

# TI Designs Long Range Bluetooth™ Low Energy Design Guide



## TI Designs

TI Designs provide the foundation that you need including methodology, testing, and design files to quickly evaluate and customize the system. TI Designs help you accelerate your time to market.

## Design Resources

[TIDC-Bluetooth-Low-Energy-Long-Range SWRA422](#)

Tool Folder Containing Design Files

App Note PDF



[ASK Our E2E Experts](#)  
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## Design Features

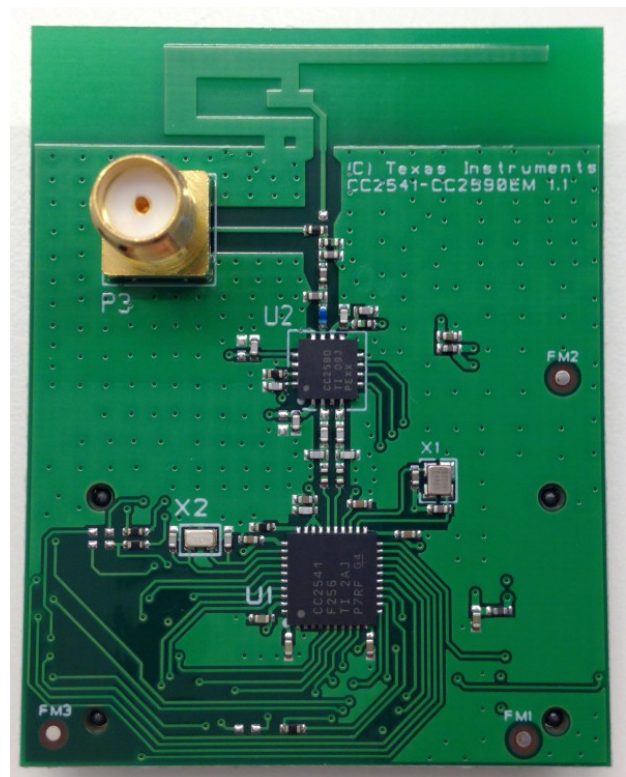
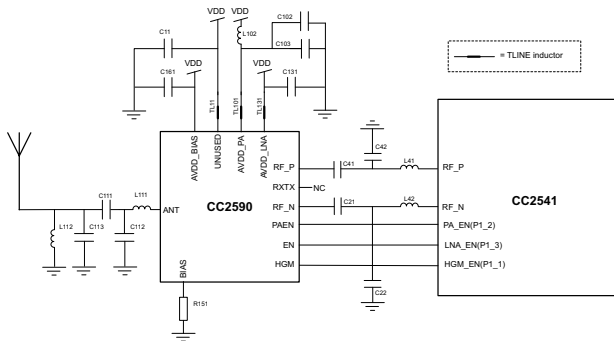
Bluetooth™ Smart Long-Range Designs:

- Bluetooth Low Energy (Bluetooth Smart) is suited for long-range applications with a smartphone or tablet
- Users can achieve a range of up to 500 meters with CC2590 at both ends of the link
- Suitable for full-house coverage with Bluetooth Low Energy

## Featured Applications

For Internet of Things (IoT) applications that require up to 500+ meters range:

- Home and Building Automation
- Industrial Remote Display
- Retail Beaconing
- Home Health Monitoring



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## 1 System Description

For complete data, see *Using CC2590 Front End with CC2541 Application Note* ([SWRA422](#)).

This TI design is based on CC2541 with the CC2590 range extender to increase output power and improve sensitivity, achieving longer range through increased link budget.

The CC2541 is one of TI's Bluetooth™ low-energy RF System-on-Chips (SoCs). The CC2590 is a range extender that can be used together with TI's RF SoC for the 2.4-GHz unlicensed industrial, scientific, and medical (ISM) band. The CC2590 includes a power amplifier (PA) for higher output power and a low-noise amplifier (LNA) for improved receiver sensitivity. When used together, the solution has output power of 10 dBm and sensitivity reaching -95 dBm. This power gives a total link budget of 105 dB when the CC2541 and CC2590 are used on both sides of the link. The CC2590 can connect directly to the CC2541 with the addition of a few passive components. The CC2590 has an internal balun and a single-ended RF output pin. Three control signals are required to control the range extender; the SW control is handled automatically by the Bluetooth low-energy stack. To achieve the best RF performance, users must follow the reference design closely when using the CC2590.

### 1.1 Performance

For complete data, see *Using CC2590 Front End with CC2541 Application Note* ([SWRA422](#)).

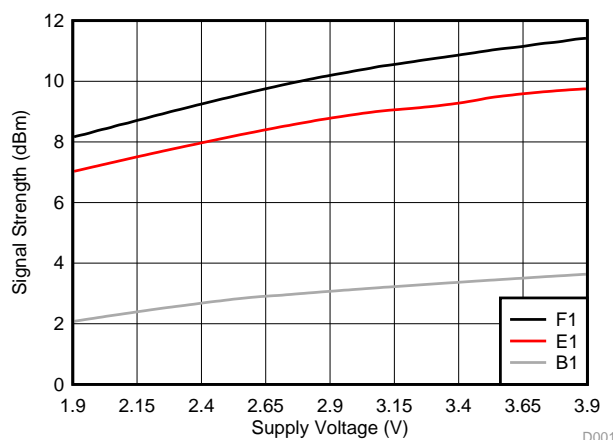
#### 1.1.1 Current Consumption

TC = 25°C, VDD = 3.0 V, f = 2440 MHz. The CC2541 and CC2590 are both set to receive in high-gain mode. All parameters are measured in the CC2541–CC2590EM reference design with a load of 50 Ω.

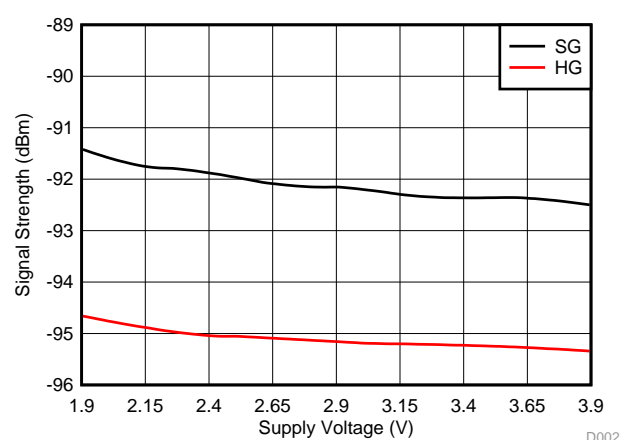
**Table 1. CC2541–CC2590EM Current Consumption**

PARAMETER	CONDITION	TYPICAL	UNIT
Receive Current	Wait for sync, -90 dBm input level Wait for sync, -50 dBm input level	21.6	mA
Transmit Current	TXPOWER = 0xF1	41.1	mA
	TXPOWER = 0xE1	36.6	
	TXPOWER = 0xD1	32.8	
	TXPOWER = 0xC1	30.5	
	TXPOWER = 0xB1	28.8	
	TXPOWER = 0xA1	27.5	
Power Down Current	PM2	1	μA

#### 1.1.2 RF Performance



**Figure 1. Output Power vs. Supply Voltage**



**Figure 2. Sensitivity vs. Supply Voltage**

## 2 References

TI Documents:

1. *Using CC2590 Front End with CC2541 Application Note* ([SWRA422](#))
2. *CC2541 2.4-GHz Bluetooth™ low energy and Proprietary System-on-Chip Data Manual* ([SWRS110](#))
3. *CC2540 2.4-GHz Bluetooth™ low energy System-on-Chip Data Manual* ([SWRS084](#))
4. *CC2590 2.4-GHz RF Front End, 14-dBm Output Power Data Manual* ([SWRS080](#))

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