

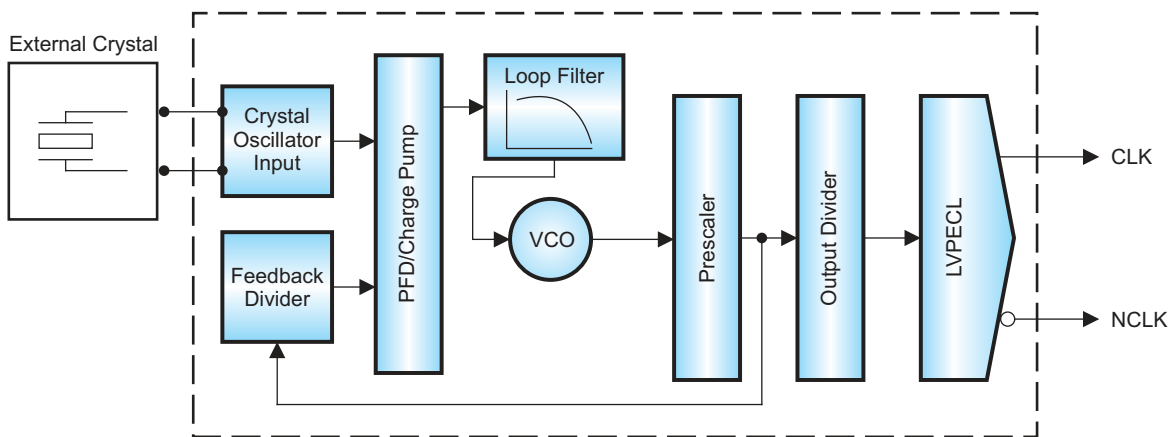
## FULLY INTEGRATED FIXED FREQUENCY LOW-JITTER, CRYSTAL-OSCILLATOR CLOCK GENERATOR

### FEATURES

- Single 3.3 V Supply
- High-Performance Clock Generator, Incorporating Crystal Oscillator Circuitry With Integrated Frequency Synthesizer
- Low Output Jitter, as Low as 380 fs (rms integrated between 10 kHz–20 MHz)
- Low Phase Noise at 312.5 MHz, Less Than –120 dBc/Hz at 10 kHz and –147 dBc/Hz at 10 MHz Offset From the Carrier
- Supports Crystal Frequencies or LVCMOS Input Frequencies at 31.25 MHz, 33.33 MHz, and 35.42 MHz
- Output Frequencies: 100 MHz, 106.25 MHz, 125 MHz, 156.25 MHz, 212.5 MHz, 250 MHz, and 312.5 MHz
- Differential Low-Voltage Positive Emitter Coupled Logic (LVPECL) Output
- Fully Integrated Voltage-Controlled Oscillator (VCO) Running from 1.75 GHz to 2.35 GHz
- Typical Power Consumption 300 mW
- Chip-Enable Control Pin
- QFN-24 Package
- ESD Protection Exceeds 2 kV HBM
- Industrial Temperature Range –40°C to 85°C

### APPLICATIONS

- Low-Cost, Low-Jitter Frequency Multiplier



B0216-02

### DESCRIPTION

CDC421xxx is a high-performance, low-phase-noise clock generator. It has an integrated low-noise, LC-based voltage-controlled oscillator (VCO) that operates within the 1.75 GHz–2.35 GHz frequency range. It has an integrated crystal oscillator that operates in conjunction with an external AT-cut crystal to produce a stable frequency reference for the PLL-based frequency synthesizer. The output frequency ( $f_{out}$ ) is proportional to the frequency of the input crystal ( $f_{xtal}$ ).

The device operates in a 3.3 V supply environment and is characterized for operation from –40°C to 85°C.

CDC421xxx is available in a QFN-24 package.

A high-level block diagram of the CDC421xxx is shown in [Figure 1](#).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

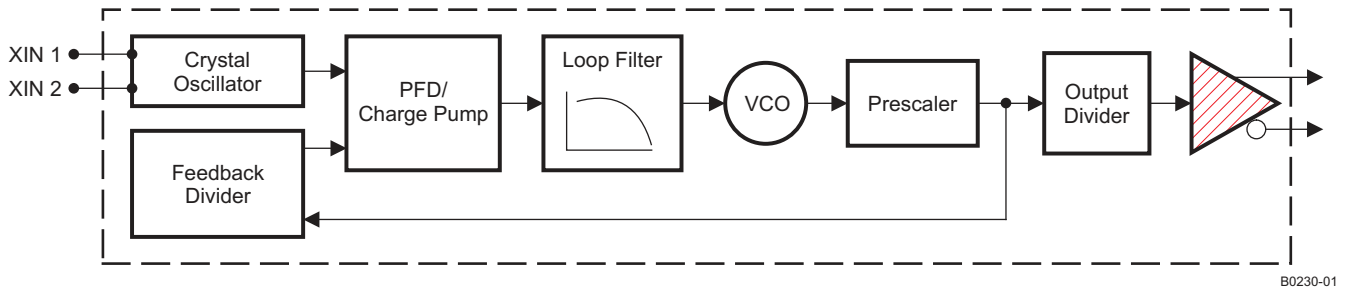


Figure 1. High-Level Block Diagram of the CDC421xxx

**PACKAGE (QFN-24)**

The CDC421xxx is packaged in a QFN-24 terminal package. The QFN package footprint is shown. Terminal locations and numbers are shown in Figure 2.

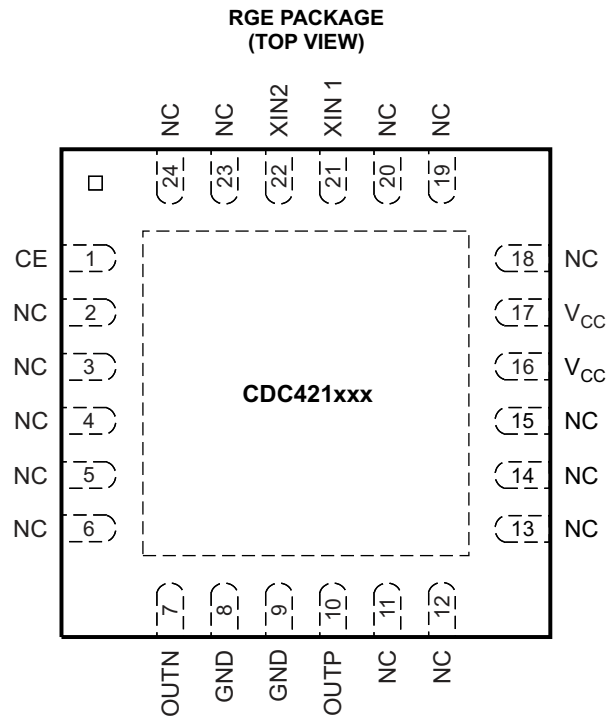


Figure 2. Pinout of the CDC421xxx QFN-24 Package

The terminal functions table shows the terminal descriptions for the CDC421xxx QFN-24 package.

**Table 1. TERMINAL FUNCTIONS**

TERMINAL		TYPE	ESD PROTECTION	DESCRIPTION
NAME	NO.			
V <sub>CC</sub>	16, 17	Power	Y	3.3V power supply
GND	8, 9	GND	Y	Ground
XIN 1	21	I	Y	In crystal input mode, connect XIN1 to one end of the crystal and XIN2 to the other end of the crystal. In LVCMOS single-ended driven mode, XIN1 (pin 21) acts as input reference and XIN2 should connect to GND.
XIN 2	22	I	N	

**Table 1. TERMINAL FUNCTIONS (continued)**

TERMINAL		TYPE	ESD PROTECTION	DESCRIPTION
NAME	NO.			
CE	1	I	Y	Chip enable (LVCMOS input) CE = 1 enables the device and the outputs. CE = 0 disables all current sources (LVPECLP = LVPECLN = Hi-Z).
OUTP	10	O	Y	High-speed positive differential LVPECL output. (Outputs are enabled by CE )
OUTN	7	O	Y	High-speed negative differential LVPECL output. (Outputs are enabled by CE )
NC	2–6, 11–15, 18–20, 23, 24	I or O	Y	TI test pin. Do not connect; leave floating.

## DEVICE SELECTION

The CDC421xxx device is an LVPECL low-phase-noise clock generator designed to work with a low-frequency AT-crystal oscillator of a single-ended LVCMOS.

**Table 2. Device Selection Table for CDC421xxx**

CDC421xxx		PACKAGE	INPUT FREQUENCY OR CRYSTAL VALUE (MHz)	OUTPUT FREQUENCY FOR THE SPECIFIED INPUT FREQUENCY (MHz)
DEVICE MARKING	ORDERING PART NUMBER			
421100	CDC421100RGER	QFN-24 tape and reel	33.3333	100.00
421100	CDC421100RGET	QFN-24 small tape and reel	33.3333	100.00
421106	CDC421106RGER	QFN-24 tape and reel	35.4167	106.25
421106	CDC421106RGET	QFN-24 small tape and reel	35.4167	106.25
421125	CDC421125RGER	QFN-24 tape and reel	31.2500	125.00
421125	CDC421125RGET	QFN-24 small tape and reel	31.2500	125.00
421156	CDC421156RGER	QFN-24 tape and reel	31.2500	156.25
421156	CDC421156RGET	QFN-24 small tape and reel	31.2500	156.25
421212	CDC421212RGER	QFN-24 tape and reel	35.4167	212.50
421212	CDC421212RGET	QFN-24 small tape and reel	35.4167	212.50
421250	CDC421250RGER	QFN-24 tape and reel	31.2500	250.00
421250	CDC421250RGET	QFN-24 small tape and reel	31.2500	250.00
421312	CDC421312RGER	QFN-24 tape and reel	31.2500	312.50
421312	CDC421312RGET	QFN-24 small tape and reel	31.2500	312.50

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		VALUE	UNIT
V <sub>CC</sub>	Supply voltage <sup>(2)</sup>	–0.5 to 4.6	V
V <sub>I</sub>	Voltage range for all other input pins <sup>(2)</sup>	–0.5 to V <sub>CC</sub> + 0.5	V
I <sub>O</sub>	Output current for LVPECL	–50	mA
	Electrostatic discharge (HBM)	2 k	V
T <sub>A</sub>	Characterized free-air temperature range (no airflow)	–40 to 85	°C
T <sub>J</sub>	Maximum junction temperature	125	°C
T <sub>stg</sub>	Storage temperature range	–65 to 150	°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to network ground terminal.

## RECOMMENDED OPERATING CONDITIONS

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

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	3	3.3	3.6	V
$T_A$	Ambient temperature, no airflow, no heat sink	–40		85	°C

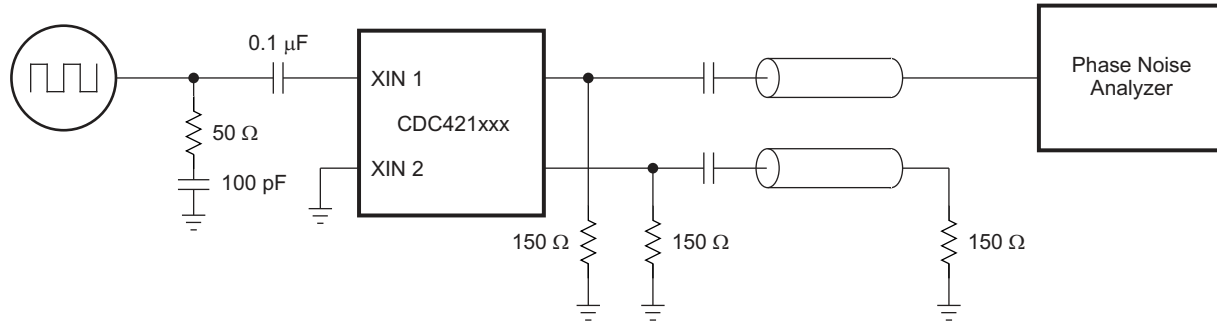
## ELECTRICAL CHARACTERISTICS

over recommended operating conditions for CDC421xxx device

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$V_{CC}$	Supply voltage	3	3.3	3.6	V	
$I_{VCC}$	Total current at 3.3 V	3.3 V, 312.5 MHz		91	110	mA
<b>LVPECL OUTPUT</b>						
$f_{CLK}$	Output frequency	100		312.5	MHz	
$V_{OH}$	LVPECL high-level output voltage	$V_{CC} - 1.20$		$V_{CC} - 0.81$	V	
$V_{OL}$	LVPECL low-level output voltage	$V_{CC} - 2.17$		$V_{CC} - 1.36$	V	
$ V_{OD} $	LVPECL differential output voltage	407		1076	mV	
$t_r$	Output rise time	20% to 80% of $V_{OUTpp}$		170	ps	
$t_f$	Output fall time	80% to 20% of $V_{OUTpp}$		170	ps	
	Duty cycle of the output waveform	45%		55%		
<b>LVCMOS INPUT</b>						
$V_{IL,CMOS}$	Low-level CMOS input voltage	$V_{CC} = 3.3$ V		$0.3 V_{CC}$	V	
$V_{IH,CMOS}$	High-level CMOS input voltage	$V_{CC} = 3.3$ V		$0.7 V_{CC}$	V	
$I_{L,CMOS}$	Low-level CMOS input current	$V_{CC} = V_{CC\ max}$ , $V_{IL} = 0$ V		–200	μA	
$I_{H,CMOS}$	High-level CMOS input current	$V_{CC} = V_{CC\ min}$ , $V_{IH} = 3.7$ V		200	μA	

## JITTER CHARACTERISTICS IN INPUT CLOCK MODE

The jitter characterization test is performed using an LVCMOS input signal driving the CDC421xxx device.



S0246-02

Figure 3. Jitter Test Configuration for an LVTTTL Input Driving CDC421xxx

For the cases of the CDC421xxx being referenced by an external, clean LVCMOS input of 31.25 MHz, 33.33 MHz and 35.4167 MHz, the following tables list the measured SSB phase noise of all the outputs supported by the CDC421xxx device, (100 MHz, 106.25 MHz, 125 MHz, 156.25 MHz, 212.5 MHz, 250 MHz, and 312.5 MHz) from 100 Hz to 20 MHz from the carrier.

Table 3. Phase Noise Parameters With LVCMOS Input of 33.3333 MHz and LVPECL Output at 100.00 MHz

PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 33.3333</math> MHz, <math>f_{out} = 100.00</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-111		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-121		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-131		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-133		dBc/Hz
phn <sub>1M</sub>	Phase Noise at 1 MHz		-142		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-149		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-149		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		507		fs
T <sub>j</sub>	Total jitter		35.33		ps
D <sub>j</sub>	Deterministic jitter		11.54		ps

Table 4. Phase Noise Parameters With LVCMOS Input of 35.4167 MHz and LVPECL Output at 106.25 MHz

PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 35.4167</math> MHz, <math>f_{out} = 106.25</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-112		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-121		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-125		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-129		dBc/Hz
phn <sub>1M</sub>	Phase noise at 1 MHz		-142		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-151		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-151		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		530		fs
T <sub>j</sub>	Total jitter		30.39		ps
D <sub>j</sub>	Deterministic jitter		11		ps

**Table 5. Phase Noise Parameters With LVCMOS Input of 31.2500 MHz and LVPECL Output at 125.00 MHz**

PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 31.2500</math> MHz, <math>f_{out} = 125.00</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-108		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-118		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-127		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-130		dBc/Hz
phn <sub>1M</sub>	Phase noise at 1 MHz		-139		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-147		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-147		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		529		fs
T <sub>j</sub>	Total jitter		47.47		ps
D <sub>j</sub>	Deterministic jitter		25.2		ps

**Table 6. Phase Noise Parameters With LVCMOS Input of 31.2500 MHz and LVPECL Output at 156.25 MHz**

PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 31.2500</math> MHz, <math>f_{out} = 156.25</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-106		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-117		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-126		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-128		dBc/Hz
phn <sub>1M</sub>	Phase noise at 1 MHz		-139		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-147		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-147		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		472		fs
T <sub>j</sub>	Total jitter		31.54		ps
D <sub>j</sub>	Deterministic jitter		9.12		ps

**Table 7. Phase Noise Parameters With LVCMOS Input of 35.4167 MHz and LVPECL Output at 212.50 MHz**

PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 35.4167</math> MHz, <math>f_{out} = 212.50</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-105		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-115		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-119		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-123		dBc/Hz
phn <sub>1M</sub>	Phase noise at 1 MHz		-135		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-148		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-148		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		512		fs
T <sub>j</sub>	Total jitter		33.96		ps
D <sub>j</sub>	Deterministic jitter		13.78		ps

**Table 8. Phase Noise Parameters With LVCMOS Input of 31.2500 MHz and LVPECL Output at 250.00 MHz**

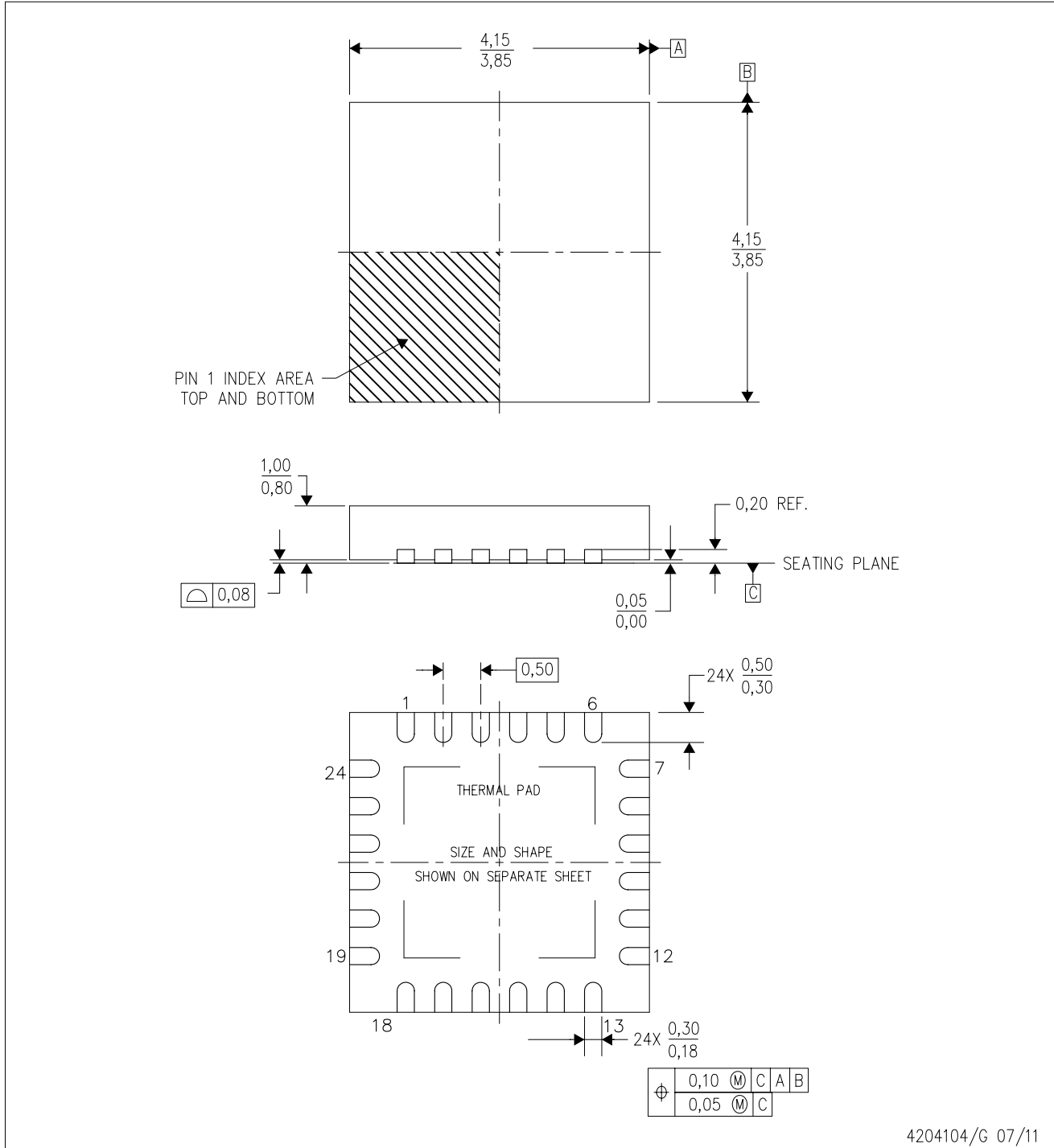
PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 31.2500</math> MHz, <math>f_{out} = 250.00</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-103		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-112		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-121		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-124		dBc/Hz
phn <sub>1M</sub>	Phase noise at 1 MHz		-134		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-148		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-149		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		420		fs
T <sub>j</sub>	Total jitter		36.98		ps
D <sub>j</sub>	Deterministic jitter		18.52		ps

**Table 9. Phase Noise Parameters With LVCMOS Input of 31.2500 MHz and LVPECL Output at 312.50 MHz**

PARAMETER		MIN	TYP	MAX	UNIT
<b>Phase Noise Specifications Under Following Conditions: <math>f_{in} = 31.2500</math> MHz, <math>f_{out} = 312.50</math> MHz</b>					
phn <sub>100</sub>	Phase noise at 100 Hz		-102		dBc/Hz
phn <sub>1K</sub>	Phase noise at 1 kHz		-111		dBc/Hz
phn <sub>10k</sub>	Phase noise at 10 kHz		-120		dBc/Hz
phn <sub>100k</sub>	Phase noise at 100 kHz		-123		dBc/Hz
phn <sub>1M</sub>	Phase noise at 1 MHz		-135		dBc/Hz
phn <sub>10M</sub>	Phase noise at 10 MHz		-147		dBc/Hz
phn <sub>20M</sub>	Phase noise at 20 MHz		-147		dBc/Hz
J <sub>RMS</sub>	RMS jitter integrated from 12 kHz to 20 MHz		378		fs
T <sub>j</sub>	Total jitter		29.82		ps
D <sub>j</sub>	Deterministic jitter		11		ps

RGE (S-PVQFN-N24)

PLASTIC QUAD FLATPACK NO-LEAD



4204104/G 07/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Quad Flatpack, No-Leads (QFN) package configuration.
  - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - F. Falls within JEDEC MO-220.



## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)