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 to 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 carrier**
- **Supports Crystal 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) Outputs**
- **Fully-Integrated Voltage-Controlled Oscillator (VCO): Runs from 1.75 GHz to 2.35 GHz**
- **Typical Power Consumption: 300 mW**
- **Chip Enable Control Pin**
- **Available in 4-mm × 4-mm QFN-24 Package**
- **ESD Protection Exceeds 2 kV (HBM)**
- **Industrial Temperature Range: –40°C to +85°C**

APPLICATIONS

- **Low-Cost, Low-Jitter Frequency Multiplier**

DESCRIPTION

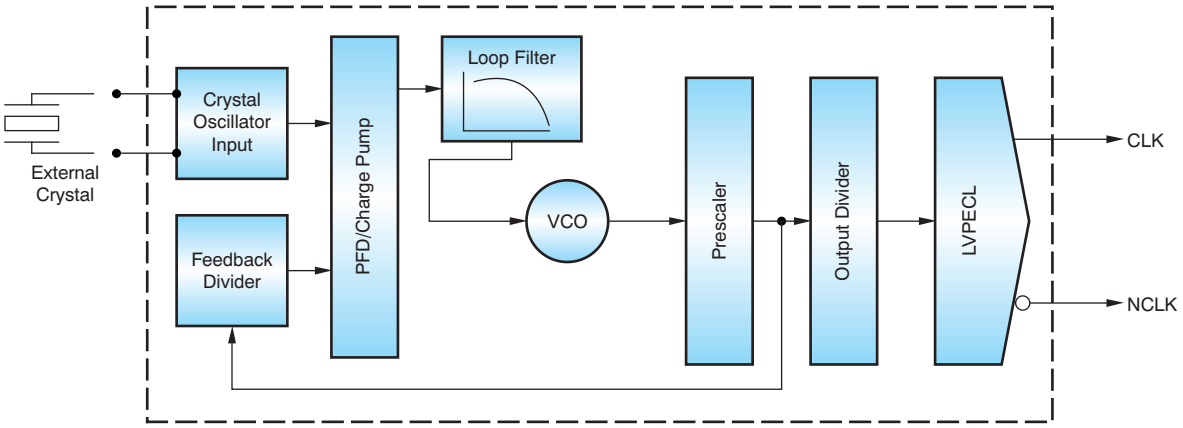
The CDC421Axxx is a high-performance, low-phase-noise clock generator. It has an integrated low-noise, LC-based voltage-controlled oscillator (VCO) that operates within the 1.75 GHz to 2.35 GHz frequency range. It has an integrated crystal oscillator that operates in conjunction with an external AT-cut crystal to produce a stable frequency reference for a phase-locked loop (PLL)-based frequency synthesizer. The output frequency (f_{OUT}) is proportional to the frequency of the input crystal (f_{XTAL}).

The device operates in 3.3-V supply environment and is characterized for operation from –40°C to +85°C. The CDC421Axxx is available in a QFN-24 4-mm × 4-mm package.

The CDC421Axxx differs from the CDC421xxx in the following ways:

- ***Device Startup***

  The CDC421Axxx has an improved startup circuit to enable correct operation for all power-supply ramp times.



CDC421Axxx

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.

AVAILABLE OPTIONS(1)

PRODUCT	INPUT FREQUENCY OR CRYSTAL VALUE (MHz)	OUTPUT FREQUENCY FOR SPECIFIED INPUT FREQUENCY (MHz)	PACKAGE-LEAD	PACKAGE MARKING	ORDERING INFORMATION	TRANSPORT MEDIA, QUANTITY
CDC421A100	33.3333	100.00	QFN-24	421A100	CDC421A100RGET	Tape and reel, 250
					CDC421A100RGER	Tape and reel, 2500
CDC421A106	35.4167	106.25	QFN-24	421A106	CDC421A106RGET	Tape and reel, 250
					CDC421A106RGER	Tape and reel, 2500
CDC421A125	31.2500	125.00	QFN-24	421A125	CDC421A125RGET	Tape and reel, 250
					CDC421A125RGER	Tape and reel, 2500
CDC421A156	31.2500	156.25	QFN-24	421A156	CDC421A156RGET	Tape and reel, 250
					CDC421A156RGER	Tape and reel, 2500
CDC421A212	35.4167	212.50	QFN-24	421A212	CDC421A212RGET	Tape and reel, 250
					CDC421A212RGER	Tape and reel, 2500
CDC421A250	31.2500	250.00	QFN-24	421A250	CDC421A250RGET	Tape and reel, 250
					CDC421A250RGER	Tape and reel, 2500
CDC421A312	31.2500	312.50	QFN-24	421A312	CDC421A312RGET	Tape and reel, 250
					CDC421A312RGER	Tape and reel, 2500

(1) For the most current specifications and package information, see the Package Option Addendum located at the end of this data sheet or refer to our web site at www.ti.com.

ABSOLUTE MAXIMUM RATINGS(1)

Over operating free-air temperature range (unless otherwise noted).

PARAMETER		CDC421Axxx	UNIT
V_{CC}	Supply voltage(2)	–0.5 to 4.6	V
V_I	Voltage range for all other input pins(2)	–0.5 to V_{CC} to +0.5	V
I_O	Output current for LVPECL	–50	mA
ESD	Electrostatic discharge (HBM)	2	kV
T_A	Specified free-air temperature range (no airflow)	–40 to +85	°C
T_J	Maximum junction temperature	+125	°C
T_{STG}	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 condition* 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	3.0	3.30	3.60	V
T_A	Ambient temperature (no airflow, no heatsink)	–40		+85	°C

ELECTRICAL CHARACTERISTICS

Over recommended operating conditions (unless otherwise noted).

PARAMETER		TEST CONDITIONS	CDC421Axxx			UNIT
			MIN	TYP	MAX	
V_{CC}	Supply voltage		3.00	3.30	3.60	V
I_{VCC}	Total current			91	110	mA
LVPECL OUTPUT						
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
$\lvert V_{OD} \rvert$	LVPECL differential output voltage		407		1076	mV
t_R	Output rise time	20% to 80% of $V_{OUT(PP)}$		230		ps
t_F	Output fall time	20% to 80% of $V_{OUT(PP)}$		230		ps
	Duty cycle of the output waveform		45		55	%
t_j	RMS jitter	10 kHz to 20 MHz			1	ps, RMS
LVCMOS INPUT						
$V_{IL, CMOS}$	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} = 0.0 V			–200	µA
$I_{H, CMOS}$	High-level CMOS input current	V_{CC} = $V_{CC, min}$, V_{IH} = 3.7 V			200	µA

FUNCTIONAL BLOCK DIAGRAM

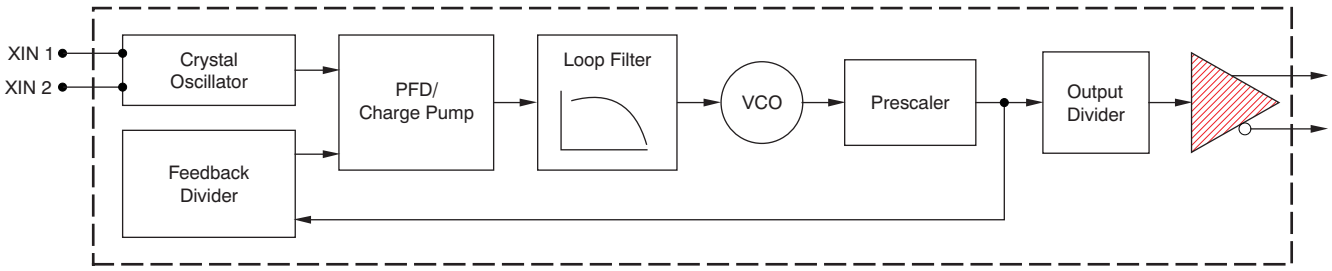
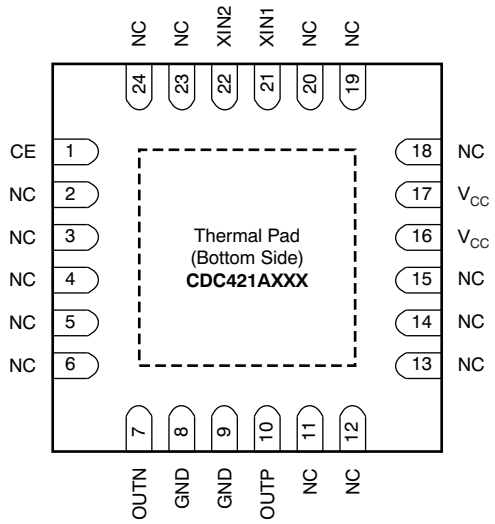


Figure 1. CDC421Axxx: High-Level Block Diagram

DEVICE INFORMATION

RGE PACKAGE
QFN-24
(TOP VIEW)



CDC421Axxx Pin Descriptions

TERMINAL		TYPE	ESD PROTECTION	DESCRIPTION
NAME	NO.			
V_{CC}	16, 17	Power	Y	3.3-V power supply
GND	8, 9	Ground	Y	Ground
XIN1	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.
XIN2	22	I	N	
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 pin.)
OUTN	7	O	Y	High-speed negative differential LVPECL output. (Outputs are enabled by CE pin.)
NC	2–6, 11–15, 18–20, 23, 24	—	Y	TI test pin. Do not connect; leave floating.

JITTER CHARACTERISTICS IN INPUT CLOCK MODE

Jitter characterization tests are performed using an LVCMOS input signal driving the CDC421Axxx device, as Figure 2 illustrates.

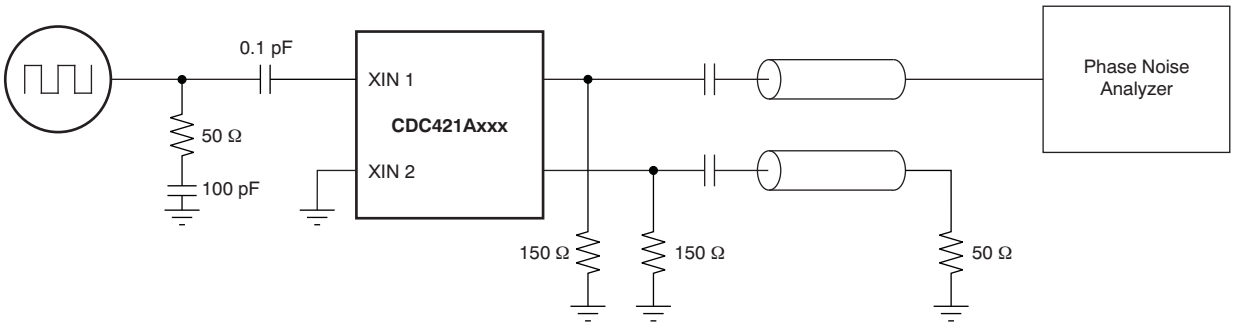


Figure 2. Jitter Test Configuration for an LVTTL Input Driving CDC421Axxx

When the CDC421Axxx is referenced by an external, clean LVCMOS input of 31.25 MHz, 33.33 MHz, and 35.4167 MHz, Table 1 to Table 7 list the measured SSB phase noise of all the outputs supported by the CDC421Axxx 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 1. Phase Noise Data with LVCMOS Input of 33.3333 MHz and LVPECL Output at 100.00 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–111		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–121		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–131		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–133		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–142		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–149		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–149		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		507		fs
T_j	Total jitter		35.33		ps
D_j	Deterministic jitter		11.54		ps

(1) Phase noise specifications under following conditions: input frequency = 33.3333 MHz, output frequency = 100.00 MHz.

Table 2. Phase Noise Data with LVCMOS Input of 35.4167 MHz and LVPECL Output at 106.25 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–112		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–121		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–125		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–129		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–142		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–151		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–151		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		530		fs
T_j	Total jitter		30.39		ps
D_j	Deterministic jitter		11		ps

(1) Phase noise specifications under following conditions: input frequency = 35.4167 MHz, output frequency = 106.25 MHz.

Table 3. Phase Noise Data with LVCMOS Input of 31.2500 MHz and LVPECL Output at 125.00 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–108		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–118		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–127		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–130		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–139		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–147		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–147		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		529		fs
T_j	Total jitter		47.47		ps
D_j	Deterministic jitter		25.2		ps

(1) Phase noise specifications under following conditions: input frequency = 31.2500 MHz, output frequency = 125.00 MHz.

Table 4. Phase Noise Data with LVCMOS Input of 31.2500 MHz and LVPECL Output at 156.25 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–106		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–117		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–126		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–128		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–139		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–147		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–147		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		472		fs
T_j	Total jitter		31.54		ps
D_j	Deterministic jitter		9.12		ps

(1) Phase noise specifications under following conditions: input frequency = 31.2500 MHz, output frequency = 156.25 MHz.

Table 5. Phase Noise Data with LVCMOS Input of 35.4167 MHz and LVPECL Output at 212.50 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–105		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–115		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–119		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–123		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–135		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–148		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–148		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		512		fs
T_j	Total jitter		33.96		ps
D_j	Deterministic jitter		13.78		ps

(1) Phase noise specifications under following conditions: input frequency = 35.4167 MHz, output frequency = 212.50 MHz.

Table 6. Phase Noise Data with LVCMOS Input of 31.2500 MHz and LVPECL Output at 250.00 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–105		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–112		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–121		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–124		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–134		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–148		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–149		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		420		fs
T_j	Total jitter		36.98		ps
D_j	Deterministic jitter		18.52		ps

(1) Phase noise specifications under following conditions: input frequency = 31.2500 MHz, output frequency = 250.00 MHz.

Table 7. Phase Noise Data with LVCMOS Input of 31.2500 MHz and LVPECL Output at 312.50 MHz(1)

PARAMETER		MIN	TYP	MAX	UNIT
phn_{100}	Phase noise at 100 Hz		–102		dBc/Hz
phn_{1k}	Phase noise at 1 kHz		–111		dBc/Hz
phn_{10k}	Phase noise at 10 kHz		–120		dBc/Hz
phn_{100k}	Phase noise at 100 kHz		–123		dBc/Hz
phn_{1M}	Phase noise at 1 MHz		–135		dBc/Hz
phn_{10M}	Phase noise at 10 MHz		–147		dBc/Hz
phn_{20M}	Phase noise at 20 MHz		–147		dBc/Hz
J_{RMS}	RMS jitter integrated from 12 kHz to 20 MHz		378		fs
T_j	Total jitter		29.82		ps
D_j	Deterministic jitter		11		ps

(1) Phase noise specifications under following conditions: input frequency = 31.2500 MHz, output frequency = 312.50 MHz.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
CDC421A100RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 100	Samples
CDC421A100RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 100	Samples
CDC421A106RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 106	Samples
CDC421A106RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 106	Samples
CDC421A125RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 125	Samples
CDC421A125RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-55 to 125	421A 125	Samples
CDC421A156RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 156	Samples
CDC421A156RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-55 to 125	421A 156	Samples
CDC421A212RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 212	Samples
CDC421A212RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 212	Samples
CDC421A250RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 250	Samples
CDC421A250RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 250	Samples
CDC421A312RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 312	Samples
CDC421A312RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	421A 312	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

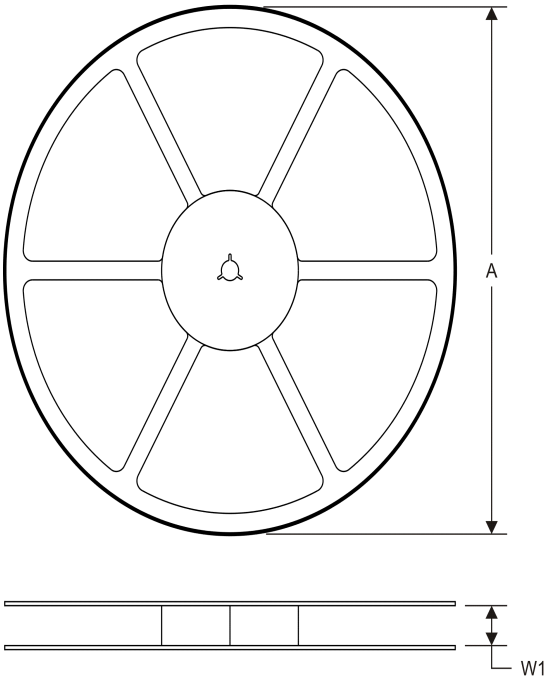
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

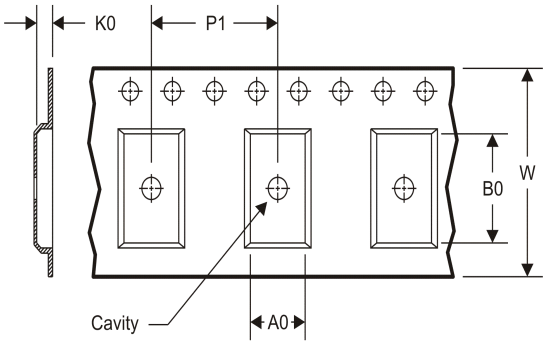
(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



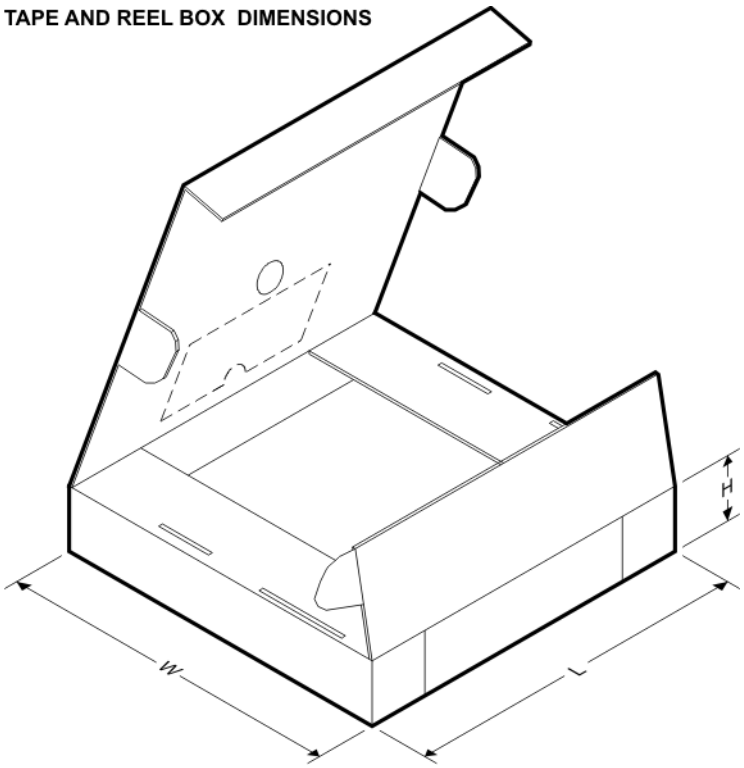
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CDC421A100RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A100RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A106RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A106RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A125RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A125RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A156RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A156RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A212RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A212RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A250RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A250RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A312RGER	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
CDC421A312RGET	VQFN	RGE	24	250	180.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

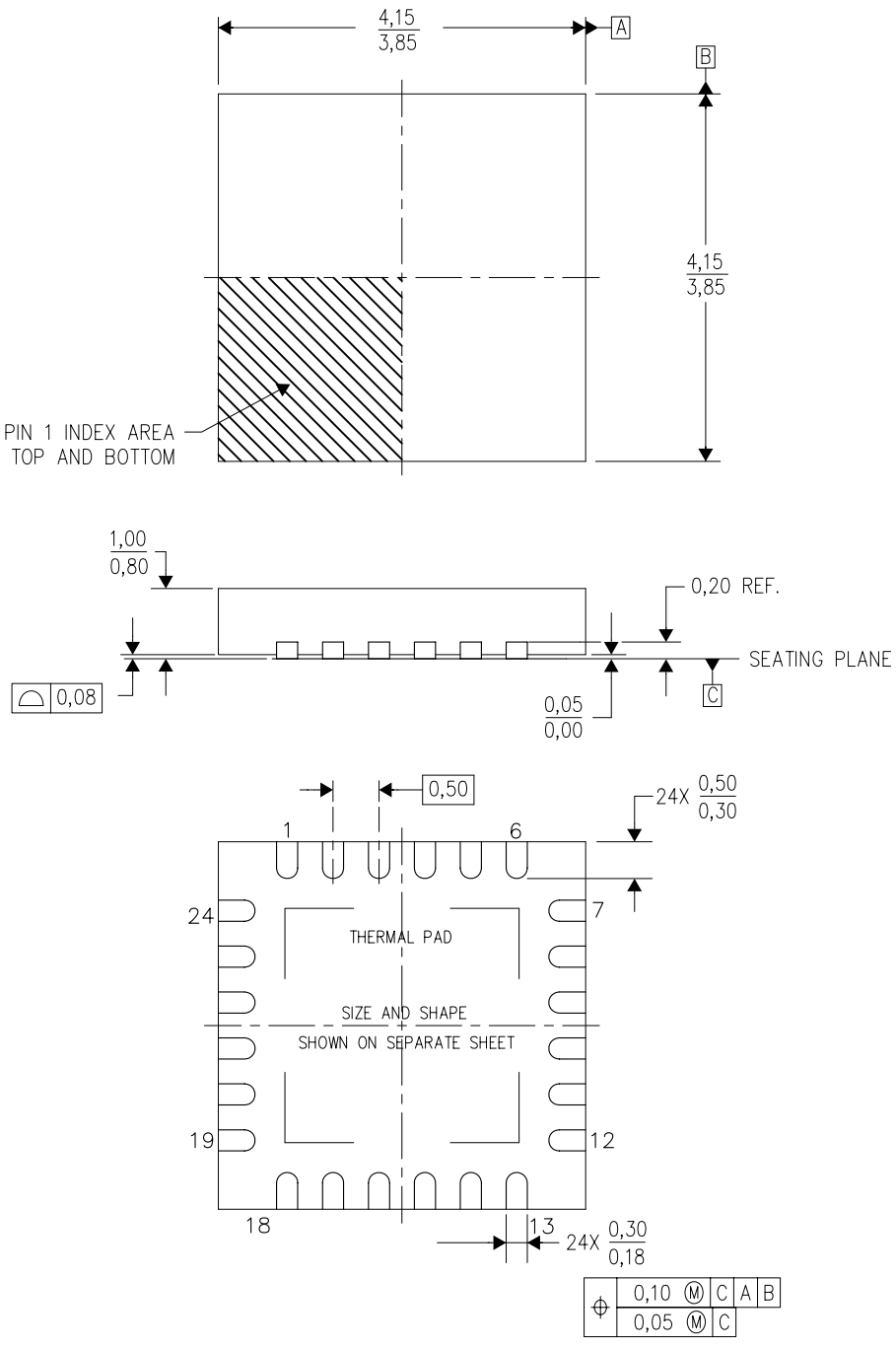
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDC421A100RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A100RGET	VQFN	RGE	24	250	210.0	185.0	35.0
CDC421A106RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A106RGET	VQFN	RGE	24	250	210.0	185.0	35.0
CDC421A125RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A125RGET	VQFN	RGE	24	250	210.0	185.0	35.0
CDC421A156RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A156RGET	VQFN	RGE	24	250	210.0	185.0	35.0
CDC421A212RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A212RGET	VQFN	RGE	24	250	210.0	185.0	35.0
CDC421A250RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A250RGET	VQFN	RGE	24	250	210.0	185.0	35.0
CDC421A312RGER	VQFN	RGE	24	3000	367.0	367.0	35.0
CDC421A312RGET	VQFN	RGE	24	250	210.0	185.0	35.0

RGE (S–PVQFN–N24) PLASTIC QUAD FLATPACK NO–LEAD



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.

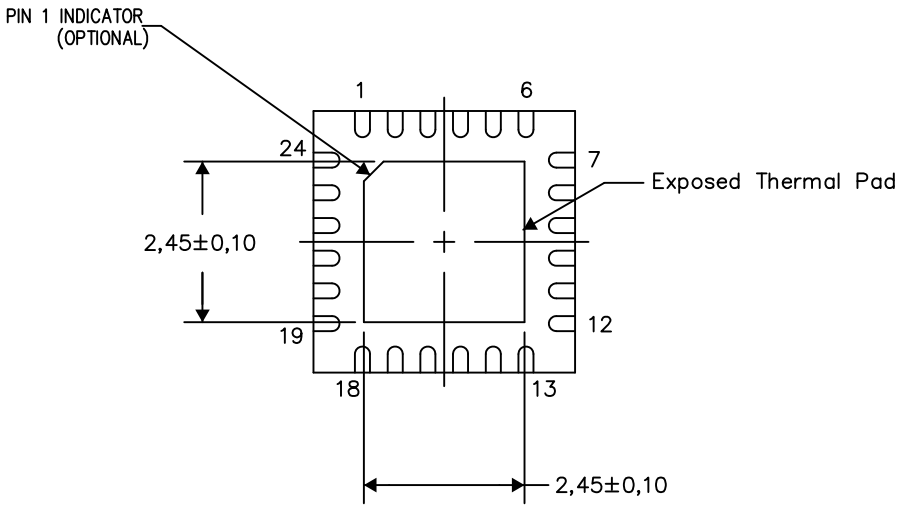
RGE (S–PVQFN–N24) PLASTIC QUAD FLATPACK NO–LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No–Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



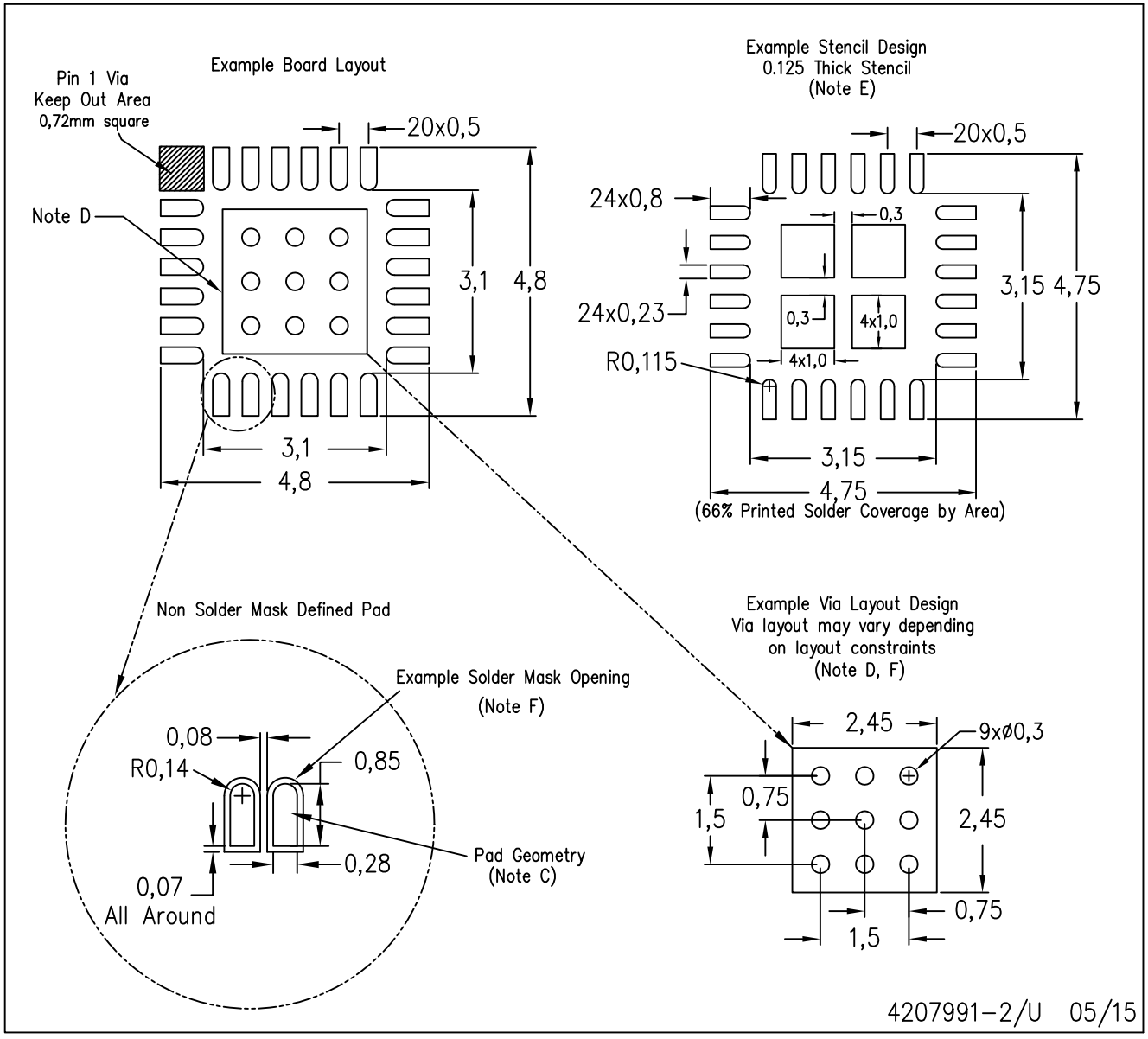
Bottom View

Exposed Thermal Pad Dimensions

4206344–3/AK 08/15

NOTES: A. All linear dimensions are in millimeters

RGE (S–PVQFN–N24) PLASTIC QUAD FLATPACK NO–LEAD



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat–Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <http://www.ti.com>.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
F. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

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		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265