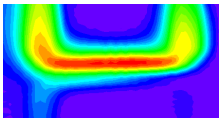




## Overview

This RFD199A is a compact energy harvesting system that converts RF/microwave signals to pulsed DC voltages between 4.2V...5.3V for mobile phone charging applications. The RF199A-MOD can convert 10MHz to 2.5GHz signals to a regulated DC output voltage that may be pulsed in low power conditions or continuous in high power conditions. The module consists of an RF-DC converter and a power management system that switches the DC output (VOUT) on when the internal voltage of the RF-DC converter and internal 5100uF storage capacitor reaches 5.3V. The DC output (VOUT) switches off when the RF-DC converter voltage and storage capacitor voltage falls below 4.2V. Up to 50mA is possible between 4.2V-5.3V with this module. An input power of 2W (33dBm) should not be exceeded or module damage may occur.

When connected to an antenna, the module can extract power from wireless sources and produce a pulsed or continuous DC output voltage depending upon how much power is available. Please note that the input power to the module should be typically greater than +5dBm in order to achieve >5.3V from the RF-DC converter. The minimum input power will vary depending upon the frequency of operation and the impedance matching used between the module and the antenna. The VOUT lines are isolated so these modules may be tied together in parallel to improve output current for high power charging applications such as mobile phone charging.

In CW operation with a 100-Ohm load the RFD199A can deliver 30-50mA of current with 3V...5V at 30% RF-DC conversion efficiency at 2.4GHz. Efficiency increases with higher value loads up to 50% RF-DC conversion efficiency is achievable with this design. The RFD199A


**Figure 1. RFD199A photo. The plastic housing is 38.6mm x 57.6mm x 20.0mm and has an SMA connector at the RF input and two screw terminal banana plugs at the DC output.**

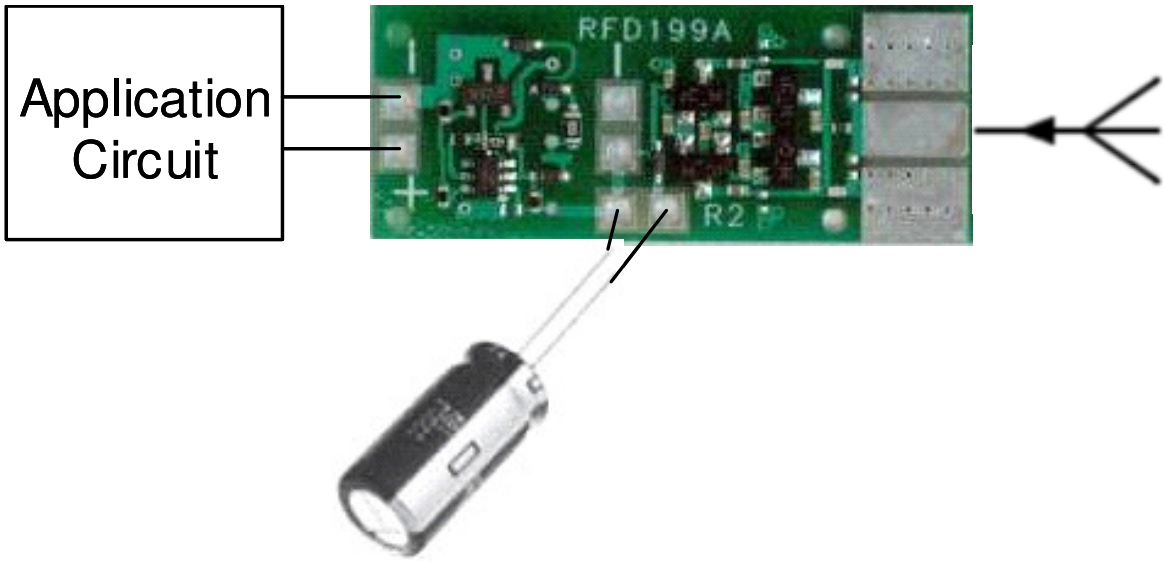



**Figure 2. The RFD199A uses the RFD199A-PCB. The wiring diagram of the RFD199A-PCB is shown in a typical energy harvesting system block diagram.**

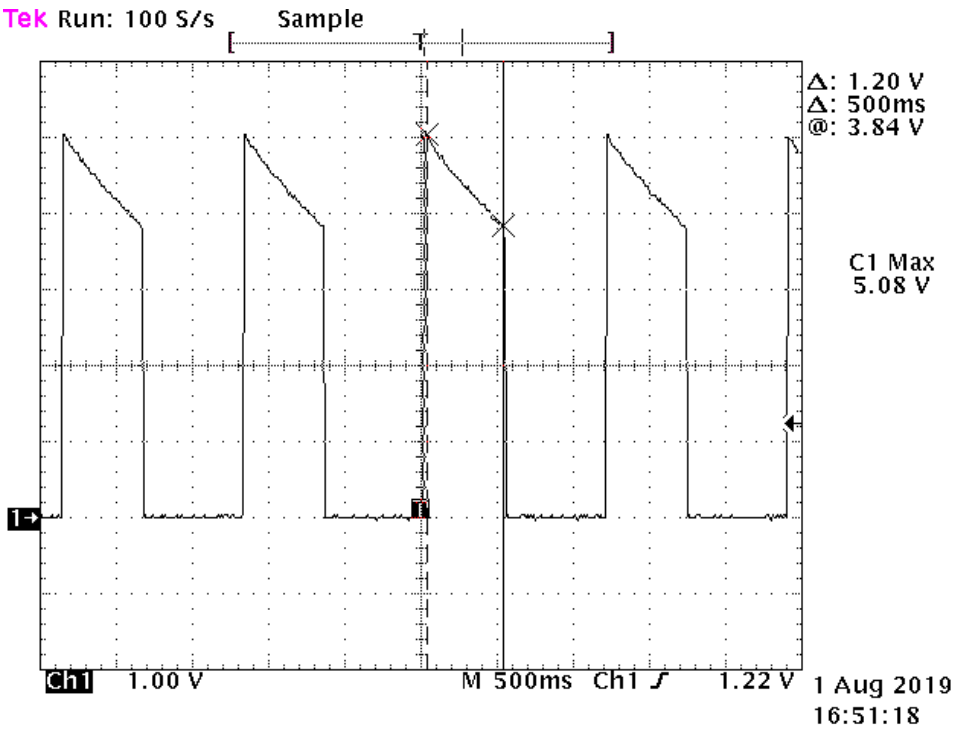



**Figure 3a. RFD199A DC output waveform into a 200-Ohm load with 20dBm input power at 2.4GHz.**

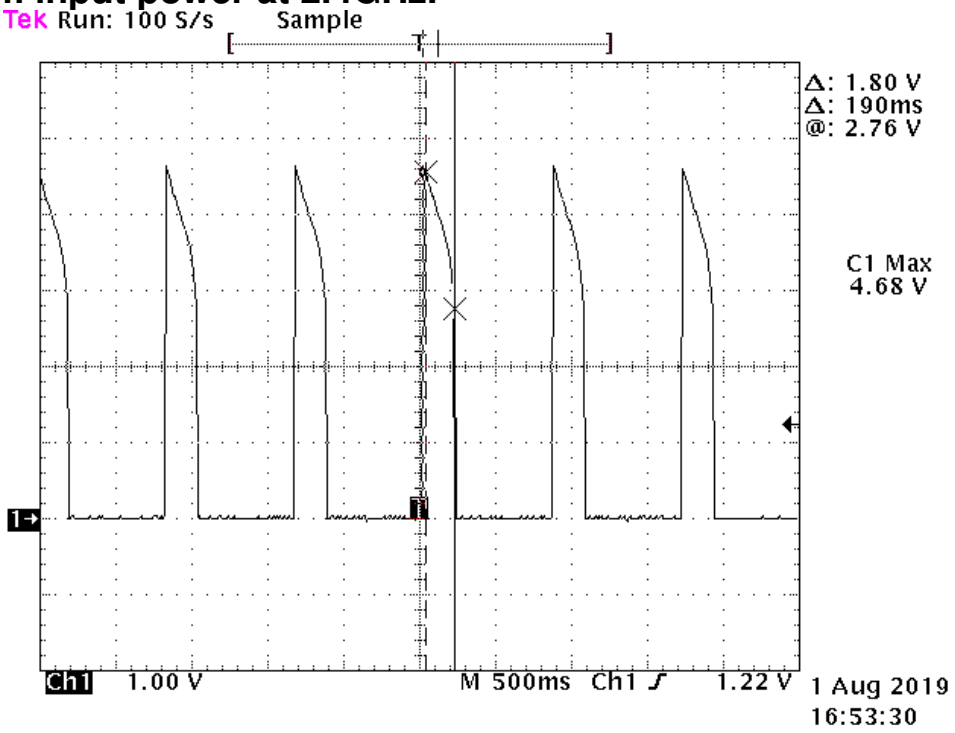



**Figure 3b. RFD199A DC output waveform into a 100-Ohm load with 20dBm input power at 2.4GHz.**

**Typical Data at 20C, 915MHz, 200-Ohm Load. DC Output Range: 4.7V...2.7V.**

Input Power For 50% Duty Cycle: 21.1dBm, 39% RF-DC Conversion Efficiency (312ms duration, 3.7Vavg/37mA)

Minimum Input Power For Continuous DC Output: 26.1dBm, 2.7V/27mA, 18% RF-DC Efficiency.

**Typical Data at 20C, 915MHz, 100-Ohm Load. DC Output Range: 4.7V...2.7V.**

Input Power For 50% Duty Cycle: 24.1dBm, 27% RF-DC Conversion Efficiency (312ms duration, 3.7Vavg/37mA)

Minimum Input Power For Continuous DC Output: 26.1dBm, 2.7V/27mA, 18% RF-DC Efficiency.

**Typical Data at 20C, 2400MHz, 200-Ohm Load. DC Output Range: 5.3V...3.8V.**

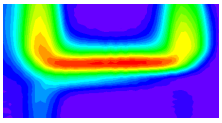
Input Power For 50% Duty Cycle: 20.5dBm, 45% RF-DC Conversion Efficiency (600ms duration, 4.5Vavg/22.5mA)

Minimum Input Power For Continuous DC Output: 22.8dBm, 3.8V/19mA, 38% RF-DC Efficiency.

**Typical Data at 20C, 2400MHz, 100-Ohm Load. DC Output Range: 4.7V...2.7V.**

Input Power For 50% Duty Cycle: 23.1dBm, 33% RF-DC Conversion Efficiency (400ms duration, 3.7Vavg/37mA)

Minimum Input Power For Continuous DC Output: 24.5dBm, 2.7V/27mA, 26% RF-DC Efficiency.





**Typical Data at 20C, 2400MHz, 200-Ohm Load. DC Output Range: 5.3V...3.8V.**

Input Power For 50% Duty Cycle: 20.5dBm, 45% RF-DC Conversion Efficiency (600ms duration, 4.5Vavg/22.5mA)

Minimum Input Power For Continuous DC Output: 22.8dBm, 3.8V/19mA, 38% RF-DC Efficiency.

## Design Notes

The DC outputs of the RFD199A can be connected in parallel if several units are used for energy harvesting. The solar engine circuit used presents a high impedance when it is off so it will not load another RFD199A if it is in discharge mode.

The typical input power operating range for the RFD199A is from +5dBm...+33dBm but depends on the frequency. The RF power must be high enough for the RF-DC converter to achieve 5.3V in order for the solar engine circuit to switch on. Additional matching may be required to optimize power transfer to the RF-DC converter circuit.

At low input powers (+5dBm...+10dBm) and with low output loads the RFD199A will output a pulsed signal. As the input power increases the design can output continuous DC. If the input power becomes high enough and the load cannot dissipate the DC power then an internal 5.6V Zener diode will dissipate the input power.

Users may discover a situation where a high pulsed current is desired but that the part is outputting CW DC at slightly higher than 4.2V. This is normal operation for a solar engine circuit which stays on between the VLOW (4.2V) and VHIGH (5.3V)

range. A lower load resistance may be needed to make sure that the system will go lower than VLOW in order for the solar engine to shut off and recharge the capacitor.

Further customization of this design is possible. Users may request alternative voltage ranges or access to the RF-DC converter output voltage. Please contact us directly with information about your requirements.

## Disclaimer

This module is guaranteed to be defect free upon shipment. However the module is not intended for use in critical applications such as medical devices, automotive safety, or anywhere else where poor performance can result in injury, loss of life or property. The user agrees to assume all risks arising from use of the module and releases RF Diagnostics from all liability for its malfunction or misuse. Specifications listed on datasheets are subject to change without notice.

Datasheet Revision: 1-27-2020