**2.4-GHz RF FRONT END**

Check for Samples: **CC2595**

**FEATURES**
- Low Cost and Small Package
- Very Few External Components
- 2.0-V to 3.6-V Operation
- Less Than 1-μA Current Consumption in Power Down Mode
- Low Transmit Current Consumption
- 98 mA at 3 V for +20.7 dBm Out (PAE = 40%)
- RoHS Compliant 3- x 3-mm QFN-16 Package

**DESCRIPTION**
CC2595 is a PA solution that extends the range of any Zigbee or Bluetooth transceiver. It is a cost-effective and high performance RF front end for low-power and low-voltage wireless applications in the 2.4-GHz band. Its single-ended RF input and output make it compatible with any manufacturer’s transceiver if appropriate external parts are used. When a transmit/receive (T/R) switch and a balun are used, it can interface with existing and future CC24XX and CC25XX transceiver products. CC2595 extends the link budget by providing a power amplifier for improved output power. It is highly effective for high (+20 dBm) output power making it suitable for battery-operated systems. CC2595 contains PA and RF-matching for simple design of high performance wireless applications. It is packaged in a 3- x 3-mm, 16-lead QFN package with exposed paddle.

**FUNCTIONAL BLOCK DIAGRAM**

![Functional Block Diagram](image-url)
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.

**PIN ASSIGNMENTS**

![CC2595 Pinout Diagram](image)

**Figure 1. CC2595 Pinout**

**Table 1. Pin Descriptions for CC2595**

<table>
<thead>
<tr>
<th>PIN NO.</th>
<th>PIN NAME</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RF_IN</td>
<td>RF in/out</td>
<td>RF single-ended input</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>AVDD_BIAS</td>
<td>Power</td>
<td>Supply voltage, analog and logic</td>
</tr>
<tr>
<td>6</td>
<td>RBIAS1</td>
<td>Analog</td>
<td>Bias set resistor, stage 1</td>
</tr>
<tr>
<td>7</td>
<td>RBIAS2</td>
<td>Analog</td>
<td>Bias set resistor, stage 2</td>
</tr>
<tr>
<td>8</td>
<td>PAEN</td>
<td>Digital in</td>
<td>Chip enable: high = PA on</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RF_OUT</td>
<td>RF in/out</td>
<td>RF single-ended output (1 of 2)</td>
</tr>
<tr>
<td>11</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RF_OUT</td>
<td>RF in/out</td>
<td>RF single-ended output (2 of 2)</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>AVDD_PA1</td>
<td>Power</td>
<td>Supply voltage, PA stage 1</td>
</tr>
<tr>
<td>16</td>
<td>GND</td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. ORDERING INFORMATION

<table>
<thead>
<tr>
<th>TA</th>
<th>PACKAGE(2)</th>
<th>ORDERABLE PART NUMBER</th>
<th>TOP-SIDE MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>–40°C to 85°C</td>
<td>RGT (QFN)</td>
<td>CC2595RGTR</td>
<td>C2595</td>
</tr>
</tbody>
</table>

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

ABSOLUTE MAXIMUM RATINGS

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>-0.3 to 3.6</td>
<td>V</td>
</tr>
<tr>
<td>Voltage on any digital pin</td>
<td>-0.3 to VDD + 0.3, max 3.6</td>
<td>V</td>
</tr>
<tr>
<td>RF input power RF_IN</td>
<td>+10</td>
<td>dBm</td>
</tr>
<tr>
<td>TSTG Storage temperature range</td>
<td>–50 to 150</td>
<td>°C</td>
</tr>
<tr>
<td>TJ Junction temperature</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>ESD RF pins</td>
<td>1500</td>
<td>V</td>
</tr>
<tr>
<td>Excluding RF pins</td>
<td>2000</td>
<td>V</td>
</tr>
</tbody>
</table>

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

RECOMMENDED OPERATING CONDITIONS

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MIN</th>
<th>NOM</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating supply voltage</td>
<td>2</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>TA Operating free air temperature range</td>
<td>–40</td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS

TJ = 25°C, VDD = 3 V (unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>No input signal</td>
<td>30</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power down current</td>
<td>EN = LOW</td>
<td>1</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High input level (control pin)</td>
<td>VDD</td>
<td>1.3</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low input level (control pin)</td>
<td></td>
<td>0.3</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power down → Transmit</td>
<td>Time from EN goes HIGH to settled in TX</td>
<td>1</td>
<td>μs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## RF CHARACTERISTICS

$T_J = 25^\circ C$, $V_{DD} = 3 \text{ V (unless otherwise specified)}$

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f$</td>
<td>Frequency range of operation</td>
<td>2400</td>
<td>2483.5</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>$P_{OUT}$</td>
<td>Output power</td>
<td>Pin = 0 dBm</td>
<td>+20</td>
<td>+20.7</td>
<td>dBm</td>
</tr>
<tr>
<td>PAE</td>
<td>Power added efficiency</td>
<td>Pin = 0 dBm</td>
<td>40</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>$P_{OUTH}$</td>
<td>Output power (high)</td>
<td>$V_{DD} = 3.3 \text{ V, Pin} = +3 \text{ dBm}$</td>
<td>+22</td>
<td>+22.5</td>
<td>dBm</td>
</tr>
<tr>
<td>PAE$_{H}$</td>
<td>Power added efficiency (high)</td>
<td>$V_{DD} = 3.3 \text{ V, Pin} = +3 \text{ dBm}$</td>
<td>45</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>$P_{1dB}$</td>
<td>Output 1-dB compression point</td>
<td>Pin = 0 dBm</td>
<td>+17</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>IRL</td>
<td>Input return loss</td>
<td>Pin = 0 dBm</td>
<td>10</td>
<td>15</td>
<td>dB</td>
</tr>
<tr>
<td>ORL</td>
<td>Output return loss</td>
<td>Pin = 0 dBm</td>
<td>8</td>
<td>10</td>
<td>dB</td>
</tr>
<tr>
<td>Harmonics</td>
<td>Output power variation over frequency</td>
<td>2400 MHz to 2483.5 MHz</td>
<td>0.5</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Harmonics</td>
<td>Output power variation over supply voltage</td>
<td>2 V to 3.6 V</td>
<td>4</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Harmonics</td>
<td>Output power variation over temperature</td>
<td>-40°C to 85°C</td>
<td>1</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>K</td>
<td>Stability</td>
<td></td>
<td></td>
<td></td>
<td>Unconditionally stable</td>
</tr>
</tbody>
</table>

The harmonics can be further reduced by using an external LC filter and antenna.

Compliant with international regulatory standards

Compliant with international regulatory standards

No damage at 10:1 VSWR condition; all phases
TYPICAL CHARACTERISTICS

PA Output Power, PAE, Current Consumption and Gain

Input Power (3-V Supply)

Figure 2.

PA Output Power

Supply, 0-dBm Input

Figure 3.

Noise Figure and Gain

Frequency (3-V Supply)

Figure 4.

P_OUT and PAE

Frequency (3-V Supply, 0-dBm Input and 3.3-V Supply, +3-dBm Input)

Figure 5.
TYPICAL CHARACTERISTICS (continued)
P_OUT and PAE vs Frequency
(Three Temperatures and 3-V Supply, 0-dBm Input)

Figure 6.
## PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC2595RGTR</td>
<td>ACTIVE</td>
<td>QFN</td>
<td>RGT</td>
<td>16</td>
<td>3000</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU NIPDAU</td>
<td>Level-2-260C-1 YEAR</td>
<td>-40 to 85</td>
<td>C2595</td>
<td><img src="Images/Samples.png" alt="Samples" /></td>
</tr>
<tr>
<td>CC2595RGTT</td>
<td>ACTIVE</td>
<td>QFN</td>
<td>RGT</td>
<td>16</td>
<td>250</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU NIPDAU</td>
<td>Level-2-260C-1 YEAR</td>
<td>-40 to 85</td>
<td>C2595</td>
<td><img src="Images/Samples.png" alt="Samples" /></td>
</tr>
</tbody>
</table>

(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](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) 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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0 (mm)</th>
<th>B0 (mm)</th>
<th>K0 (mm)</th>
<th>P1 (mm)</th>
<th>W (mm)</th>
<th>Pin1 Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC2595RGTR</td>
<td>QFN</td>
<td>RGT</td>
<td>16</td>
<td>3000</td>
<td>330.0</td>
<td>12.4</td>
<td>3.3</td>
<td>3.3</td>
<td>1.1</td>
<td>8.0</td>
<td>12.0</td>
<td>Q2</td>
</tr>
<tr>
<td>CC2595RGTT</td>
<td>QFN</td>
<td>RGT</td>
<td>16</td>
<td>250</td>
<td>180.0</td>
<td>12.4</td>
<td>3.3</td>
<td>3.3</td>
<td>1.1</td>
<td>8.0</td>
<td>12.0</td>
<td>Q2</td>
</tr>
</tbody>
</table>

*All dimensions are nominal.*

---

**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

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**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

- **Sprocket Holes**
- **Pocket Quandrants**
- **User Direction of Feed**
### TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal*

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC2595RGTR</td>
<td>QFN</td>
<td>RGT</td>
<td>16</td>
<td>3000</td>
<td>338.1</td>
<td>338.1</td>
<td>20.6</td>
</tr>
<tr>
<td>CC2595RGTT</td>
<td>QFN</td>
<td>RGT</td>
<td>16</td>
<td>250</td>
<td>210.0</td>
<td>185.0</td>
<td>35.0</td>
</tr>
</tbody>
</table>
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.

![Exposed Thermal Pad Dimensions](image)

**NOTE:** All linear dimensions are in millimeters.
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, QFN/SON PCB Attachment, 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 minimum solder mask web tolerances between signal pads.
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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.

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  - www.ti-rfid.com
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  - www.ti.com/omap
- **Wireless Connectivity**
  - www.ti.com/wirelessconnectivity

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- **Consumer Electronics**
  - www.ti.com/consumer-apps
- **Energy and Lighting**
  - www.ti.com/energy
- **Industrial**
  - www.ti.com/industrial
- **Medical**
  - www.ti.com/medical
- **Security**
  - www.ti.com/security
- **Space, Avionics and Defense**
  - www.ti.com/space-avionics-defense
- **Video and Imaging**
  - www.ti.com/video

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