

# High Performance RF Transmitter for Narrowband Systems

## Applications

- One-way narrowband ultra low power wireless systems with channel spacing down to 6.25 kHz
- 170 / 315 / 433 / 868 / 915 / 950 MHz ISM/SRD band systems
- Wireless Metering and Wireless Smart Grid (AMR and AMI)
- IEEE 802.15.4g systems
- Home and building automation
- Wireless alarm and security systems
- Industrial monitoring and control
- Wireless healthcare applications
- Wireless sensor networks and Active RFID

## Regulations

Suitable for systems targeting compliance with:

<b>Europe</b>	ETSI EN 300 220 ETSI EN 54-25
<b>US</b>	FCC CFR47 Part 15 FCC CFR47 Part 90, 24 and 101
<b>Japan</b>	ARIB RCR STD-T30 ARIB STD-T67 ARIB STD-T96

## Key Features

- High performance single chip transmitter
  - Very low phase noise: -111 dBc/Hz at 10 kHz offset
- High spectral efficiency (9.6 kbps in 12.5 kHz channel in compliance with FCC narrowbanding mandate)
- Programmable output power up to +16 dBm with 0.4 dB step size
- Power Supply
  - Wide supply voltage range (2.0 V - 3.6 V)
  - Low current consumption:
    - TX: 45 mA at +14 dBm
    - Power down: 0.3  $\mu$ A
- Automatic output power ramping
- Configurable data rates: 0 to 200 kbps
- Supported modulation formats: 2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, OOK
- RoHS compliant 5x5mm QFN 32 package

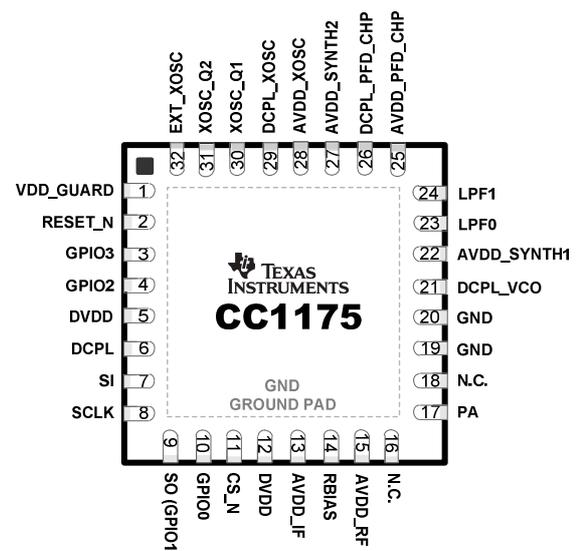
## Peripherals and Support Functions

- 128-byte TX FIFO
- TCXO support and control, also in power modes
- Optional Coding Gain feature for increased range and robustness
- Support for seamless integration with the **CC1190** for increased range giving up to +27dBm output power

## Description

The **CC1175** is a fully integrated single-chip transmitter designed for high performance at very low power and low voltage operation in cost effective wireless systems. All filters are integrated, removing the need for costly external SAW and IF filters. The device is mainly intended for the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency bands at 164-192 MHz, 274-320 MHz, 410-480 MHz and 820-960 MHz.

The **CC1175** provides extensive hardware support for packet handling, data buffering and burst transmissions. The **CC1175** main operating parameters can be controlled via an SPI interface. In a typical system, the **CC1175** will be used together with a microcontroller and only few external passive components.



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## 1 Electrical Specifications

All measurements performed on CC1120EM\_868\_915 rev.1.0.1, CC1120EM\_955 rev.1.2.1, CC1120EM\_420\_470 rev.1.0.1 or CC1120EM\_169 rev.1.2

### 1.1 Absolute Max Ratings

Parameter	Min	Typ	Max	Unit	Condition
Supply Voltage	-0.3		3.9	V	
Storage Temperature Range	-40		125	°C	
ESD			2000	V	HBM
ESD			500	V	CDM
Voltage on Any Digital Pin	-0.3		3.9	V	
Voltage on Analog Pins (including "DCPL" pins)	-0.3		2.0	V	

### 1.2 General Characteristics

Parameter	Min	Typ	Max	Unit	Condition
Voltage Supply Range	2.0		3.6	V	
Temperature Range	-40		85	°C	

### 1.3 RF Characteristics

Parameter	Min	Typ	Max	Unit	Condition
Frequency Bands	820		960	MHz	
	410		480	MHz	
	274		320	MHz	Please see application note AN115 "Using the CC112x/CC1175 at 274 to 320 MHz" for more information
	164		192	MHz	
Frequency Resolution		30		Hz	In 820-960 MHz band
		15		Hz	In 410-480 MHz band
		6		Hz	In 164-192 MHz band
Datarate	0		200	kbps	Packet mode
	0		100	kbps	Transparent mode
Datarate Step Size		1e-4		bps	

**1.4 Regulatory Standards**

Performance Mode	Frequency Band	Suitable for compliance with	Comments
High Performance Mode	820 – 960 MHz	ARIB T-96 ETSI EN 300 220 ETSI EN 54-25 FCC PART 101 FCC PART 24 SUBMASK D FCC PART 15.247 FCC PART 15.249 FCC PART 90 MASK G FCC PART 90 MASK J	Performance also suitable for systems targeting maximum allowed output power in the respective bands, using a range extender such as the <b>CC1190</b>
	410 – 480 MHz	ARIB T-67 ARIB RCR STD-30 ETSI EN 300 220 FCC PART 90 MASK D FCC PART 90 MASK G	Performance also suitable for systems targeting maximum allowed output power in the respective bands, using a range extender
	164 – 192 MHz	ETSI EN 300 220 FCC PART 90 MASK D	Performance also suitable for systems targeting maximum allowed output power in the respective bands, using a range extender
Low Power Mode	820 – 960 MHz	ETSI EN 300 220 FCC PART 15.247 FCC PART 15.249	
	410 – 480 MHz	ETSI EN 300 220	
	164 – 192 MHz	ETSI EN 300 220	

### 1.5 Current Consumption, Static Modes

T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Power Down with Retention		0.3	1	μA	
		0.5		μA	Low-power RC oscillator running
XOFF Mode		170		μA	Crystal oscillator / TCXO disabled
IDLE Mode		1.3		mA	Clock running, system waiting with no radio activity

### 1.6 Current Consumption, Transmit Modes

#### 950 MHz band (High Performance Mode)

T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
TX Current Consumption +10 dBm		37		mA	
TX Current Consumption 0 dBm		26		mA	

#### 868/915 MHz bands (High Performance Mode)

T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
TX Current Consumption +14 dBm		45		mA	
TX Current Consumption +10 dBm		34		mA	

#### 434 MHz band (High Performance Mode)

T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
TX Current Consumption +15 dBm		50		mA	
TX Current Consumption +14 dBm		45		mA	
TX Current Consumption +10 dBm		34		mA	

#### 170 MHz band (High Performance Mode)

T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
TX Current Consumption +15 dBm		54		mA	
TX Current Consumption +14 dBm		49		mA	
TX Current Consumption +10 dBm		41		mA	

#### Low Power Mode

T<sub>A</sub> = 25°C, VDD = 3.0 V, f<sub>c</sub> = 869.5 MHz if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
TX Current Consumption +10 dBm		32		mA	

## 1.7 Transmit Parameters

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$ ,  $f_c = 869.5\text{ MHz}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Max Output Power		+12			At 950 MHz
		+14			At 915 MHz
		+15			At 915 MHz with $V_{DD} = 3.6\text{ V}$
		+15			At 868 MHz
		+16			At 868 MHz with $V_{DD} = 3.6\text{ V}$
		+15			At 433 MHz
	+16			At 433 MHz with $V_{DD} = 3.6\text{ V}$	
	+15			At 170 MHz	
	+16			At 170 MHz with $V_{DD} = 3.6\text{ V}$	
Min Output Power		-11		dBm	Within fine step size range
		-40		dBm	Within coarse step size range
Output Power Step Size		0.4		dB	Within fine step size range
Adjacent Channel Power		-75		dBc	4-GFSK 9.6 kbps in 12.5 kHz channel, measured in 100 Hz bandwidth at 434 MHz (FCC Part 90 Mask D compliant)
		-58		dBc	4-GFSK 9.6 kbps in 12.5 kHz channel, measured in 8.75 kHz bandwidth (ETSI 300 220 compliant)
		-61		dBc	2-GFSK 2.4 kbps in 12.5 kHz channel, 1.2 kHz deviation
Spurious Emissions (Not including harmonics)		< -60		dBm	
Harmonics					Transmission at +14 dBm (or maximum allowed in applicable band where this is less than +14dBm) using TI reference design
2 <sup>nd</sup> Harm, 170 MHz		-39		dBm	Radiated emissions measured according to ARIB T-96 in 950 MHz band, ETSI EN 300-220 in 170, 433 and 868 MHz bands and FCC part 15.247 in 450 and 915 MHz band
3 <sup>rd</sup> Harm, 170 MHz		-58		dBm	
2 <sup>nd</sup> Harm, 433 MHz		-56		dBm	
3 <sup>rd</sup> Harm, 433 MHz		-51		dBm	
2 <sup>nd</sup> Harm, 450 MHz		-60		dBm	
3 <sup>rd</sup> Harm, 450 MHz		-45		dBm	
2 <sup>nd</sup> Harm, 868 MHz		-40		dBm	
3 <sup>rd</sup> Harm, 868 MHz		-42		dBm	
2 <sup>nd</sup> Harm, 915 MHz		56		dBuV/m	
3 <sup>rd</sup> Harm, 915 MHz		52		dBuV/m	
4 <sup>th</sup> Harm, 915 MHz		60		dBuV/m	
2 <sup>nd</sup> Harm, 950 MHz		-58		dBm	
3 <sup>rd</sup> Harm, 950 MHz		-42		dBm	Fourth harmonic in 915 MHz band will require extra filtering to meet FCC requirements if transmitting in long intervals (>50 ms periods)

## 1.8 PLL Parameters

### High Performance Mode

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$ ,  $f_c = 869.5\text{ MHz}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Phase Noise in 950 MHz Band		-99		dBc/Hz	$\pm 10\text{ kHz offset}$
		-99		dBc/Hz	$\pm 100\text{ kHz offset}$
		-123		dBc/Hz	$\pm 1\text{ MHz offset}$
Phase Noise in 868/915 MHz Bands		-99		dBc/Hz	$\pm 10\text{ kHz offset}$
		-100		dBc/Hz	$\pm 100\text{ kHz offset}$
		-122		dBc/Hz	$\pm 1\text{ MHz offset}$
Phase Noise in 433 MHz Band		-106		dBc/Hz	$\pm 10\text{ kHz offset}$
		-107		dBc/Hz	$\pm 100\text{ kHz offset}$
		-127		dBc/Hz	$\pm 1\text{ MHz offset}$
Phase Noise in 170 MHz Band		-111		dBc/Hz	$\pm 10\text{ kHz offset}$
		-116		dBc/Hz	$\pm 100\text{ kHz offset}$
		-135		dBc/Hz	$\pm 1\text{ MHz offset}$

### Low Power Mode

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$ ,  $f_c = 869.5\text{ MHz}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Phase Noise in 950 MHz Band		-90		dBc/Hz	$\pm 10\text{ kHz offset}$
		-92		dBc/Hz	$\pm 100\text{ kHz offset}$
		-124		dBc/Hz	$\pm 1\text{ MHz offset}$
Phase Noise in 868/915 MHz Bands		-95		dBc/Hz	$\pm 10\text{ kHz offset}$
		-95		dBc/Hz	$\pm 100\text{ kHz offset}$
		-124		dBc/Hz	$\pm 1\text{ MHz offset}$
Phase Noise in 433 MHz Band		-98		dBc/Hz	$\pm 10\text{ kHz offset}$
		-102		dBc/Hz	$\pm 100\text{ kHz offset}$
		-129		dBc/Hz	$\pm 1\text{ MHz offset}$
Phase Noise in 170 MHz Band		-106		dBc/Hz	$\pm 10\text{ kHz offset}$
		-110		dBc/Hz	$\pm 100\text{ kHz offset}$
		-136		dBc/Hz	$\pm 1\text{ MHz offset}$

## 1.9 Wake-up and Timing

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$ ,  $f_c = 869.5\text{ MHz}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Powerdown to IDLE		0.4		ms	Depends on crystal
IDLE to TX		166		$\mu\text{s}$	Calibration disabled
		461		$\mu\text{s}$	Calibration enabled
TX to IDLE time		296		$\mu\text{s}$	Calibrate when leaving TX enabled
		0		$\mu\text{s}$	Calibrate when leaving TX disabled
Frequency Synthesizer Calibration		0.4		ms	When using SCAL strobe

## 1.10 32 MHz Crystal Oscillator

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Crystal Frequency	32		33.6	MHz	Note: It is recommended that the crystal frequency is chosen so that the RF channel(s) are >1 MHz away from multiples of XOSC
Load Capacitance ( $C_L$ )		10		$\mu\text{F}$	
ESR			60	$\Omega$	Simulated over operating conditions
Start-up Time		0.4		ms	Depends on crystal

## 1.11 32 MHz Clock Input (TCXO)

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Clock Frequency	32		33.6	MHz	
Clock input amplitude (peak-to-peak)	0.8		VDD	V	Simulated over operating conditions

## 1.12 32 kHz Clock Input

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$  if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Clock Frequency		32		kHz	
32 kHz Clock Input Pin Input High Voltage	$0.8 \times V_{DD}$			V	
32 kHz Clock Input Pin Input Low Voltage			$0.2 \times V_{DD}$	V	

### 1.13 32 kHz RC Oscillator

T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated.

Parameter	Min	Typ	Max	Unit	Condition
Frequency		32		kHz	After Calibration
Frequency Accuracy After Calibration		±0.1		%	Relative to frequency reference (i.e. 32 MHz crystal or TCXO)
Initial Calibration Time		1.6		ms	

### 1.14 I/O and Reset

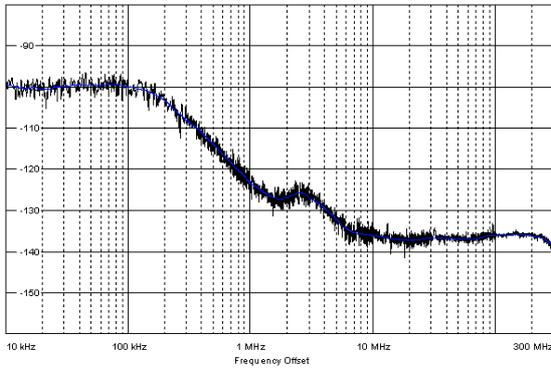
T<sub>A</sub> = 25°C, VDD = 3.0 V if nothing else stated

Parameter	Min	Typ	Max	Unit	Condition
Logic Input High Voltage	0.8×VDD			V	
Logic Input Low Voltage			0.2×VDD	V	
Logic Output High Voltage	0.8×VDD			V	At 4 mA output load or less
Logic Output Low Voltage			0.2×VDD	V	
Power-on Reset Threshold		1.3		V	Voltage on DVDD pin

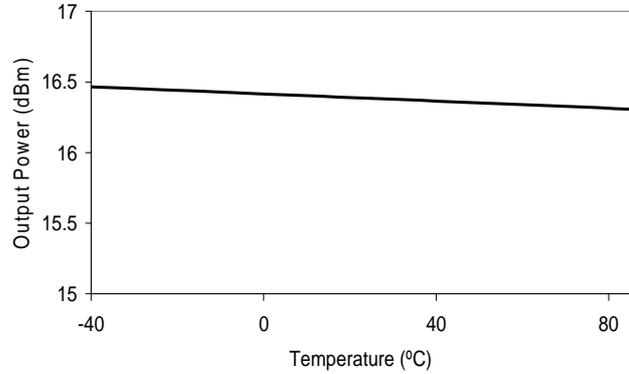
## 2 Typical Performance Curves

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 3.0\text{ V}$  if nothing else stated

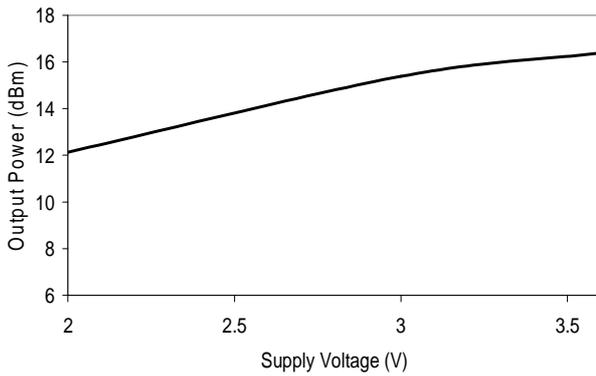
**Phase Noise in 868 MHz band**



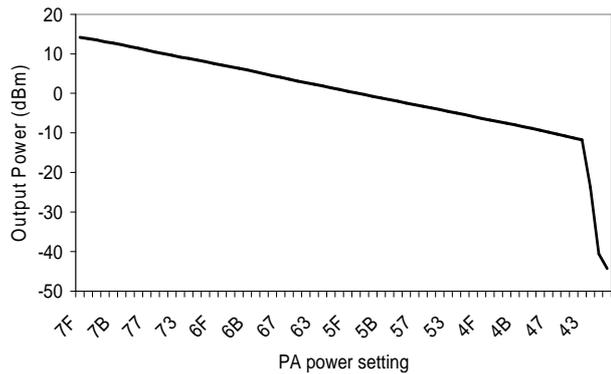
**Output Power vs Temperature**  
Max Setting, 170 MHz, 3.6V



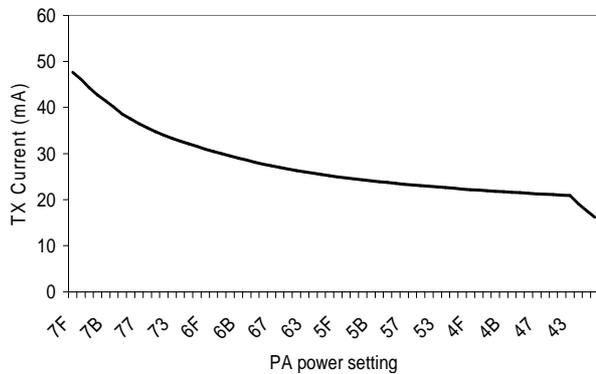
**Output Power vs Voltage**  
Max Setting, 170 MHz



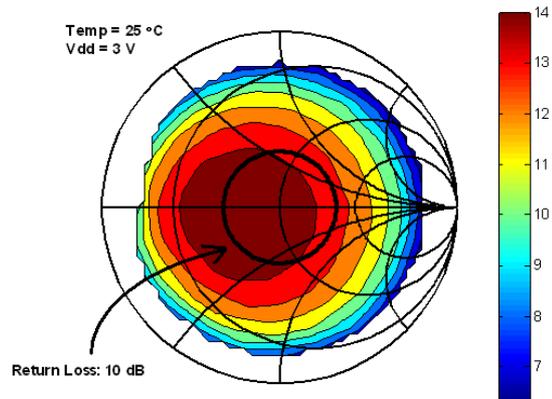
**Output Power at 868MHz**  
vs PA power setting



**TX Current at 868MHz**  
vs PA power setting



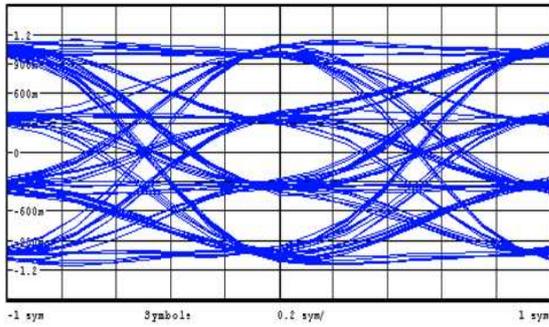
**Output Power vs Load impedance (+14dBm setting)**



PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

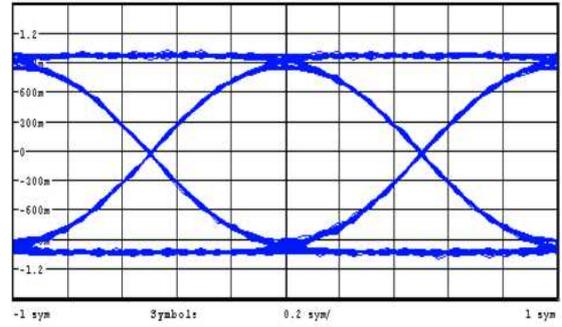
Eye Diagram

200 kbps, DEV=83 kHz (outer symbols), 4GFSK

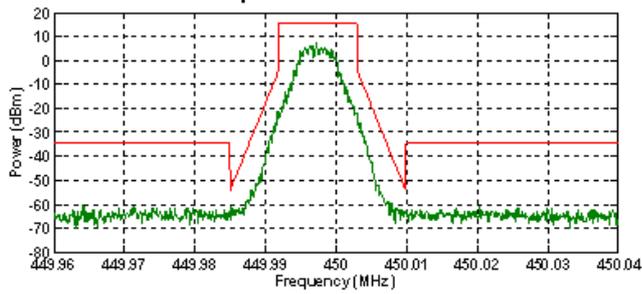


Eye Diagram

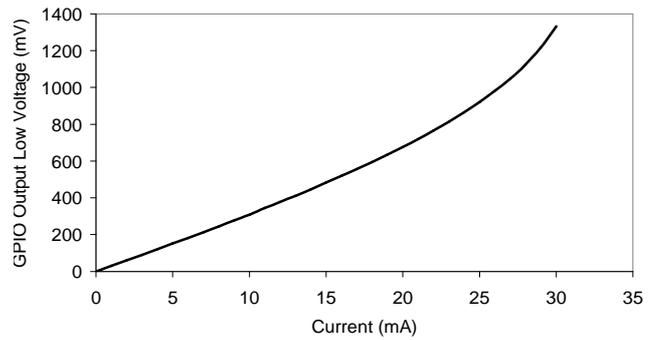
1.2 kbps 2-FSK, DEV=4 kHz



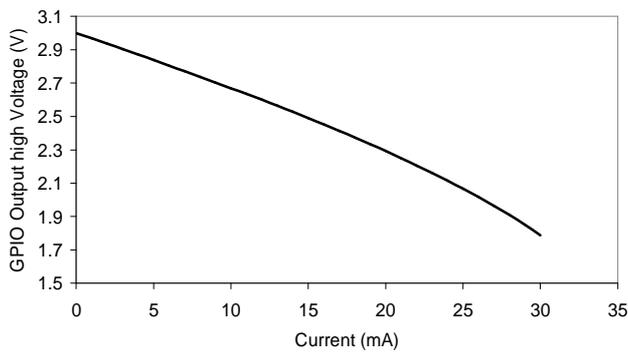
FCC Part 90 Mask D  
9.6 kbps in 12.5 kHz Channel



GPIO Output Low Voltage vs Current Being Sunked



GPIO Output High Voltage vs Current Being Sourced



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### 3 Pin Configuration

The **CC1175** pin-out is shown in the table below.

Pin #	Pin name	Type / direction	Description
1	VDD_GUARD	Power	2.0 - 3.6 V VDD
2	RESET_N	Digital Input	Asynchronous, active-low digital reset
3	GPIO3	Digital Input/Output	General purpose IO
4	GPIO2	Digital Input/Output	General purpose IO
5	DVDD	Power	2.0 - 3.6 VDD to internal digital regulator
6	DCPL	Power	Digital regulator output to external decoupling capacitor
7	SI	Digital Input	Serial data in
8	SCLK	Digital Input	Serial data clock
9	SO(GPIO1)	Digital Input/Output	Serial data out (General purpose IO)
10	GPIO0	Digital Input/Output	General purpose IO
11	CS_N	Digital Input	Active-low chip-select
12	DVDD	Power	2.0 - 3.6 V VDD
13	AVDD_IF	Power	2.0 - 3.6 V VDD
14	RBIAS	Analog	External high precision R
15	AVDD_RF	Power	2.0 - 3.6 V VDD
16	NC		Not connected
17	PA	Analog	Single-ended TX output
18	Not connected		
19	GND1	Analog	Analog GND
20	GND0	Analog	Analog GND
21	DCPL_VCO	Power	Pin for external decoupling of VCO supply regulator
22	AVDD_SYNTH1	Power	2.0 - 3.6 V VDD
23	LPF0	Analog	External loopfilter components
24	LPF1	Analog	External loopfilter components
25	AVDD_PFD_CHP	Power	2.0 - 3.6 V VDD
26	DCPL_PFD_CHP	Power	Pin for external decoupling of PFD and CHP regulator
27	AVDD_SYNTH2	Power	2.0 - 3.6 V VDD
28	AVDD_XOSC	Power	2.0 - 3.6 V VDD
29	DCPL_XOSC	Power	Pin for external decoupling of XOSC supply regulator
30	XOSC_Q1	Analog	Crystal oscillator pin 1 (must be grounded if a TCXO or other external clock connected to EXT_XOSC is used)
31	XOSC_Q2	Analog	Crystal oscillator pin 2 (must be left floating if a TCXO or other external clock connected to EXT_XOSC is used)
32	EXT_XOSC	Digital Input	Pin for external XOSC input (must be grounded if a regular XOSC connected to XOSC_Q1 and XOSC_Q2 is used)
-	GND	Ground Pad	The ground pad must be connected to a solid ground plane

## 4 Block Diagram

A system block diagram of **CC1175** is shown Figure 4.1.

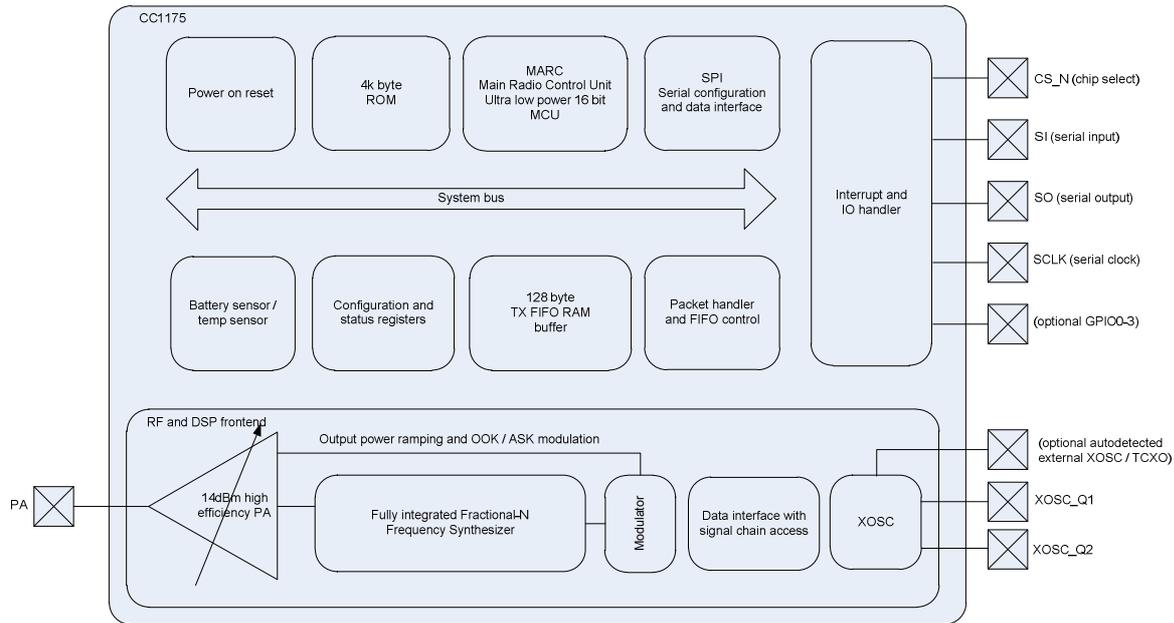


Figure 4.1 : System Block Diagram

### 4.1 Frequency Synthesizer

At the heart of **CC1175** there is a fully integrated, fractional-N, ultra high performance frequency synthesizer. The frequency synthesizer is designed for excellent phase noise performance. The system is designed to comply with the most stringent regulatory spectral masks at maximum transmit power.

Either a crystal can be connected to XOSC\_Q1 and XOSC\_Q2, or a TCXO can be connected to the EXT\_XOSC input. The oscillator generates the reference frequency for the synthesizer, as well as clocks for the digital part. If a TCXO is used, the **CC1175** will automatically turn the TCXO on and off when needed to support low power modes.

### 4.2 Transmitter

The **CC1175** transmitter is based on direct synthesis of the RF frequency (in-loop modulation). To achieve effective spectrum usage, **CC1175** has extensive data filtering and shaping in TX to support high throughput data communication in narrowband channels. The modulator also controls power ramping to remove issues such as spectral splattering when driving external high power RF amplifiers.

The modulator also controls the PA power level to support on/off keying (OOK) and amplitude shift keying (ASK).

### 4.3 Radio Control and User Interface

The **CC1175** digital control system is built around MARC (Main Radio Control) implemented using a high performance 16 bit ultra low power MCU. MARC handles power modes, radio sequencing and protocol timing.

A 4-wire SPI serial interface is used for configuration and data buffer access. The digital baseband includes support for channel configuration, packet handling, and data buffering. The host MCU can burst write data to TX FIFO and stay in power down until the RF packet has been transmitted, greatly reducing the power consumption required from the host MCU.

The **CC1175** radio control and user interface is designed from the widespread sub-GHz **CC1101** transceiver to enable easy SW transition between the two platforms. The command strobes and the main radio states are the same on the two platforms.

For legacy formats **CC1175** also has support for two serial modes. In synchronous serial mode **CC1175** provides the MCU with a bit clock for sampling input data. In transparent mode **CC1175** samples the input pin at a configurable rate.

#### **4.4 Low Power / High Performance Mode**

The **CC1175** is highly configurable, enabling trade-offs between power and performance to be made based on the needs of the application. This data sheet describes two modes - low power mode and high performance mode - which represent configurations where the device is optimized for either power or performance.

## 5 Typical Application Circuit

Very few external components are required for the operation of **CC1175**. A typical application circuit is shown below. Note that it does not show how the board layout should be done, which will greatly influence the RF performance of **CC1175**.

This section is meant as an introduction only. Note that decoupling capacitors for power pins are not shown in the figure below.

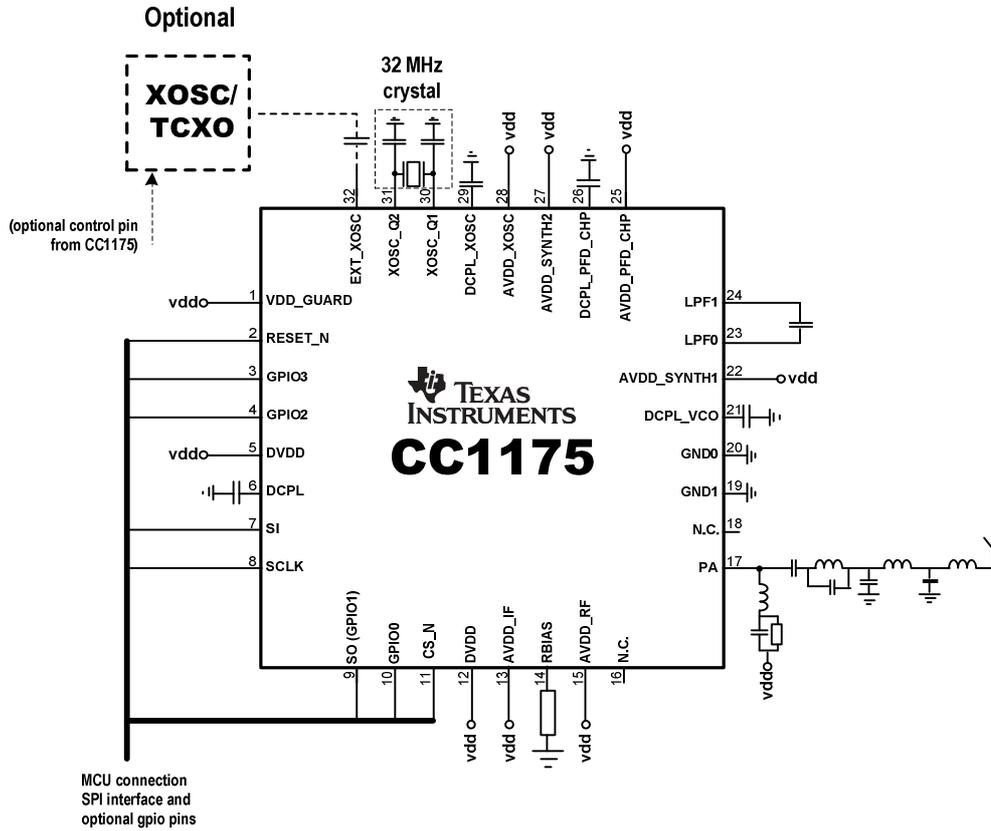


Figure 5.1 : Typical application circuit

## 6 History

Revision	Date	Description / Changes
SWRS116B	April 2012	Added ground pad on page 1 pin-out and pin description Fixed typo in EM list: CC1120EM_420_970 is corrected to CC1120EM_420_470 Added TCXO clock input voltage requirement Changed wording in some sections, and fixed various typos/case errors Added 274 - 320 MHz band and pointed to app note for more info (added mention of 315 MHz band on front page) Removed reflow temperature from abs max ratings Moved ESR to max column Added history section
SWRS116A	Nov. 2011	Initial release

**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
CC1175RHBR	ACTIVE	QFN	RHB	32	3000	Green (RoHS & no Sb/Br)	CU NIPDAUAG	Level-3-260C-168 HR	-40 to 85		
CC1175RHBT	ACTIVE	QFN	RHB	32	250	Green (RoHS & no Sb/Br)	CU NIPDAUAG	Level-3-260C-168 HR	-40 to 85		

(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)

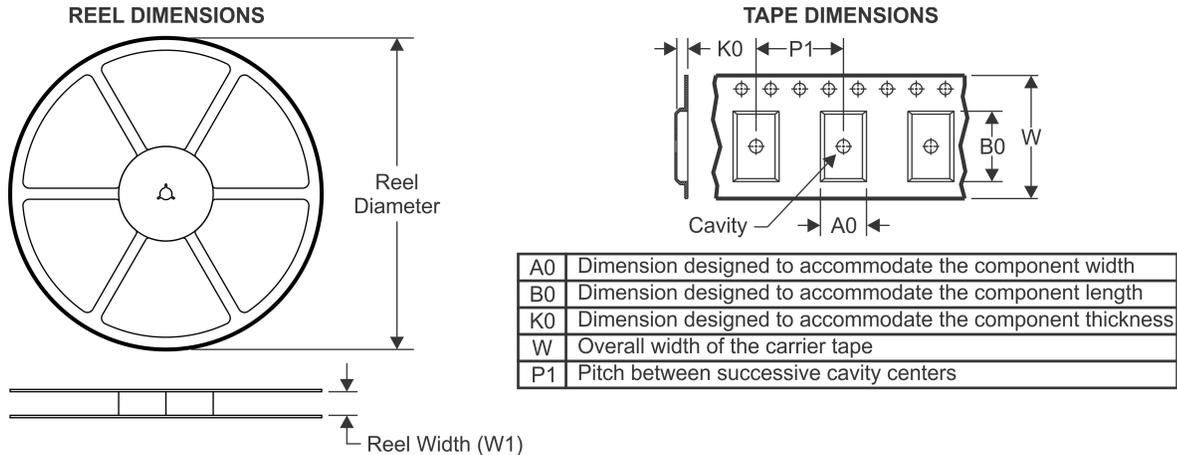
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Only one of markings shown within the brackets will appear on the physical device.

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## TAPE AND REEL INFORMATION

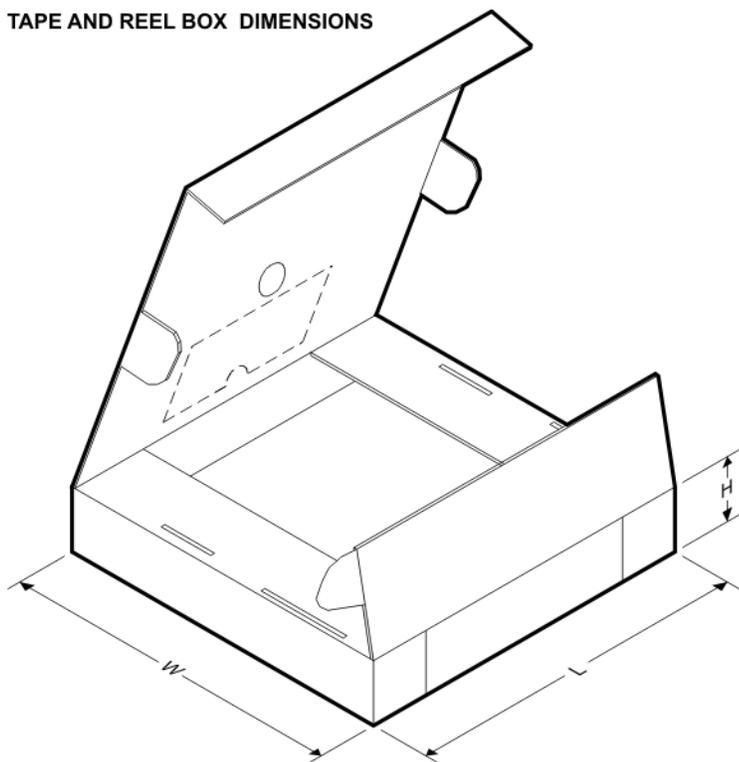


### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*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
CC1175RHBR	QFN	RHB	32	3000	330.0	12.4	5.3	5.3	1.5	8.0	12.0	Q2
CC1175RHBT	QFN	RHB	32	250	330.0	12.4	5.3	5.3	1.5	8.0	12.0	Q2

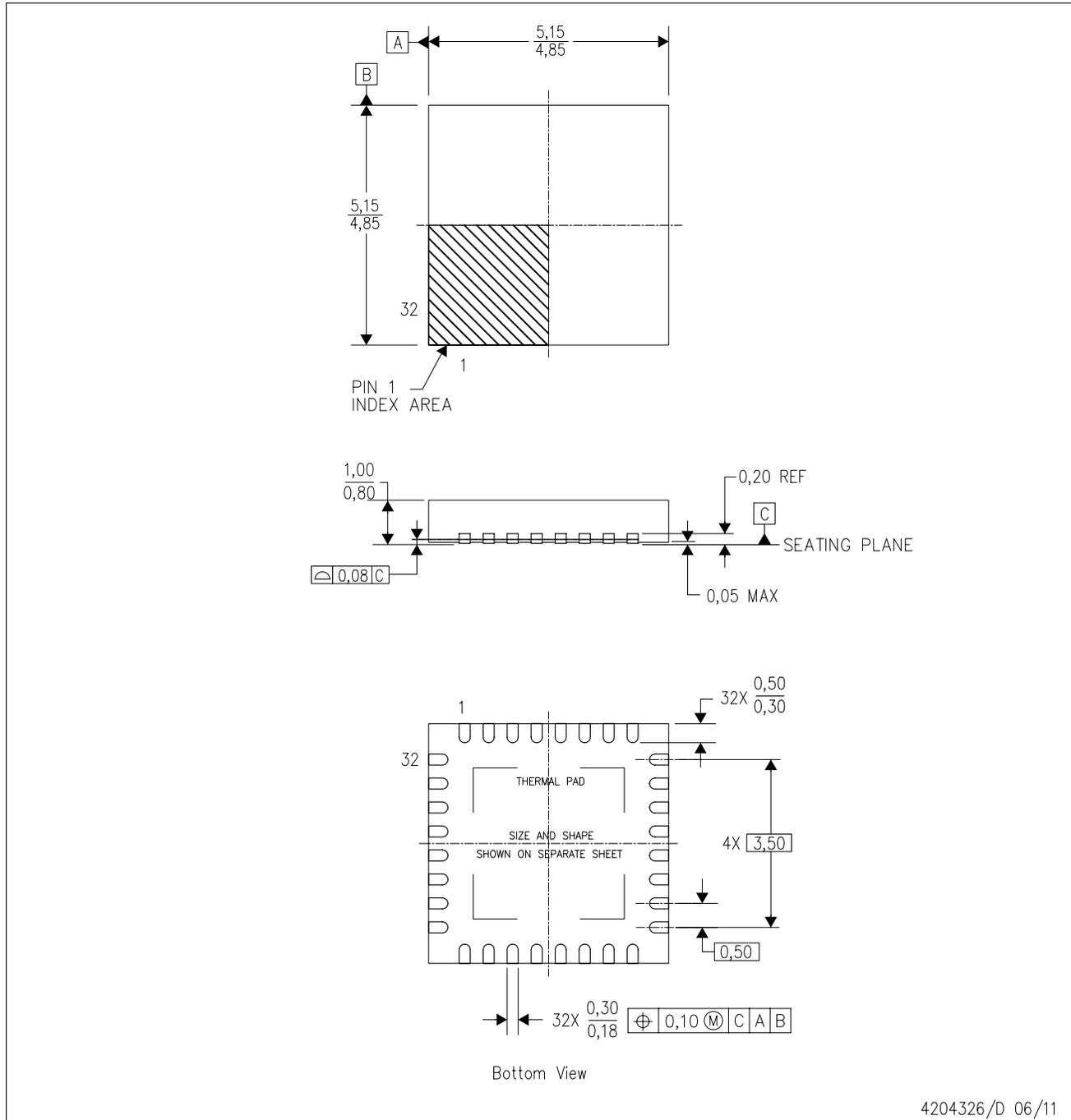
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CC1175RHBR	QFN	RHB	32	3000	338.1	338.1	20.6
CC1175RHBT	QFN	RHB	32	250	338.1	338.1	20.6

RHB (S-PVQFN-N32)

PLASTIC QUAD FLATPACK NO-LEAD



4204326/D 06/11

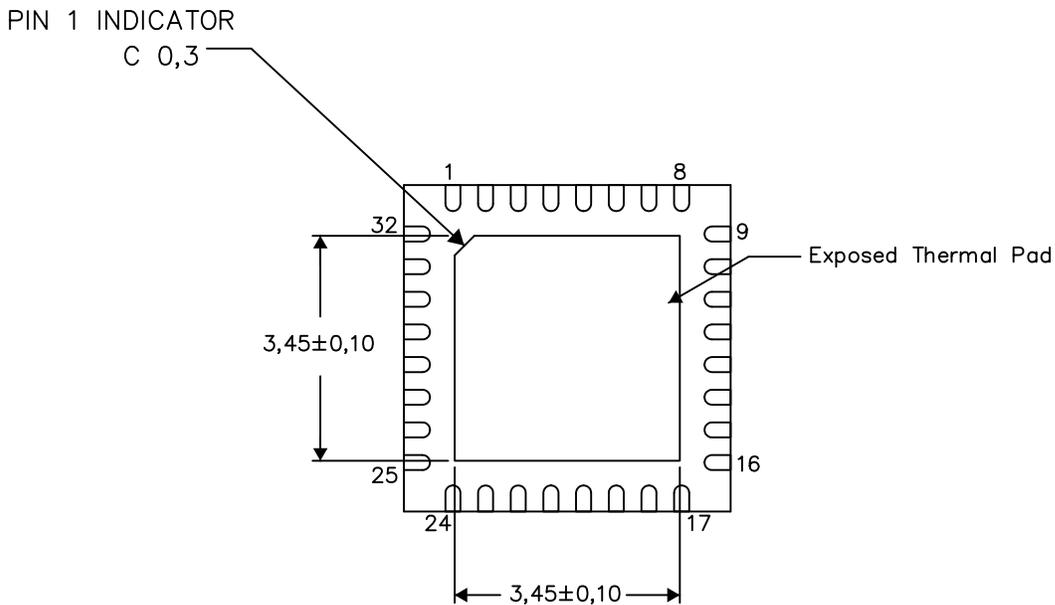
- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) Package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.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

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](http://www.ti.com).

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



Bottom View

Exposed Thermal Pad Dimensions

4206356-2/X 12/12

NOTE: A. All linear dimensions are in millimeters



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