TEXAS INSTRUMENTS

CC3350, CC3351
SWRS284A – APRIL 2024 – REVISED JULY 2024

CC335x SimpleLink™ 2.4GHz and 5GHz Dual-Band Wi-Fi 6 and Bluetooth® Low Energy Companion IC

1 Features

Key Features

- Wi-Fi 6 (802.11ax)
- Bluetooth® Low Energy 5.4 in CC33x1 devices
- Companion IC to any processor or MCU host capable of running a TCP/IP stack
- Integrated 2.4GHz and 5GHz PA for complete wireless solution with up to +20.5dBm output power.
- Operating temperature: –40°C to +105°C
- Application throughput up to 50Mbps

Extended Features

- Wi-Fi 6
  - 2.4GHz and 5GHz, 20MHz, single spatial stream
  - MAC, baseband, and RF transceiver with support for IEEE 802.11 a/b/g/n/ax
  - OFDMA, trigger frame, MU-MIMO (downlink), basic service set coloring, and target wake time (TWT) for improved efficiency
  - Hardware-based encryption and decryption supporting WPA2 and WPA3
  - Excellent interoperability
  - Support for 4-bit SDIO or SPI host interfaces

- Bluetooth Low Energy 5.4
  - LE coded PHYs (long range), LE 2M PHY (high speed) and advertising extension
  - Host controller interface (HCI) transport with option for UART or shared SDIO

- Enhanced security
  - Secured host interface
  - Firmware authentication
  - Anti-rollback protection

- Multirole support (for example, concurrent STA and AP) to connect with Wi-Fi devices on different RF channels (Wi-Fi networks)
- Optional antenna diversity or selection

- 3-wire or 1-wire PTA for external coexistence with additional 2.4GHz radios (for example, Thread or Zigbee)

- Power management
  - V_{MAIN}, V_{IO}, V_{pp}: 1.8V
  - V_{PA}: 3.3V
- Clock sources
  - 40MHz XTAL fast clock
  - Internal slow clock or external 32.768kHz slow clock
- Small package size
  - Easy to design with 40-pin, 5mm × 5mm quad flat no-leaded (QFN) package, 0.4mm pitch

2 Applications

- Grid infrastructure
  - Electricity meter
  - String inverter
  - Micro inverter
  - Energy storage power conversion system (PCS)
  - EV charging infrastructure
- Building and home automation
  - HVAC controller
  - HVAC gateway
  - Thermostat
  - Building security gateway
  - Garage door system
  - IP network camera and video doorbell
  - Wireless security camera
- Appliances
  - Refrigerator and freezer
  - Oven
  - Washer and dryer
  - Residential water heater and heating system
  - Air purifier and humidifier
  - Coffee machine
  - Air conditioner indoor unit
  - Vacuum robot
  - Robotic lawn mower
- Medical
  - Infusion pump
  - Electronic hospital bed and bed control
  - Multiparameter patient monitor
  - Blood pressure monitor
  - CPAP machine
  - Telehealth systems
  - Ultrasound scanner
  - Ultrasound smart probe
  - Electric toothbrush
- Retail automation and payment
- Printers

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3 Description

The SimpleLink™ Wi-Fi CC33xx family of devices is where affordability meets reliability, enabling engineers to connect more applications with confidence. CC33xx are single-chip Wi-Fi 6 and Bluetooth Low Energy 5.4 devices. The CC3350 and CC3351 are the first dual-band devices in this pin-to-pin compatible family.

* CC3350: A 2.4GHz and 5GHz Wi-Fi 6 companion IC
* CC3351: A 2.4GHz and 5GHz Wi-Fi 6 and Bluetooth Low Energy 5.4 companion IC

The CC335x offers Wi-Fi 6 and BLE while maintaining compatibility with Wi-Fi 4 (802.11 a/b/g/n) and Wi-Fi 5 (802.11ac). These CC335x are the 10th-generation connectivity combination chip from Texas Instruments. As such, the CC335x is based on proven technology. These devices are ideal for cost-sensitive embedded applications with a Linux or RTOS host running TCP/IP. CC335x brings the efficiency of Wi-Fi 6 to embedded device applications for the Internet of Things (IoT) with a small PCB footprint and a highly optimized bill of materials.

Device Information

PART NUMBER	WI-FI 2.4/5GHz SISO	BLUETOOTH LOW ENERGY
CC3350ENJARSBR	✔	
CC3351ENJARSBR	✔	✔

4 System Diagram

Figure 4-1 shows a basic system diagram for the CC3351.
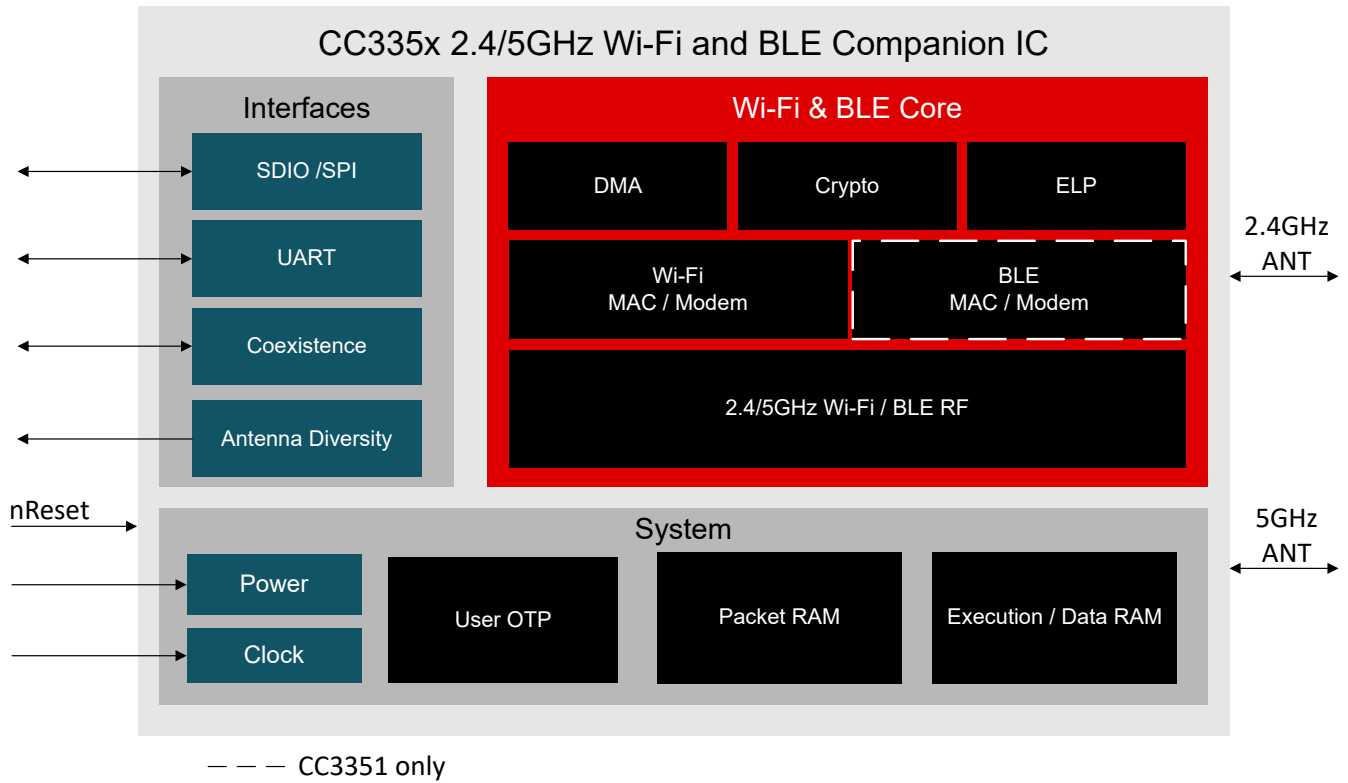
Figure 4-1. CC3351 High-Level System Diagram

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5 Pin Configuration and Functions

5.1 Pin Diagram

Figure 5-1 shows pin assignments for the 40-pin WQFN package.
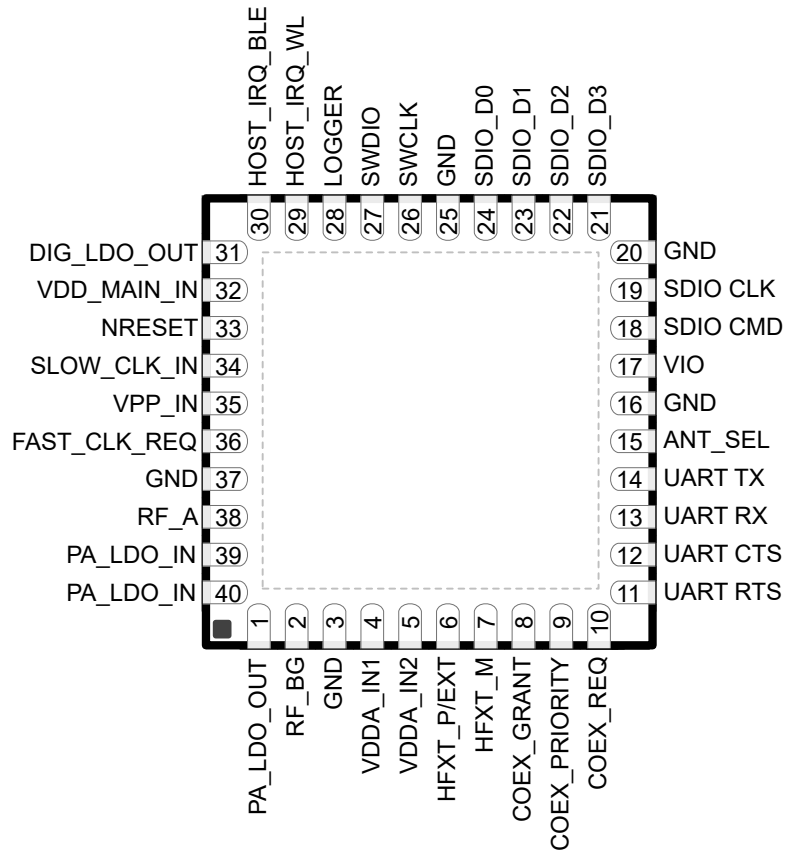
Figure 5-1. CC3351 Pin Diagram

Product Folder Links: *CC3350 CC3351*

5.2 Pin Attributes

Table 5-1. Pin Attributes

PIN	SIGNAL NAME	TYPE	DIR (I/O)	VOLTAGE LEVEL	SHUTDOWN STATE[1]	STATE AFTER POWER-UP	DESCRIPTION
1	PA_LDO_OUT	Analog					RF power amplifier LDO output
2	RF_BG	RF	I/O				Bluetooth Low Energy and WLAN 2.4GHz RF port
3	GND	GND					GND
4	VDDA_IN1	POW					1.8V supply for analog domain
5	VDDA_IN2	POW					1.8V supply for analog domain
6	HFXT_P	Analog		Sine			XTAL_P
7	HFXT_M	Analog					XTAL_N
8	COEX_GRANT[2]	Digital	O	V_{IO}	PD	PD	External coexistence interface - grant
9	COEX_PRIORITY[2]	Digital	I	V_{IO}	PU	PU	External coexistence interface - priority
10	COEX_REQ[2]	Digital	I	V_{IO}	PU	PU	External coexistence interface - request
11	UART RTS	Digital	O	V_{IO}	PU	PU	Device RTS signal - flow control for BLE HCI
12	UART CTS	Digital	I	V_{IO}	PU	PU	Device CTS signal - flow control for BLE HCI
13	UART RX	Digital	I	V_{IO}	PU	PU	UART RX for BLE HCI
14	UART TX	Digital	O	V_{IO}	PU	PU	UART TX for BLE HCI
15	ANT_SEL[2]	Digital	O	V_{IO}	PD	PD	Antenna select control line
16	GND	GND					GND
17	VIO	POW					1.8V IO supply
18	SDIO CMD	Digital	I/O	V_{IO}	HiZ	HiZ	SDIO command or SPI PICO
19	SDIO CLK	Digital	I	V_{IO}	HiZ	HiZ	SDIO clock or SPI clock
20	GND	GND					GND
21	SDIO D3	Digital	I/O	V_{IO}	HiZ	PU	SDIO data D3 or SPI CS
22	SDIO D2	Digital	I/O	V_{IO}	HiZ	HiZ	SDIO data D2
23	SDIO D1	Digital	I/O	V_{IO}	HiZ	HiZ	SDIO data D1
24	SDIO D0	Digital	I/O	V_{IO}	HiZ	HiZ	SDIO data D0 or SPI POCI
25	GND	GND					GND
26	SWCLK	Digital	I	V_{IO}	PD	PD	Serial wire debug clock
27	SWDIO	Digital	I/O	V_{IO}	PU	PU	Serial wire debug I/O

Product Folder Links: *CC3350 CC3351*

Table 5-1. Pin Attributes (continued)

PIN	SIGNAL NAME	TYPE	DIR (I/O)	VOLTAGE LEVEL	SHUTDOWN STATE[1]	STATE AFTER POWER-UP	DESCRIPTION
28	LOGGER[3]	Digital	O	V_{IO}	PU	PU	Tracer (UART TX debug logger)
29	HOST_IRQ_WL[3]	Digital	O	V_{IO}	PD	0	Interrupt request to host for WLAN
30	HOST_IRQ_BLE[3]	Digital	O	V_{IO}	PD	PD	Interrupt request to host for BLE (in shared SDIO mode)
31	DIG_LDO_OUT	Analog	O				Digital LDO output to decoupling capacitor
32	VDD_MAIN_IN	POW					1.8V supply input for SRAM and digital
33	nRESET	Digital	I	V_{IO}	PD	PD	Reset line for enabling or disabling device (active low)
34	SLOW_CLK_IN	Digital	I	V_{IO}	PD	PD	32.768kHz RTC clock input
35	VPP_IN	POW					1.8V OTP programming input supply
36	FAST_CLK_REQ	Digital	O	V_{IO}	PD	PD	Fast clock request from the device
37	GND	GND					GND
38	RF_A	RF					WLAN 5GHz RF port
39	PA_LDO_IN	POW					3.3V supply for PA
40	PA_LDO_IN	POW					3.3V supply for PA

1. All digital I/Os (with the exception of SDIO signals) are Hi-Z when the device is in Shutdown mode with internal PU/PD according to the "shutdown state" column.
2. See software release notes for support level.
3. LOGGER and HOST_IRQ_WL pins are sensed by the device during boot, see CC33xx Hardware Integration.

6 Specifications

All specifications are given at the CC335x pins. Typical values are measured with nominal device at 25°C.

6.1 Absolute Maximum Ratings

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

PARAMETER		PINS	MIN	MAX	UNIT
V_{PA}	V_{DD} PA Voltage	39,40	−0.5	4.2	V
V_{MAIN}	Main supply voltage for analog and digital - VDD_MAIN_IN, VDDA_IN1, VDDA_IN2	32, 4, 5	−0.5	2.1	V
V_{IO}	VDD IO Voltage	17	−0.5	2.1	V
	Input Voltage to all digital pins		−0.5	V_{IO} + 0.5	V
	HFXT_P Input Voltage	6	−0.5	2.1	V
V_{PP}	VPP OTP Voltage	35	−0.5	2.1	V
T_A	Operating Ambient Temperature		−40	105	°C
T_{stg}	Storage temperature		−55	155	°C

(1) Stresses beyond those listed under *Absolute Maximum Rating* 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 Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

				VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per AEC Q100-002[1]	RF pins	±1000	V
			Other pins	±2000	
		Charged device model (CDM), per AEC Q100-011	RF pins	±250	
			Other pins	±500	

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

6.3 Recommended Operating Conditions

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

PARAMETER		PINS	MIN	TYP	MAX	UNIT
V_{MAIN}	Main supply voltage digital and analog - VDD_MAIN_IN, VDDA_IN1, VDDA_IN2	32,4,5	1.62	1.8	1.98	V
V_{PA}	DC supply rail for PA	39,40	3	3.3	3.6	
V_{IO}	DC supply rail for input/output	17	1.62	1.8	1.98	
V_{PP}	DC supply rail for OTP memory	35	1.62	1.8	1.98	
T_A	Operating ambient temperature		−40		85/105[1]	°C
	Maximum power dissipation				2	W

(1) The CC3350 and CC3351 devices may operate at temperatures of up to 105°C. This allows the device to be used reliably in applications that may be exposed to higher ambient temperatures over certain periods of the product's life. At temperatures higher than 85°C, the WLAN/BLE performance may degrade.

6.4 Electrical Characteristics

PARAMETER	DESCRIPTION	TEST CONDITION	MIN	TYP	MAX	UNIT
V_{IH}	High Level Input Voltage		$0.65 \times V_{IO}$		V_{IO}	
V_{IL}	Low Level Input Voltage		0		$0.35 \times V_{IO}$	
V_{OH}	High Level Output Voltage	at 4mA	$V_{IO} - 0.45$		V_{IO}	V
V_{OL}	Low Level Output Voltage	at 4mA	0		0.45	

6.5 Thermal Resistance Characteristics

THERMAL METRIC[1]	DESCRIPTION		UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance (According to JEDEC EIA/JESD 51 document)	30.5	
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	16.7	
$R_{\theta JB}$	Junction-to-board thermal resistance	10	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	0.1	
Ψ_{JB}	Junction-to-board characterization parameter	10	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	1.7	

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

6.6 WLAN Performance: 2.4GHz Receiver Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operational Frequency Range		2412		2472	MHZ
Sensitivity: 8% PER for 11b rates, 10% PER for 11g/n/ax rates	1 Mbps DSSS		-98		dBm
	2 Mbps DSSS		-95.3		
	11 Mbps CCK		-90		
	6 Mbps OFDM		-93.2		
	54 Mbps OFDM		-75.5		
	HT MCS0 MM 4K		-93		
	HT MCS7 MM 4K		-72.9		
	HE MCS0 4K		-92.7		
	HE MCS7 4K		-72.5		
Maximum input level: 8% PER for 11b rates, 10% PER for 11g/n/ax rates	1 DSSS		0		dBm
	OFDM6, HT MCS0, HE MCS0		0		
	OFDM54, HT MCS7, HE MCS7		-9		
Adjacent Channel Rejection	1 Mbps DSSS		45		dB
	11 Mbps CCK		39		
	6 Mbps OFDM		20		
	54 Mbps OFDM		3		
	HT MCS0		20		
	HT MCS7		3		
	HE MCS0		16		
	HE MCS7		-1		
RSSI Accuracy	-90 dBm to -30dBm	-3		3	dB

Product Folder Links: CC3350 CC3351

6.7 WLAN Performance: 2.4GHz Transmitter Power

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operational Frequency Range		2412		2472	MHz
Maximum output power at V_{PA} > 3.0 V	1 Mbps DSSS		20.5		dBm
	6 Mbps OFDM		20.2		
	54 Mbps OFDM		17.4		
	HT MCS0 MM		20.2		
	HT MCS7 MM		17.4		
	HE MCS0		20.2		
	HE MCS7		17.3		

6.8 WLAN Performance: 5GHz Receiver Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operational Frequency Range		5180		5845	MHZ
Sensitivity: 10% PER for 11g/n/ax rates	6 Mbps OFDM		-93.2		dBm
Sensitivity: 10% PER for 11g/n/ax rates	54 Mbps OFDM		-75.8		
Sensitivity: 10% PER for 11g/n/ax rates	HT MCS0 MM 4K		-93		
Sensitivity: 10% PER for 11g/n/ax rates	HT MCS7 MM 4K		-73.5		
Sensitivity: 10% PER for 11g/n/ax rates	HE MCS0 4K		-92.9		
Sensitivity: 10% PER for 11g/n/ax rates	HE MCS7 4K		-73.5		
Maximum input level: 10% PER for 11g/n/ax rates	OFDM6, HT MCS0, HE MCS0		-23		
Maximum input level: 10% PER for 11g/n/ax rates	OFDM54, HT MCS7, HE MCS7		-24		
Adjacent Channel Rejection	6 Mbps OFDM		20		dB
	54 Mbps OFDM		3		
	HT MCS0		18		
	HT MCS7		0		
	HE MCS0		16		
	HE MCS7		-1		
RSSI Accuracy	-90 dBm to -30dBm	-3		3	dB

6.9 WLAN Performance: 5GHz Transmitter Power

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operational Frequency Range		5180		5845	MHZ
Maximum output power at V_{PA} > 3.0 V	6 Mbps OFDM		19.5		dBm
	54 Mbps OFDM		15.1		
	HT MCS0 MM		19.5		
	HT MCS7 MM		15.1		
	HE MCS0 20 MHz		19.5		
	HE MCS7 20 MHz		15		

6.10 BLE Performance: Receiver Characteristics

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
BLE 125Kbps (LE Coded) Receiver Characteristics					

6.10 BLE Performance: Receiver Characteristics (continued)

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
Receiver sensitivity	PER <30.2%		-102.2		dBm
Receiver saturation	PER <30.2%		0		dBm
Co-channel rejection[1]	Wanted signal at -79 dBm, modulated interferer in channel		10		dB
Selectivity, ±1 MHz[1]	Wanted signal at -79 dBm, modulated interferer at ±1 MHz.		0 / 0		dB
Selectivity, ±2 MHz[1]	Wanted signal at -79 dBm, modulated interferer at ±2 MHz.		-37 / -30		dB
Selectivity, ±3 MHz[1]	Wanted signal at -79 dBm, modulated interferer at ±3 MHz.		-39 / -36		dB
Selectivity, ±4 MHz[1]	Wanted signal at -79 dBm, modulated interferer at ±4 MHz.		-45 / -41		dB
RSSI Accuracy	Dynamic range of -90 to -20dBm	-4		4	dB
BLE 500Kbps (LE Coded) Receiver Characteristics					
Receiver sensitivity	PER <30.2%		-99.8		dBm
Receiver saturation	PER <30.2%		0		dBm
Co-channel rejection[1]	Wanted signal at -72 dBm, modulated interferer in channel.		10		dB
Selectivity, ±1 MHz[1]	Wanted signal at -72 dBm, modulated interferer at ±1 MHz.		0 / 0		dB
Selectivity, ±2 MHz[1]	Wanted signal at -72 dBm, modulated interferer at ±2 MHz.		-35 / -25		dB
Selectivity, ±3 MHz[1]	Wanted signal at -72 dBm, modulated interferer at ±3 MHz.		-40 / -37		dB
Selectivity, ±4 MHz[1]	Wanted signal at -72 dBm, modulated interferer at ±4 MHz.		-45 / -40		dB
RSSI Accuracy	Dynamic range of -90 to -20dBm	-4		4	dB
BLE 1Mbps (LE 1M) Receiver Characteristics					
Receiver sensitivity[2]	PER <30.2%, 37-byte packets		–99.4		dBm
Receiver sensitivity[2]	PER <30.2%, 255 byte-packets		–98.1		dBm
Receiver saturation	PER <30.2%		0		dBm
Co-channel rejection[1]	Wanted signal at -67 dBm, modulated interferer in channel		10		dB
Selectivity, ±1 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±1 MHz		0 / 0		dB
Selectivity, ±2 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±2 MHz.		-35 / -28		dB
Selectivity, ±3 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±3 MHz		-38 / -32		dB
Selectivity, ±4 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±4 MHz		-45 / -40		dB
Out-of-band blocking	30 MHz to 2000 MHz, Wanted signal at -67 dBm		–23		dBm
Out-of-band blocking	2003 MHz to 2399 MHz, Wanted signal at -67 dBm		–30		dBm
Out-of-band blocking	2484 MHz to 2997 MHz, Wanted signal at -67 dBm		–30		dBm
Out-of-band blocking	3000 MHz to 6 GHz, Wanted signal at -67 dBm		–21		dBm

6.10 BLE Performance: Receiver Characteristics (continued)

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
Intermodulation	Wanted signal at 2402 MHz, -64 dBm. Two interferers at 2405 and 2408 MHz respectively, at the given power level		–40		dBm
RSSI accuracy	Dynamic range of -90 to -20dBm	-4		4	dB
BLE 2Mbps (LE 2M) Receiver Characteristics					
Receiver sensitivity[3]	PER <30.2%		-95.2		dBm
Receiver saturation	PER <30.2%		0		dBm
Co-channel rejection[1]	Wanted signal at -67 dBm, modulated interferer in channel		10		dB
Selectivity, ±2 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±2 MHz.		0 / 0		dB
Selectivity, ±4 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±4 MHz		-35 / -28		dB
Selectivity, ±6 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±6 MHz		-35 / -28		dB
Alternate channel rejection, ±8 MHz[1]	Wanted signal at -67 dBm, modulated interferer at ±8 MHz		-37 / -32		dB
Out-of-band blocking	30 MHz to 2000 MHz, Wanted signal at -67 dBm		–23		dBm
Out-of-band blocking	2003 MHz to 2399 MHz, Wanted signal at -67 dBm		–30		dBm
Out-of-band blocking	2484 MHz to 2997 MHz, Wanted signal at -67 dBm		–30		dBm
Out-of-band blocking	3000 MHz to 6 GHz, Wanted signal at -67 dBm		–21		dBm
Intermodulation	Wanted signal at 2402 MHz, -64 dBm. Two interferers at 2405 and 2408 MHz respectively, at the given power level		–44		dBm
RSSI Accuracy	Dynamic range of -90 to -20dBm	-4		4	dB

(1)   Numbers given as C/I dB
(2)   BLE 1M PHY sensitivity on channels 17 and 39 may degrade by up to 2.5dB.
(3)   BLE 2M PHY sensitivity on channel 17 may degrade by up to 1.5dB.

6.11 BLE Performance—Transmitter Characteristics

The CC33X1 devices support BLE TX setting 0, 5, 10, or 20dBm.

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Power, highest setting			20		dBm

6.12 Current Consumption - 2.4-GHz WLAN Static Modes

All results are based on measurements taken using the RadioTool evaluation application (typ values are taken with nominal devices at room temp).

PARAMETER	TEST CONDITION		SUPPLY	TYP	MAX	UNIT
Continuous TX[1]	1 DSSS	TX power = 20.5 dBm	V_{Main}	92		mA
			V_{PA}	270	310[1]	mA
	6 OFDM	TX power = 20.2 dBm	V_{Main}	110	170[1]	mA
			V_{PA}	270	320[1]	mA
	54 OFDM	TX power = 17.4 dBm	V_{Main}	115		mA
			V_{PA}	215		mA
	HT MCS0	TX power = 20.2 dBm	V_{Main}	110		mA
			V_{PA}	270		mA
	HT MCS7	TX power = 17.4 dBm	V_{Main}	115		mA
			V_{PA}	215		mA
	HE MCS0	TX power = 20.2 dBm	V_{Main}	110		mA
			V_{PA}	270		mA
	HE MCS7	TX power = 17.3 dBm	V_{Main}	115		mA
			V_{PA}	215		mA
Continuous RX			V_{Main}	62		mA
			V_{PA}	0		mA
Continuous Listen (for beacon)			V_{Main}	55.5		mA
			V_{PA}	0		mA

(1)   Peak current V_{PA} can hit 450mA during device calibration.
        Peak current V_{MAIN} of 300mA including peripherals and internal CPU

6.13 Current Consumption - 2.4-GHz WLAN Use Cases

Nominal device at room temp

MODE	DESCRIPTION	MIN	TYP	MAX	UNIT
DTIM=1	System with 3.3V to Ext. DC/DC at 85% efficiency WLAN beacon reception every DTIM=1 (~102ms)		637		µA
	System with 1.8V WLAN beacon reception every DTIM=1 (~102ms)		980		
DTIM=3	System with 3.3V to Ext. DC/DC at 85% efficiency WLAN beacon reception every DTIM=3 (~306ms)		371		
	System with 1.8V WLAN beacon reception every DTIM=3 (~306ms)		570		
DTM=5	System with 3.3V to Ext. DC/DC at 85% efficiency WLAN beacon reception every DTIM=5 (~510ms)		319		
	System with 1.8V WLAN beacon reception every DTIM=5 (~510ms)		490		

6.14 Current Consumption - 5-GHz WLAN Static Modes

All results are based on measurements taken using the RadioTool evaluation application (typ values are taken with nominal devices at room temp).

PARAMETER	TEST CONDITION		SUPPLY	TYP	MAX	UNIT
Continuous TX[1]	6 OFDM	TX power = 19.5 dBm	V_{Main}	170	220[1]	mA
			V_{PA}	250	290[1]	mA
	54 OFDM	TX power = 15.1 dBm	V_{Main}	175		mA
			V_{PA}	190		mA
	HT MCS0	TX power = 19.5 dBm	V_{Main}	170		mA
			V_{PA}	250		mA
	HT MCS7	TX power = 15.1 dBm	V_{Main}	175		mA
			V_{PA}	190		mA
	HE MCS0	TX power = 19.5 dBm	V_{Main}	170		mA
			V_{PA}	250		mA
	HE MCS7	TX power = 15 dBm	V_{Main}	175		mA
			V_{PA}	190		mA
Continuous RX			V_{Main}	110		mA
			V_{PA}	0		mA
Continuous Listen (for beacon)			V_{Main}	88		mA
			V_{PA}	0		mA

(1)   Peak current V_{PA} can hit 450mA during device calibration.
Peak current V_{MAIN} of 300mA including peripherals and internal CPU

6.15 Current Consumption - 5-GHz WLAN Use Cases

Nominal device at room temp

MODE	DESCRIPTION	MIN	TYP	MAX	UNIT
DTIM=1	System with 3.3V to Ext. DC/DC at 85% efficiency WLAN beacon reception every DTIM=1 (~102ms)		735[1]		µA
	System with 1.8V WLAN beacon reception every DTIM=1 (~102ms)		1130[1]		
DTIM=3	System with 3.3V to Ext. DC/DC at 85% efficiency WLAN beacon reception every DTIM=3 (~306ms)		390[1]		
	System with 1.8V WLAN beacon reception every DTIM=3 (~306ms)		600[1]		
DTM=5	System with 3.3V to Ext. DC/DC at 85% efficiency WLAN beacon reception every DTIM=5 (~510ms)		340[1]		
	System with 1.8V WLAN beacon reception every DTIM=5 (~510ms)		520[1]		

(1)   Based on limited number of measurements (pre-optimization).

6.16 Current Consumption - BLE Static Modes

PARAMETER	TEST CONDITION	SUPPLY	TYP	MAX	UNIT
TX, Max Duty Cycle	TX power = 0 dBm	V_{Main}	105		mA
		V_{PA}	50		
	TX power = 10 dBm	V_{Main}	105		
		V_{PA}	130		
	TX power = 20 dBm	V_{Main}	110		
		V_{PA}	270		
RX		V_{Main}	62		
		V_{PA}	0		

Product Folder Links: *CC3350 CC3351*

6.17 Current Consumption—Device States

Nominal device at room temp

MODE	DESCRIPTION	SUPPLY		TYP	UNIT
Shutdown	External supplies are available, device held in reset (nReset is low)	$V_{Main} + V_{PP}$		10	μA
		V_{PA}		2	
Sleep	Low power mode - RAM in retention	$V_{Main} + V_{PP}$		330	
		V_{PA}		2	

6.18 Timing and Switching Characteristics

6.18.1 Power Supply Sequencing

For proper operation of the CC335x device, perform the recommended power-up sequencing as follows:

1. All supplies (VDD_MAIN_IN, VDDA, VIO, VPA) must be available before nReset is released.
2. For an external slow clock, ensure that the clock is stable before nReset is deasserted (high).
3. The nReset pin should be held low for at least 10μs after stabilization of the external power supplies.

6.18.2 Clocking Specifications

The CC335x device uses two clocks for operation:

- A fast clock running at 40MHz for WLAN/BLE functions
- A slow clock running at 32.768kHz for low-power modes

The slow clock can be generated internally or externally. The fast clock must be generated externally.

6.18.2.1 Slow Clock Generated Internally

In order to minimize external components, the slow clock can be generated by an internal oscillator. However, this clock is less accurate and consumes more power than sourcing the slow clock externally. For this scenario the Slow_CLK_IN pin should be left not connected.

6.18.2.2 Slow Clock Using an External Oscillator

For optimal power consumption, the slow clock can be generated externally by an oscillator or sourced from elsewhere in the system. The external source must meet the requirements listed below. This clock should be fed into the CC335x pin Slow_CLK_IN and should be stable before nReset is deasserted and device is enabled.

6.18.2.2.1 External Slow Clock Requirements

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
	Input slow clock frequency	Square wave		32768		Hz
	Frequency accuracy	Initial + temperature + aging			±250	ppm
	Input Duty cycle		30%	50%	70%	—
T_r/T_f	Rise and fall time	10% to 90% (rise) and 90% to 10% (fall) of digital signal level			100	ns
V_{IL}	Input low level		0		$0.35 \times V_{IO}$	V
V_{IH}	Input high level		$0.65 \times V_{IO}$		1.95	V
	Input impedance			1		MΩ
	Input capacitance				5	pF

6.18.2.3 Fast Clock Using an External Crystal (XTAL)

The CC335x device supports a crystal-based fast clock (XTAL). The crystal is fed directly between HFXT_P and HFXT_M pins with compatible loading capacitors, and must meet the requirements below.

6.18.2.3.1 External Fast Clock XTAL Specifications

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supported frequencies			40		MHz

6.18.2.3.1 External Fast Clock XTAL Specifications (continued)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Frequency accuracy	Initial + temperature + aging			+/- 20	ppm
Load Capacitance, C_L [(1)](#)		5		13	pF
Equivalent series resistance, ESR				30	Ω
Drive level			100		uW

(1) Load capacitance, $C_L = [C1*C2] / [C1 + C2] + C_P$, where C1, C2 are the capacitors connected on HFXT_P and HFXT_M, respectively, and C_P is the parasitic capacitance (typically 1 to 2 pF). For example, for C1 = C2 = 6.8pF and C_P = 2pF, then C_L = 5pF.

6.19 Interface Timing Characteristics

SDIO is the main host interface for WLAN, and it supports a maximum clock rate of 52MHz. The CC335x device also supports shared SDIO interface for both BLE and WLAN.
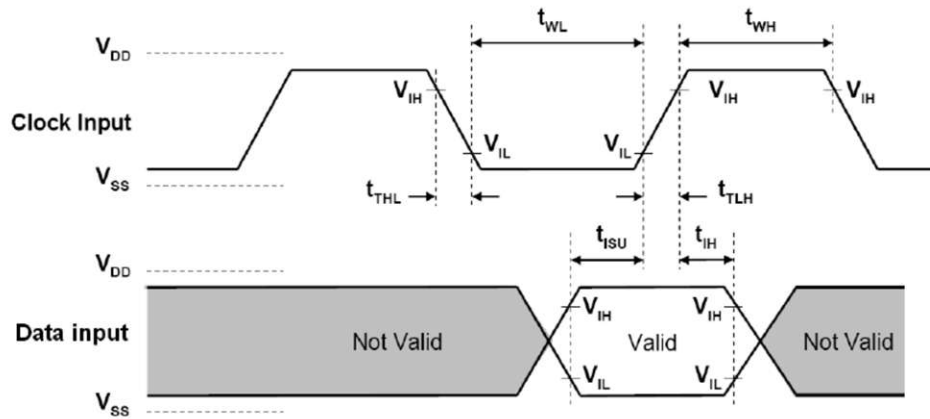
6.19.1.1 SDIO Timing Diagram—Default Speed

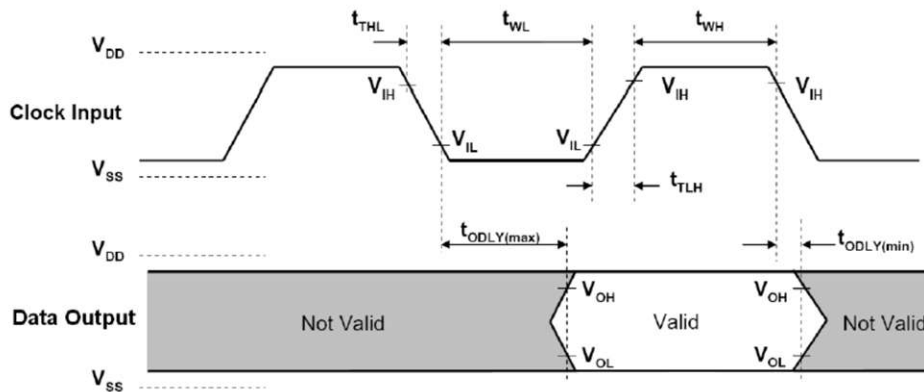
Figure 6-1. SDIO Default Input Timing

Figure 6-2. SDIO Default Output Timing

6.19.1.2 SDIO Timing Parameters—Default Speed

PARAMETER	DESCRIPTION	MIN	MAX	UNIT
f_{clock}	Clock frequency, CLK		26	MHz

6.19.1.2 SDIO Timing Parameters—Default Speed (continued)

PARAMETER	DESCRIPTION	MIN	MAX	UNIT
t_{High}	High Period	10		
t_{Low}	Low Period	10		
t_{TLH}	Rise time, CLK		10	
t_{THL}	Fall time, CLK		10	ns
t_{ISU}	Setup time, input valid before CLK ↑	5		
t_{IH}	Hold time, input valid after CLK ↑	5		
t_{ODLY}	Delay time, CLK ↓ to output valid	2	14	
C_L	Capacitive load on outputs	15	40	pF

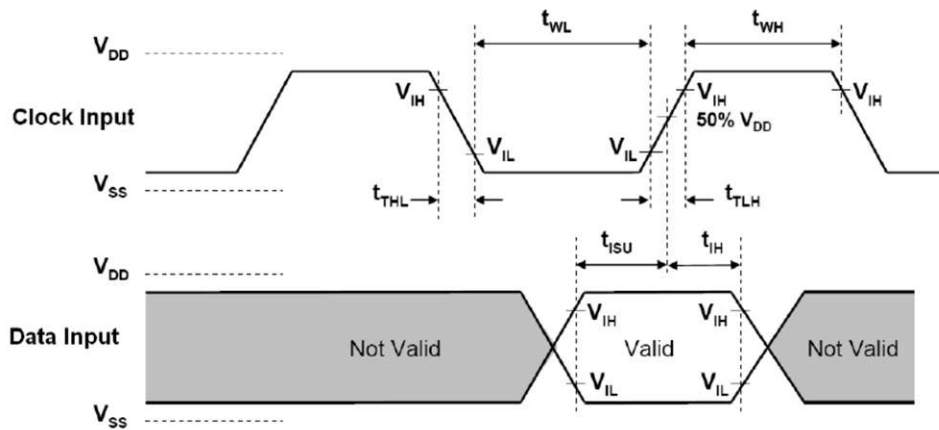### 6.19.1.3 SDIO Timing Diagram—High Speed

Figure 6-3. SDIO HS Input Timing
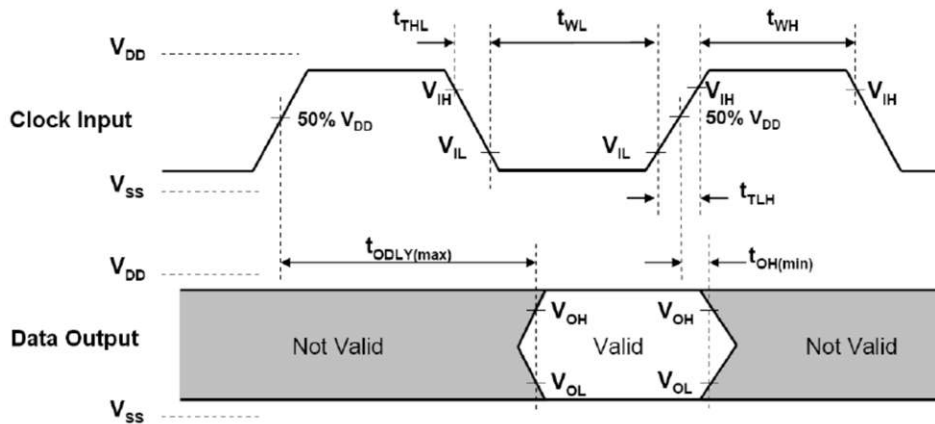
Figure 6-4. SDIO HS Output Timing

6.19.1.4 SDIO Timing Parameters—High Speed

PARAMETER	DESCRIPTION	MIN	MAX	UNIT
f_{clock}	Clock frequency, CLK		52	MHz

6.19.1.4 SDIO Timing Parameters—High Speed (continued)

PARAMETER	DESCRIPTION	MIN	MAX	UNIT
t_{High}	High Period	7		ns
t_{Low}	Low Period	7		
t_{TLH}	Rise time, CLK		3	
t_{THL}	Fall time, CLK		3	
t_{ISU}	Setup time, input valid before CLK ↑	6		
t_{IH}	Hold time, input valid after CLK ↑	2		
t_{ODLY}	Delay time, CLK ↓ to output valid	2	14	
C_L	Capacitive load on outputs	15	40	pF

6.19.2 SPI Timing Specifications

SPI is another host interface for WLAN. The CC335x device also supports shared SPI interface for both BLE and WLAN.
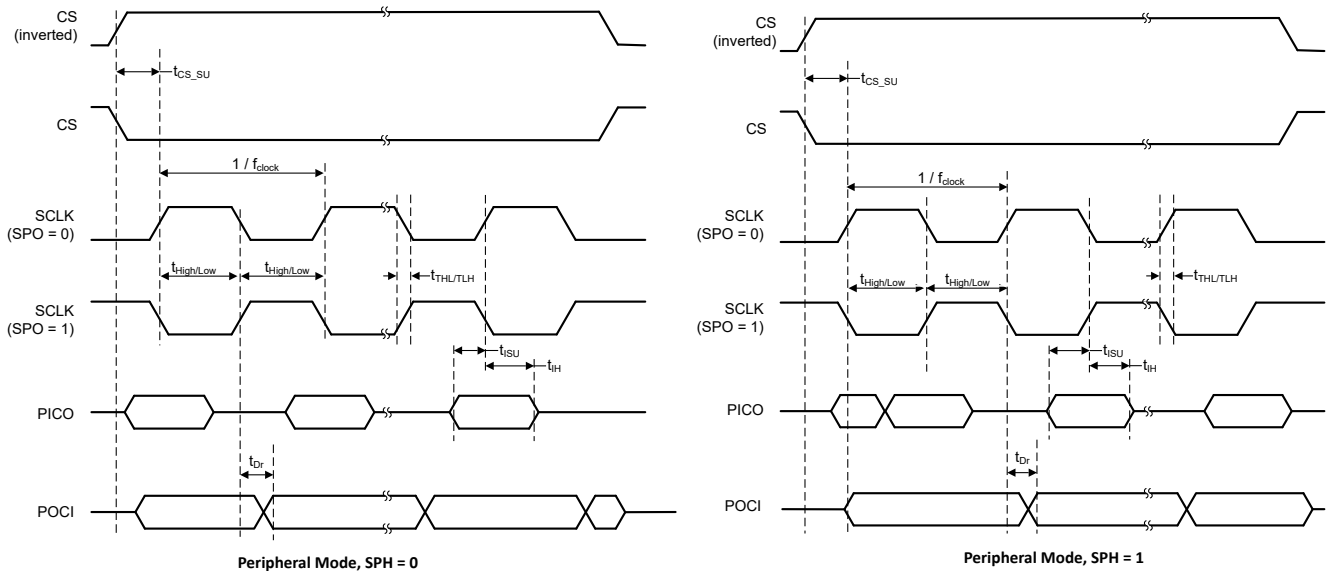
6.19.2.1 SPI Timing Diagram

Figure 6-5. SPI Timing

6.19.2.2 SPI Timing Parameters

PARAMETER	DESCRIPTION	MIN	MAX	UNIT
f_{clock}	Clock frequency, CLK		26	MHz
t_{High}	High Period	10		ns
t_{Low}	Low Period	10		
t_{TLH}	Rise time, CLK		3	
t_{THL}	Fall time, CLK		3	
t_{CSsu}	CS Setup time, CS valid before CLK ↑	3		
t_{ISU}	PICO, input valid before CLK ↑	3		
t_{IH}	PICO Hold time, input valid after CLK ↑	3		
t_{Dr}, t_{Df} - Active	Delay time, CLK ↑/↓ to output valid	2	10	
t_{Dr}, t_{Df} - Sleep	Delay time, CLK ↑/↓ to output valid		12	
C_L	Capacitive load on outputs	15	40	pF

Product Folder Links: *CC3350 CC3351*

6.19.3 UART 4-Wire Interface

UART is the main host interface for BLE, which supports host controller interface (HCI) transport layer.

6.19.3.1 UART Timing Parameters

PARAMETER	CONDITION	MIN	TYP	MAX	UNIT
Baud rate		37.5		4364	kbps
Baud rate accuracy per byte	Receive/Transmit	−2.5 %		+1.5%	
Baud rate accuracy per bit	Receive/Transmit	-12.5%		+12.5%	
CTS low to TX_DATA on		0	2		ms
CTS high to TX_DATA off	Hardware flow control			1	Byte
CTS high pulse width		1			bit
RTS low to RX_DATA on		0	2		ms
RTS high to RX_DATA off	Interrupt set to 1/4 FIFO			16	Byte

7 Applications, Implementation, and Layout

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, as well as validating and testing their design implementation to confirm system functionality.

Figure 7-1 shows the reference schematic for the CC335x using an optimized bill of materials.
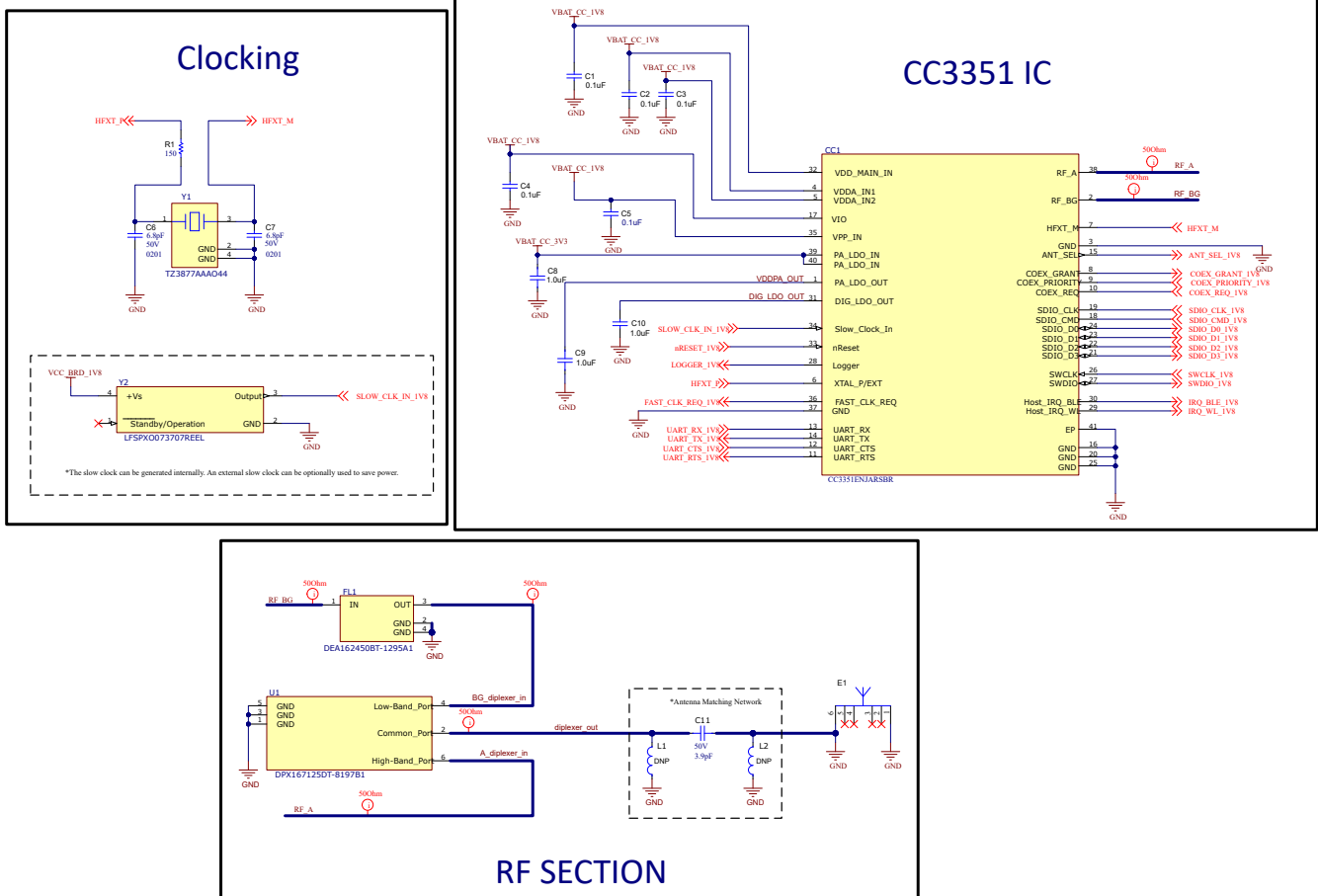
Figure 7-1. CC335x Reference Schematic

1. The slow clock can be generated internally. An external slow clock can be optionally used to save power.
2. For more information on antenna selection and matching, see the CC33xx Hardware Integration.

Product Folder Links: *CC3350 CC3351*

8 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

8.1 Third-Party Products Disclaimer

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8.2 Device Nomenclature Boilerplate

Device development evolutionary flow:

X   Experimental device that is not necessarily representative of the final device's electrical specifications and may not use production assembly flow.

P   Prototype device that is not necessarily the final silicon die and may not necessarily meet final electrical specifications.

null   Production version of the silicon die that is fully qualified.

Support tool development evolutionary flow:

TMDX   Development-support product that has not yet completed Texas Instruments internal qualification testing.

TMDS   Fully-qualified development-support product.

X and P devices and TMDX development-support tools are shipped against the following disclaimer:

Device development evolutionary flow:

TMX   Experimental device that is not necessarily representative of the final device's electrical specifications and may not use production assembly flow.

TMP   Prototype device that is not necessarily the final silicon die and may not necessarily meet final electrical specifications.

TMS   Production version of the silicon die that is fully qualified.

Support tool development evolutionary flow:

TMDX   Development-support product that has not yet completed Texas Instruments internal qualification testing.

TMDS   Fully-qualified development-support product.

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"Developmental product is intended for internal evaluation purposes."

Production devices and TMDS development-support tools have been characterized fully, and the quality and reliability of the device have been demonstrated fully. TI's standard warranty applies.

Predictions show that prototype devices (X or P) have a greater failure rate than the standard production devices. Texas Instruments recommends that these devices not be used in any production system because their expected end-use failure rate still is undefined. Only qualified production devices are to be used.

8.3 Tools and Software

Design Kits and Evaluation Modules

CC330x Reference Design Files — CC330x reference design CAD source files. TI recommends using this design as a reference when creating the layout to achieve the RF performance listed in this data sheet.

CC3351 BoosterPack plug-in module — The CC3301 BoosterPack™ plug-in module (BP-CC3351) is a test and development board that can be easily connected to TI LaunchPad™ development kits or processor boards; thus enabling rapid software development.

CC3351 M.2 card plug-in module — The CC3351 M.2 card plug-in module (M2-CC3351) is a test and development board that can be easily connected to TI processor boards or other processor boards with an M.2 Key E interface support; thus enabling rapid software development.

Software

SimpleLink Wi-Fi Toolbox — SimpleLink Wi-Fi Toolbox is a collection of tools to help development and testing of the CC33xx. The Wi-Fi toolbox package provides all the capabilities required to debug and monitor WLAN/Bluetooth® Low Energy firmware with a host, perform RF validation tests, run pretest for regulatory certification testing, and debug hardware and software platform integration issues.

CC33xx device drivers — The CC33xx are single-chip Wi-Fi 6 and Bluetooth Low Energy 5.4 companion devices suitable for both Linux and RTOS-based systems. CC33XX-SOFTWARE is a collection of software development sources aimed to facilitate quick setup, out-of-box experience, and accelerate development in Linux or RTOS environments.

8.4 Documentation Support

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

Application Reports

CC33xx Production Line Guide — Texas Instruments™ provides many resources in order to assist users in quickly examining the functionality and performance of their devices. This document provides the necessary information to guide the user in production line testing for CC33xx. The device's functions can be checked using tools and software provided by Texas Instruments. Performance testing is more involved as external equipment is required for thorough examination.

SimpleLink CC33xx Security Features — This document describes the CC33xx security related features, which are made available to vendors through an ecosystem that incorporates simple and concise APIs, tools, and documentation

User's Guides

CC33xx WLAN Features User's Guide — This document provides information about CC33xx family of devices and Wi-Fi® features, as well as TI proprietary enhancements. The document does not provide the complete application programming interface (API) set, but a high-level overview of the features.

CC33xx Hardware Integration — This document describes how to integrate the CC330x into any system and the hardware requirements for this device. Layout and schematic considerations are listed here as well, which TI highly recommends following in order to achieve the device performance listed in this datasheet.

8.5 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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8.7 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.

8.8 Glossary

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

9 Revision History

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

DATE	REVISION	NOTES
July 2024	A	Changed the document status from Advance Information to Production Data

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CC3350ENJARSBR	ACTIVE	WQFN	RSB	40	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	CC3350 ENJA	Samples
CC3351ENJARSBR	ACTIVE	WQFN	RSB	40	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 105	CC3351 ENJA	Samples

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

(2) RoHS: TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

(6) Lead finish/Ball material - Orderable Devices 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.

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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

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
CC3350ENJARSBR	WQFN	RSB	40	3000	330.0	12.4	5.3	5.3	1.1	8.0	12.0	Q2
CC3351ENJARSBR	WQFN	RSB	40	3000	330.0	12.4	5.3	5.3	1.1	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)
CC3350ENJARSBR	WQFN	RSB	40	3000	367.0	367.0	35.0
CC3351ENJARSBR	WQFN	RSB	40	3000	367.0	367.0	35.0
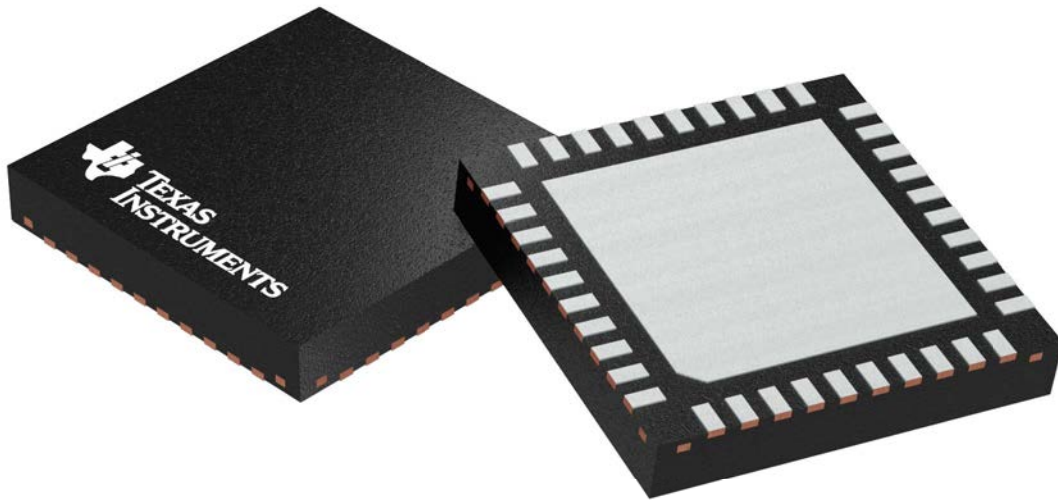
Images above are just a representation of the package family, actual package may vary.
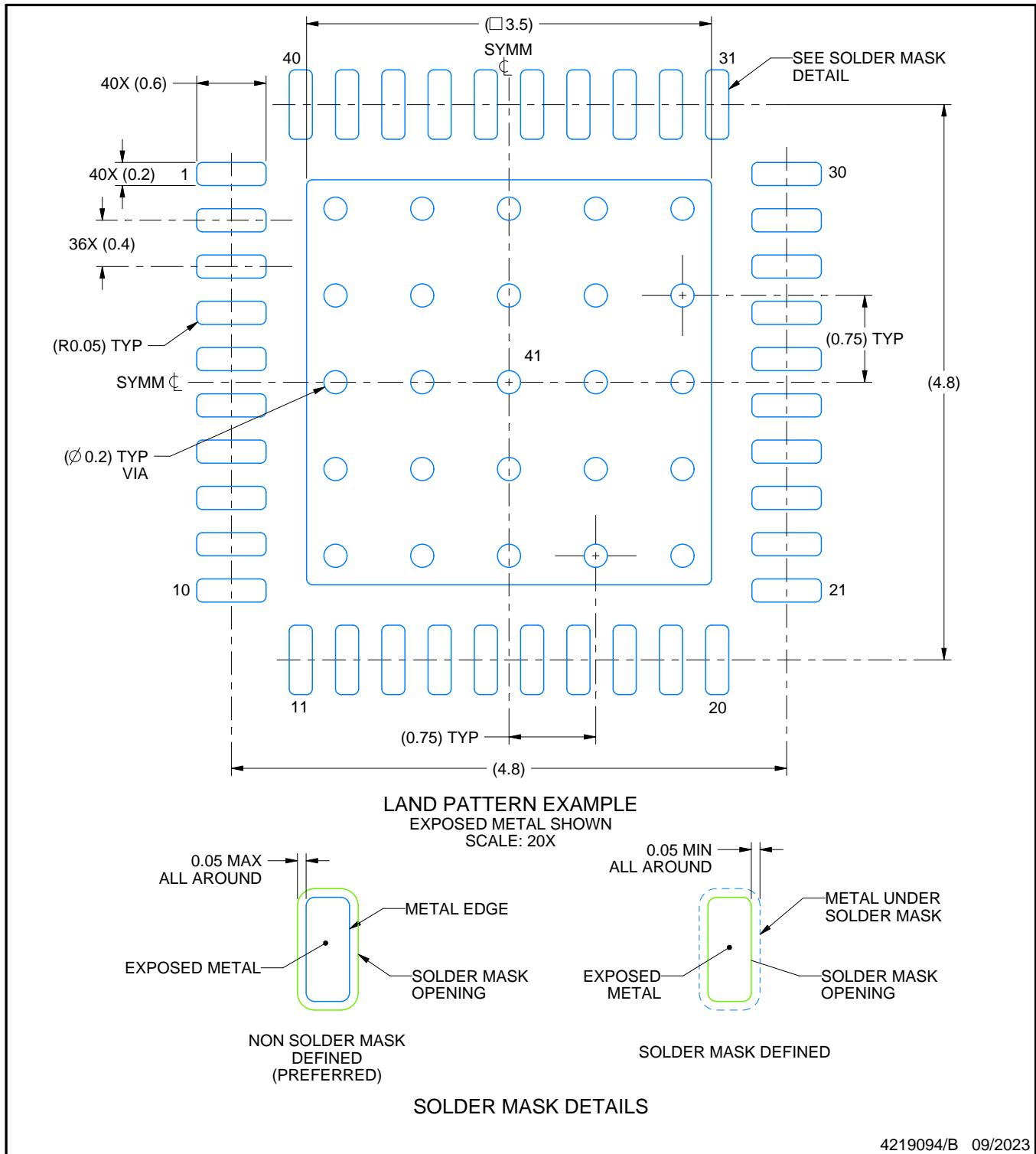Refer to the product data sheet for package details.

4207182/D

PIN 1 INDEX AREA

5.15
4.85

5.15
4.85

0.8
0.7

0.05
0.00

C

SEATING PLANE

0.08 C

2X 3.6

SYMM

EXPOSED
THERMAL PAD

11

20

10

21

SYMM

41

□ 3.5± 0.1

2X 3.6

1

30

36X 0.4

PIN 1 ID

40

31

40X 0.5
0.3

(0.2) TYP

40X 0.25
0.15

| | 0.1 Ⓜ | C | A | B |
| ⊕ | 0.05 Ⓜ | C | | |

4219094/B   09/2023

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: 20X

(□ 3.5)
SYMM
40X (0.6)
40X (0.2)
36X (0.4)
(R0.05) TYP
SYMM
(⌀ 0.2) TYP
VIA
(0.75) TYP
(4.8)
SEE SOLDER MASK DETAIL

0.05 MAX
ALL AROUND
METAL EDGE
EXPOSED METAL
SOLDER MASK OPENING
NON SOLDER MASK DEFINED (PREFERRED)

0.05 MIN
ALL AROUND
METAL UNDER SOLDER MASK
EXPOSED METAL
SOLDER MASK OPENING
SOLDER MASK DEFINED

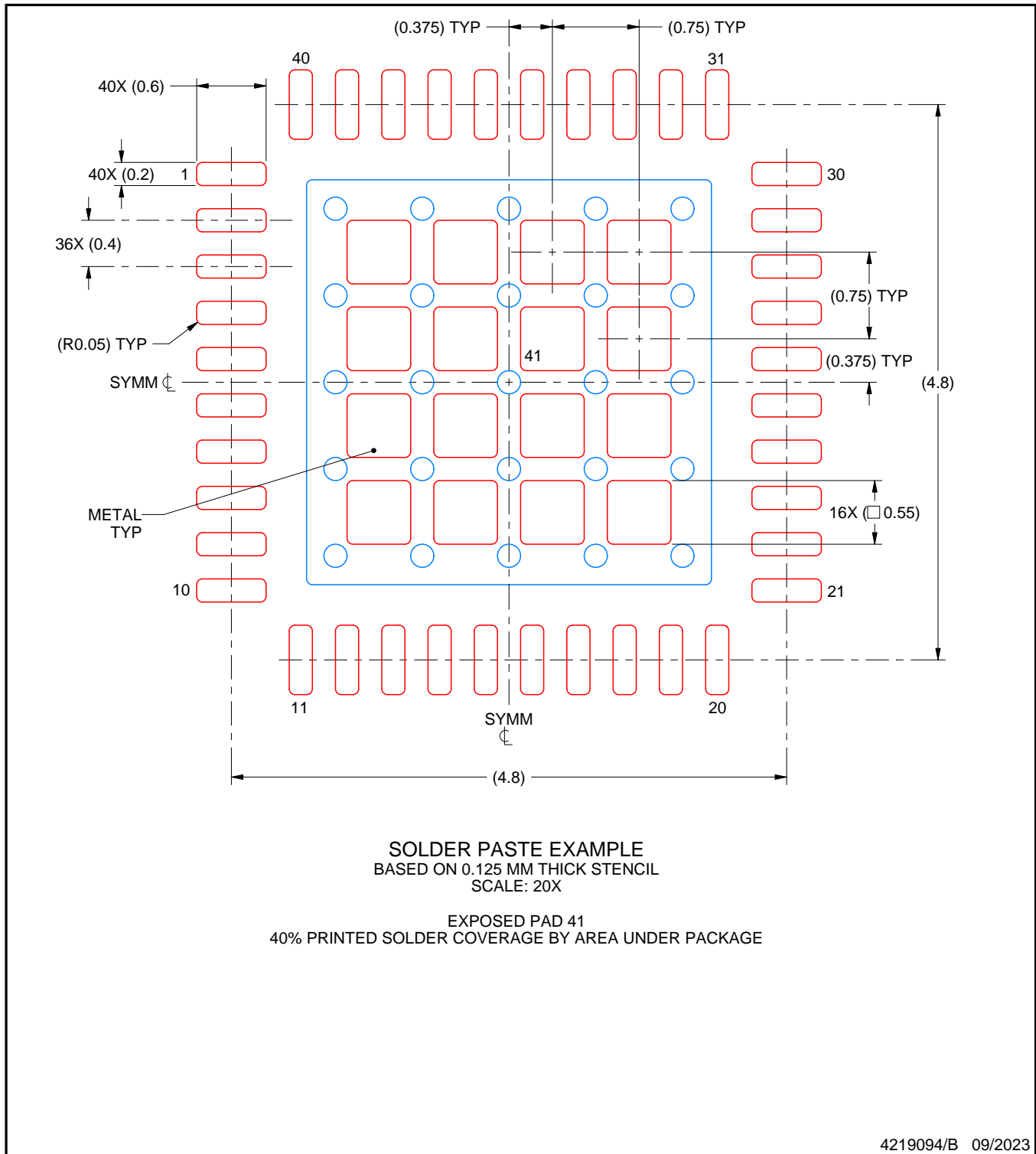SOLDER MASK DETAILS

4219094/B 09/2023

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.

(0.375) TYP

(0.75) TYP

40

31

40X (0.6)

40X (0.2)

1

36X (0.4)

30

(R0.05) TYP

(0.75) TYP

SYMM ℄

41

(0.375) TYP

(4.8)

METAL
TYP

16X (□ 0.55)

10

21

11

20

SYMM
℄

(4.8)

SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 20X

EXPOSED PAD 41
40% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4219094/B   09/2023

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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