Multilevel RF Power Detector

User Manual

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Contents

1 Introduction

This user manual provides instructions for safe operation, installation, and usage of the **Multilevel RF Power Detector**. The device is designed to detect the presence and relative power levels of RF signals in the **433 MHz** and **915 MHz** ISM bands and to indicate signal strength using an LED-based interface.

This manual is intended for students, laboratory users, and engineers working with RF systems.

2 Product Overview

2.1 Purpose of the Device

The Multilevel RF Power Detector is used to:

- Detect RF signals in the 433 MHz and 915 MHz frequency bands.
- Indicate relative RF power levels using multiple LEDs.
- Provide a quick visual assessment of RF activity without complex test equipment.

2.2 Key Features

- Dual-band RF detection (433 MHz and 915 MHz)
- Logarithmic RF power detection
- LED-based multilevel power indication
- Operates from a DC 9V power supply
- Compact PCB with RF-optimized layout

3 System Block Description

The device consists of the following functional blocks:

1. **Antenna Interface** – Receives RF signals from the environment.
2. **ESD Protection** – Protects sensitive RF components from electrostatic discharge.
3. **Band-Pass Filters** – Separates 433 MHz and 915 MHz signals.
4. **Low Noise Amplifiers (LNA)** – Amplifies weak RF signals with minimal added noise.
5. **Logarithmic Detector** – Converts RF power into a proportional DC voltage.
6. **ADC / Comparator Stage** – Converts voltage levels into LED drive signals.
7. **LED Display** – Visually represents signal power levels.

4 Technical Specifications

Parameter	Specification
Supported Frequency Bands	433 MHz, 915 MHz
Detection Method	Logarithmic RF detection
Power Indication	Multi-level LED display
Supply Voltage	9V DC
Current Consumption	200mA (typical)

5 Power Supply Requirements

- Use a regulated DC power source.
- Nominal input voltage: 9V.
- Ensure correct polarity before powering the device.
- Do **not** exceed the maximum rated voltage.

Warning: Incorrect power connections may permanently damage the device.

6 Operating Instructions

6.1 Initial Setup

1. Connect the appropriate SMA antenna to the RF input.
2. Ensure the device is placed away from strong EMI sources.
3. Connect the DC power supply.
4. Power ON the device.

6.2 Normal Operation

- When an RF signal is present, LEDs corresponding to the detected band will illuminate.
- Higher RF power levels will light more LEDs.
- Absence of illuminated LEDs indicates no detectable signal or very weak signal strength.

6.3 LED Indication (Example)

LED Status	Indicated RF Power Level
1 LED ON	Very Low Signal
2–3 LEDs ON	Moderate Signal
4+ LEDs ON	High Signal

7 Safety Precautions

- Do not expose the device to moisture.
- Avoid touching RF components while powered.
- Use only recommended antennas.
- Disconnect power before making hardware modifications.

8 Maintenance

- Clean the PCB using dry air or isopropyl alcohol if required.
- Periodically inspect SMA connectors for mechanical damage.
- Store the device in an ESD-safe environment.

9 Troubleshooting

Issue	**Possible Cause / Solution**
No LEDs ON	Check power supply and polarity
Incorrect LED behavior	Strong interference or wrong antenna
Low sensitivity	Antenna mismatch or weak RF source
Overheating	Supply voltage too high

10 Applications

- RF laboratory experiments
- ISM band signal monitoring
- Educational demonstrations
- RF presence detection in embedded systems

11 Limitations

- Does not provide absolute RF power measurement.
- Limited to predefined frequency bands.
- Not intended as a calibrated RF power meter.

12 Future Enhancements

- Addition of 2.4 GHz band detection
- Digital display output
- Microcontroller-based logging

13 Disclaimer

This device is intended for educational and experimental use. The designers are not responsible for damage caused by improper use or modification of the device.