	0	0	0	PDN SYSREF
R/W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	W-0h	R/W-0h

LEGEND: R/W = Read/Write; R = Read only; W = Write only; -n = value after reset

Table 36. Register 70Ah Description

Bit	Field	Type	Reset	Description
7	DIS CLK FILT	R/W	0h	Set this bit to improve wake-up time from global power-down mode; see the *Improving Wake-Up Time From Global Power-Down* section for details.
6-1	0	W	0h	Must write 0
0	PDN SYSREF	R/W	0h	If the SYSREF pins are not used in the system, the SYSREF buffer must be powered down by setting this bit. 0 = Normal operation 1 = Powers down the SYSREF buffer

10 Applications 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.

10.1 Application Information

Typical applications involving transformer coupled circuits are discussed in this section. Transformers (such as ADT1-1WT or WBC1-1) can be used up to 250 MHz to achieve good phase and amplitude balances at ADC inputs. While designing the dc driving circuits, the ADC input impedance must be considered. Figure 83 and Figure 84 show the impedance ($Z_{in} = R_{in} || C_{in}$) across the ADC input pins.

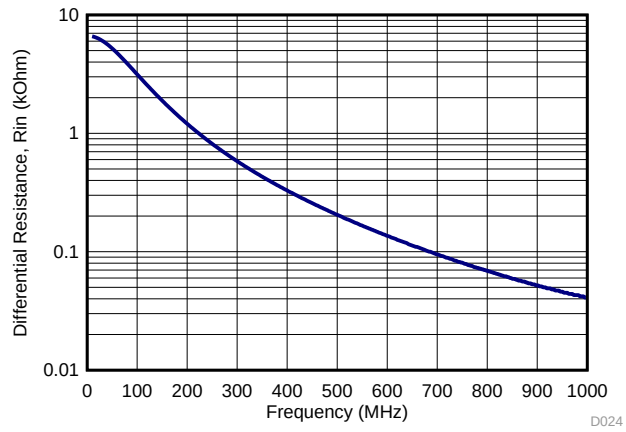

Figure 83. Differential Input Resistance (R_{IN})

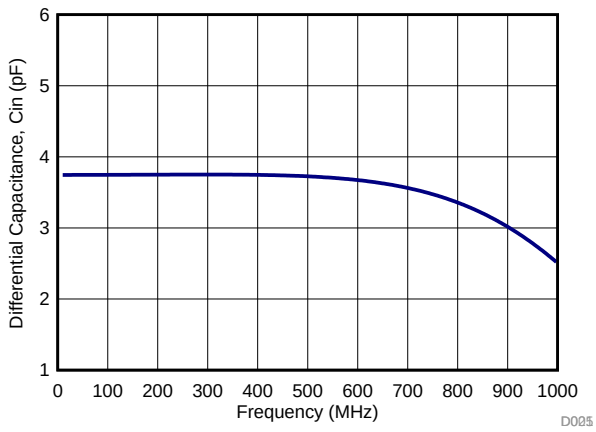

Figure 84. Differential Input Capacitance (C_{IN})

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10.2 Typical Applications

10.2.1 Driving Circuit Design: Low Input Frequencies

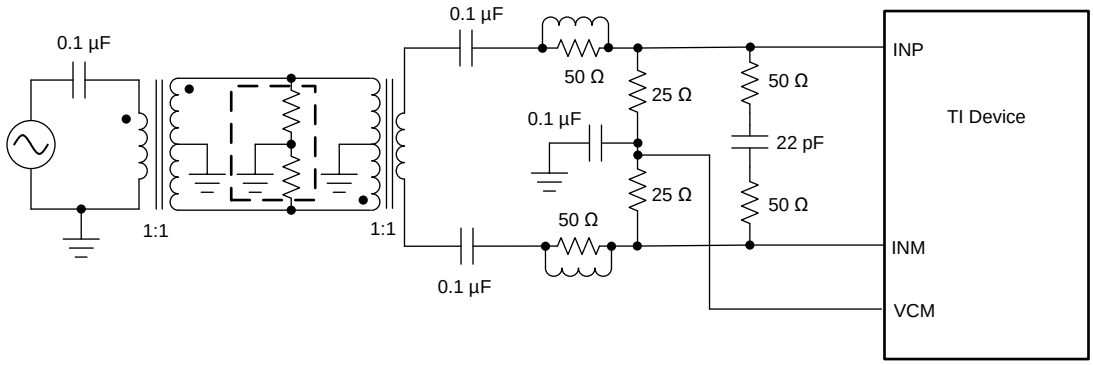


Figure 85. Driving Circuit for Low Input Frequencies

10.2.1.1 Design Requirements

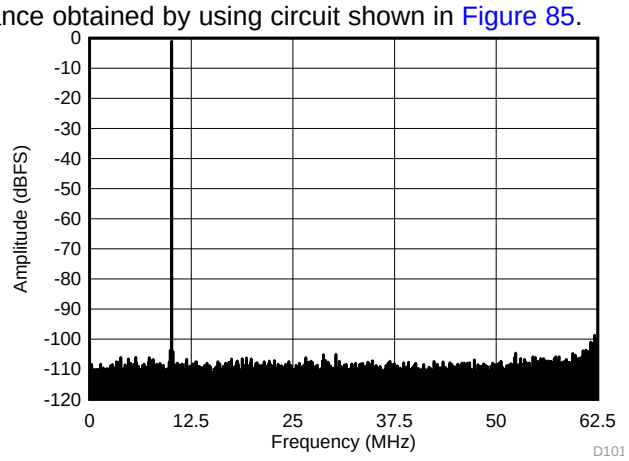
For optimum performance, the analog inputs must be driven differentially. An optional 5-Ω to 15-Ω resistor in series with each input pin can be kept to damp out ringing caused by package parasitic. The drive circuit may have to be designed to minimize the impact of kick-back noise generated by sampling switches opening and closing inside the ADC, as well as providing low insertion loss over the desired frequency range and matched impedance to the source.

10.2.1.2 Detailed Design Procedure

A typical application involving using two back-to-back coupled transformers is shown in Figure 85. The circuit is optimized for low input frequencies. An external R-C-R filter using 50-Ω resistors and a 22-pF capacitor is used with the series inductor (39 nH), this combination helps absorb the sampling glitches.

10.2.1.3 Application Curve

Figure 86 shows the performance obtained by using circuit shown in Figure 85.



SFDR = 102.6 dBc, SNR = 72.9 dBFS, SINAD = 72.8 dBFS,
THD = 99.8 dBc, HD2 = –108.6 dBc, HD3 = –104.0 dBc

Figure 86. Performance FFT at 10 MHz (Low Input Frequency)

Typical Applications (continued)

10.2.2 Driving Circuit Design: Input Frequencies Between 100 MHz to 230 MHz

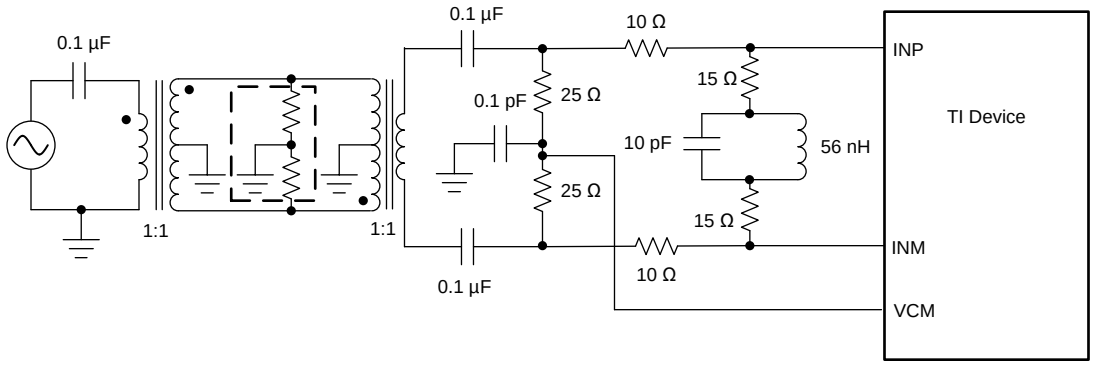


Figure 87. Driving Circuit for Mid-Range Input Frequencies (100 MHz < f_{IN} < 230 MHz)

10.2.2.1 Design Requirements

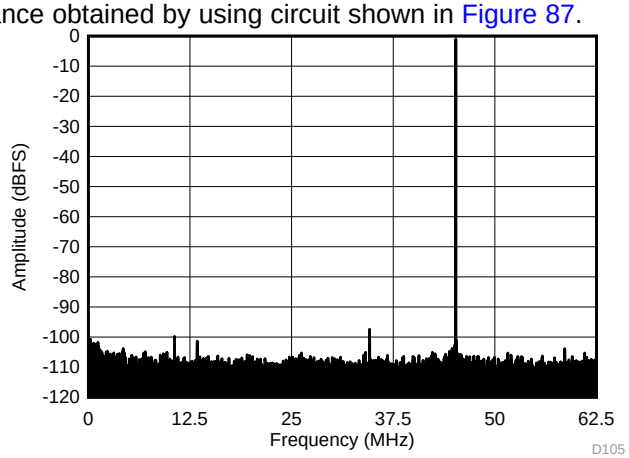
See the previous *Design Requirements* section for further details.

10.2.2.2 Detailed Design Procedure

When input frequencies are between 100 MHz to 230 MHz, an R-LC-R circuit can be used to optimize performance, as shown in Figure 87.

10.2.2.3 Application Curve

Figure 88 shows the performance obtained by using circuit shown in Figure 87.



SFDR = 96.4 dBc, SNR = 72.1 dBFS, SINAD = 72.0 dBFS,
THD = 92.6 dBc, HD2 = –96.4 dBc, HD3 = –98.8 dBc

Figure 88. Performance FFT at 170 MHz (Mid Input Frequency)

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Typical Applications (continued)

10.2.3 Driving Circuit Design: Input Frequencies Greater than 230 MHz

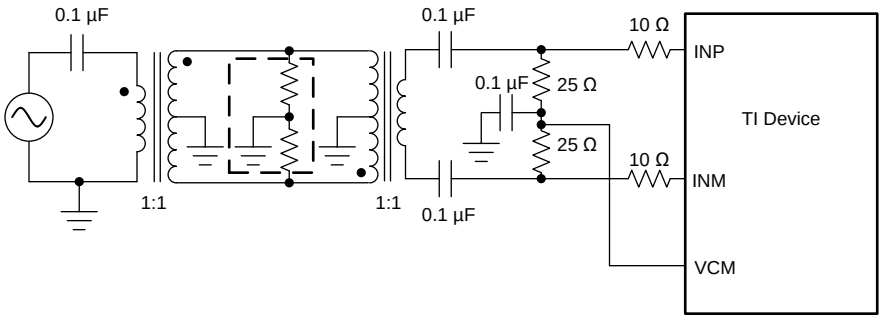


Figure 89. Driving Circuit for High input Frequencies (f_{IN} > 230 MHz)

10.2.3.1 Design Requirements

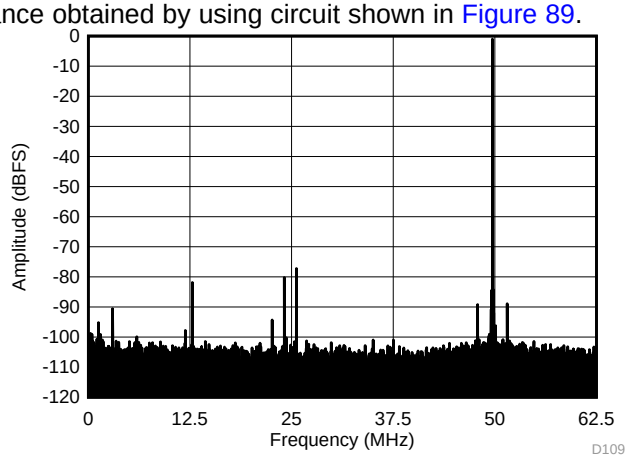
See the first *Design Requirements* section for further details.

10.2.3.2 Detailed Design Procedure

For high input frequencies (> 230 MHz), using the R-C-R or R-LC-R circuit does not show significant improvement in performance. However, a series resistance of 10 Ω can be used as shown in Figure 89.

10.2.3.3 Application Curve

Figure 90 shows the performance obtained by using circuit shown in Figure 89.



SFDR = 76.2 dBc, SNR = 68.3 dBFS, SINAD = 67.5 dBFS,
THD = 74.3 dBc, HD2 = –76.2 dBc, HD3 = –79.2 dBc

Figure 90. Performance FFT at 450 MHz (High Input Frequency)

11 Power Supply Recommendations

The device requires a 1.8-V nominal supply for AVDD and DVDD. There are no specific sequence power-supply requirements during device power-up. AVDD and DVDD can power up in any order.

12 Layout

12.1 Layout Guidelines

The ADC3244E EVM layout can be used as a reference layout to obtain the best performance. A layout diagram of the EVM top layer is provided in Figure 91. Some important points to remember during laying out the board are:

1. Place the analog inputs on opposite sides of the device pin out to provide minimum crosstalk on the package level. To minimize crosstalk onboard, the analog inputs must exit the pin out in opposite directions, as shown in the reference layout of Figure 91 as much as possible.
2. In the device pin out, place the sampling clock on a side perpendicular to the analog inputs in order to minimize coupling between them. This configuration is also maintained on the reference layout of Figure 91 as much as possible.
3. Keep digital outputs away from the analog inputs. When these digital outputs exit the pin out, do not keep the digital output traces parallel to the analog input traces because this configuration can result in coupling from digital outputs to analog inputs and degrade performance. All digital output traces to the receiver [such as a field-programmable gate array (FPGA) or an application-specific integrated circuit (ASIC)] must be matched in length to avoid skew among outputs.
4. At each power-supply pin (AVDD and DVDD), keep a 0.1-µF decoupling capacitor close to the device. A separate decoupling capacitor group consisting of a parallel combination of 10-µF, 1-µF, and 0.1-µF capacitors can be kept close to the supply source.

12.2 Layout Example

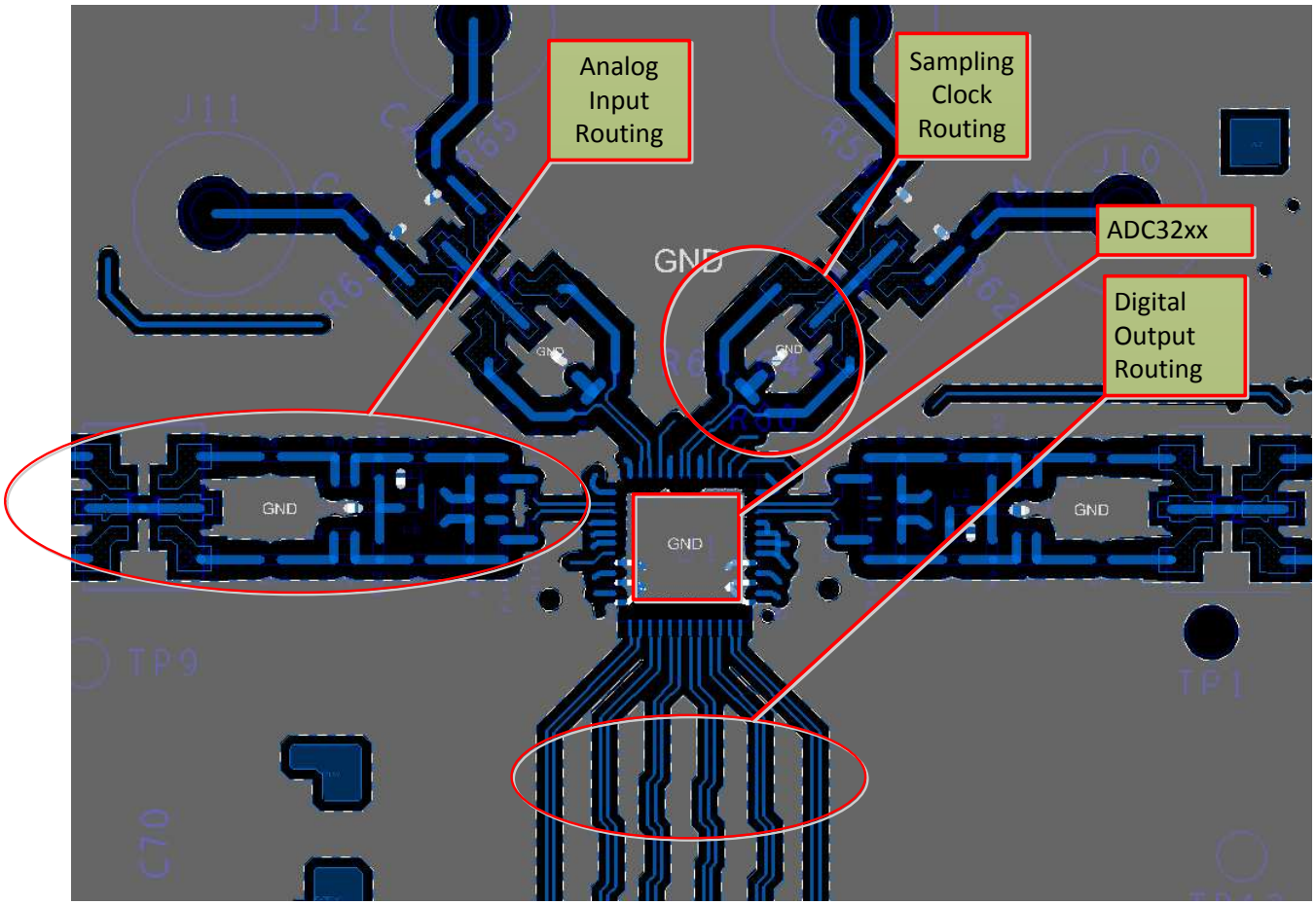


Figure 91. Typical Layout of the ADC3244E Board

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13 Device and Documentation Support

13.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

13.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

13.3 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

13.4 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

13.5 Glossary

SLYZ022 — *TI Glossary*.

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

14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
ADC3244EIRGZT	Active	Production	VQFN (RGZ) | 48	250 | SMALL T&R	Yes	NIPDAUAG	Level-3-260C-168 HR	-50 to 105	AZ3244E
ADC3244EIRGZT.A	Active	Production	VQFN (RGZ) | 48	250 | SMALL T&R	Yes	NIPDAUAG	Level-3-260C-168 HR	-50 to 105	AZ3244E

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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.

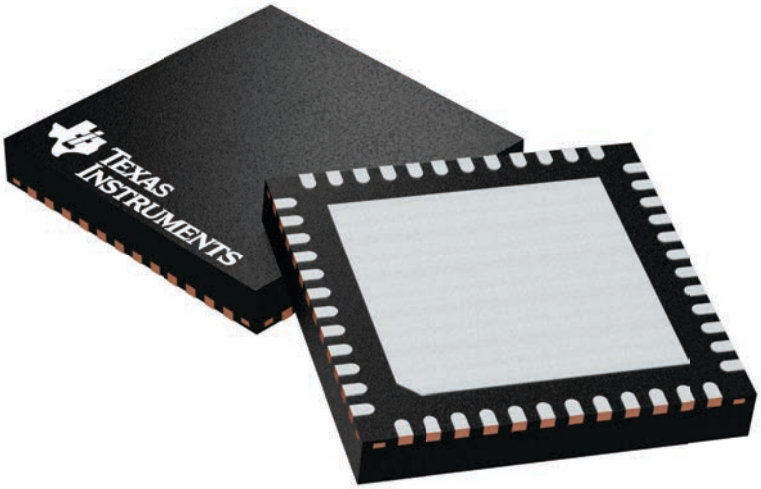
GENERIC PACKAGE VIEW

RGZ 48

VQFN - 1 mm max height

7 x 7, 0.5 mm pitch

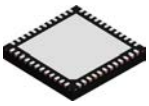
PLASTIC QUADFLAT PACK- NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4224671/A

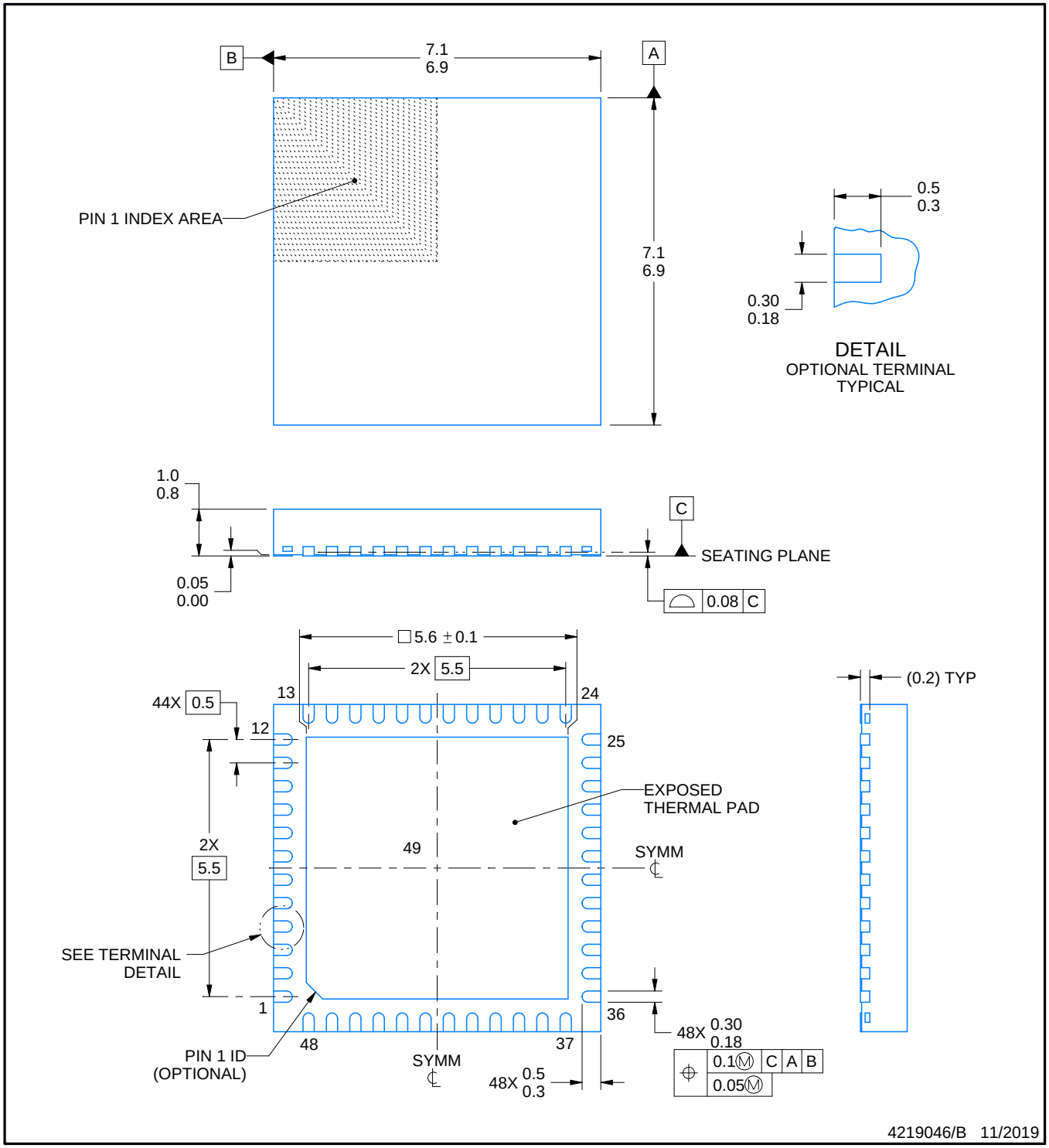
RGZ0048D



PACKAGE OUTLINE

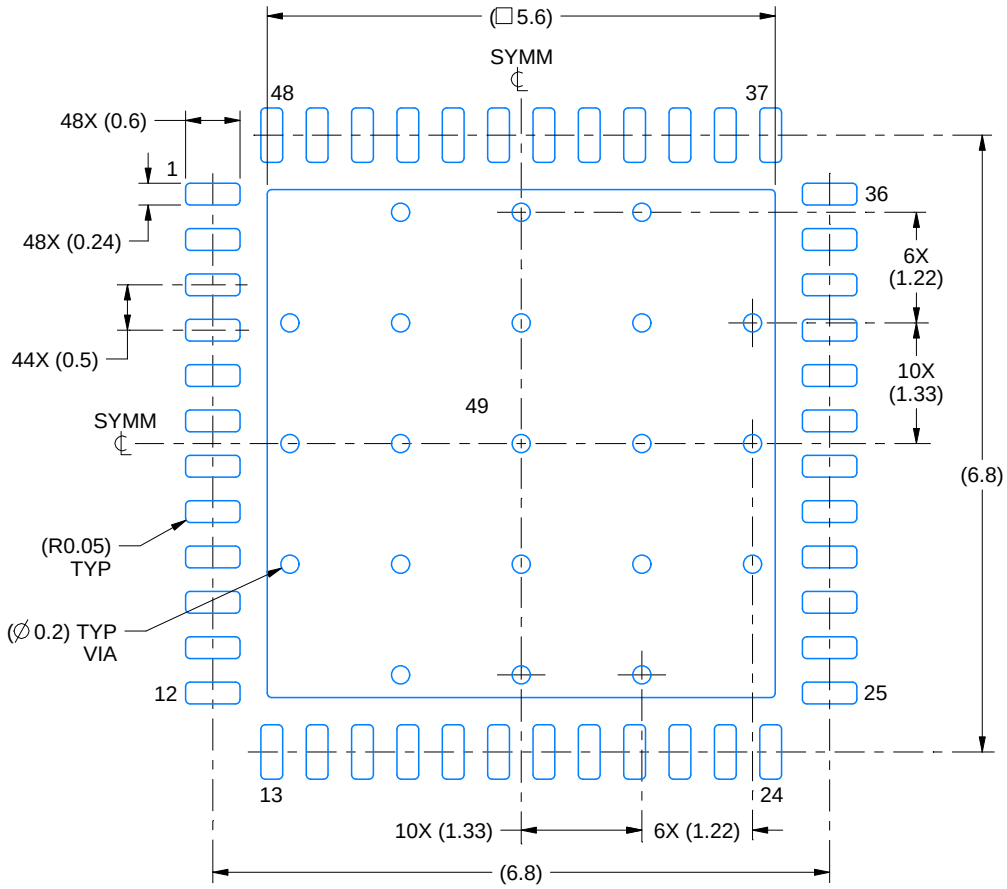
VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

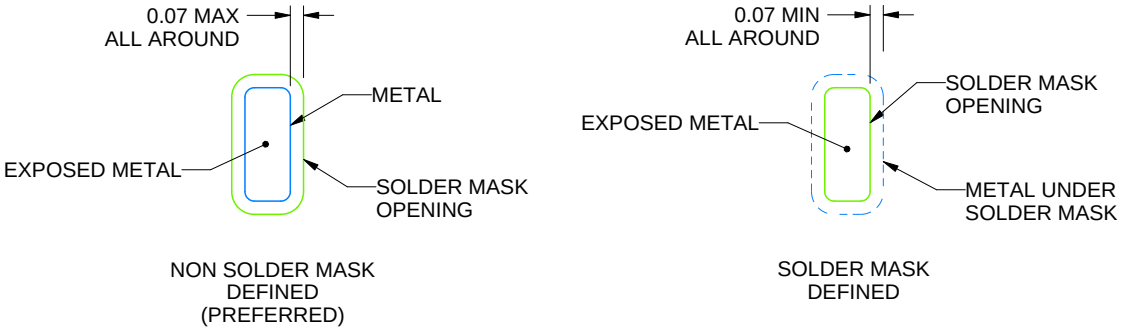


NOTES:

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.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:12X



SOLDER MASK DETAILS

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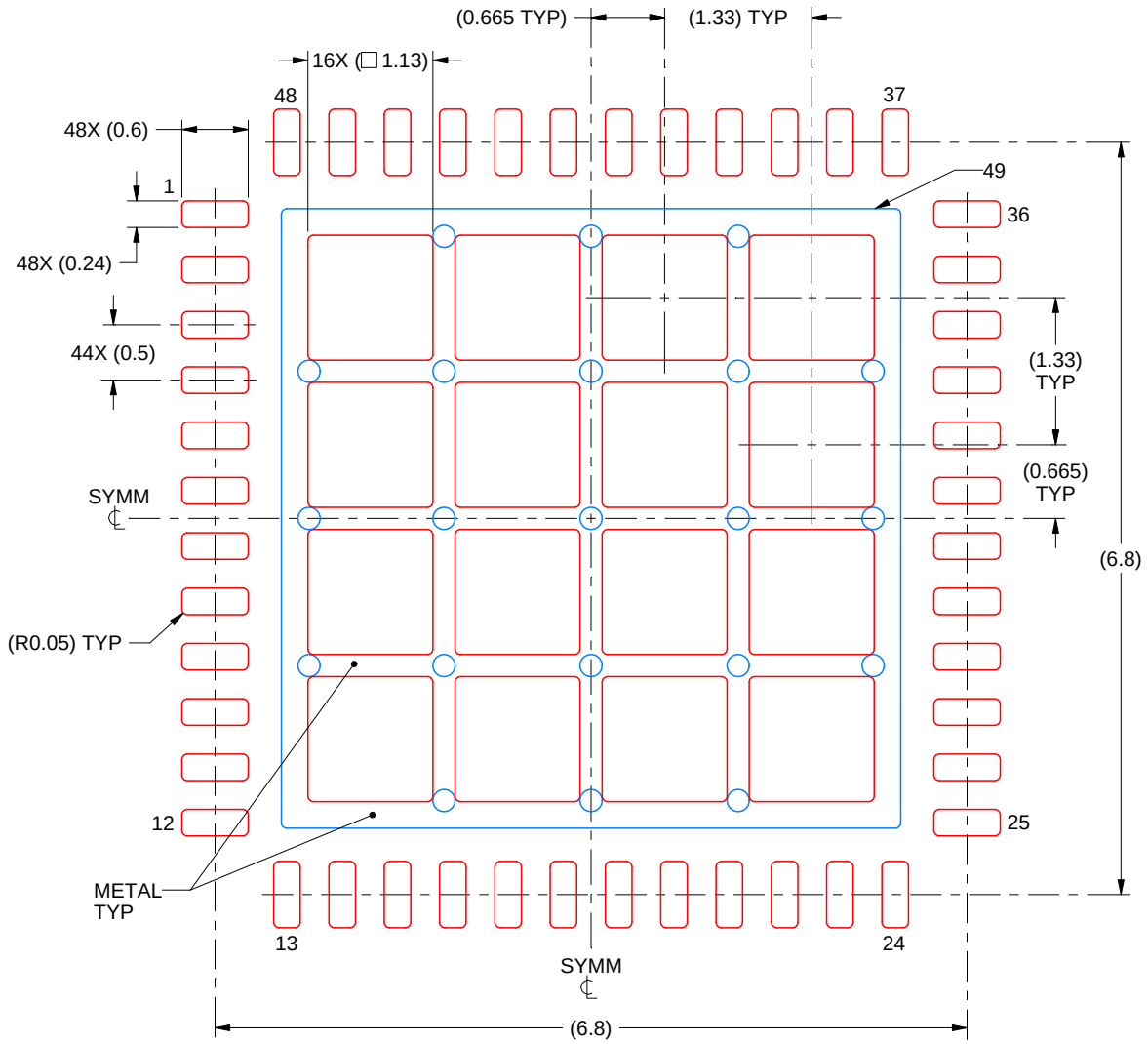
NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 49
66% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:15X

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NOTES: (continued)

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

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