**Objective**

This document outlines the testing procedures for validating the performance and functionality of an SDR (Software Defined Radio) operating in the frequency range of **2750 MHz to 4750 MHz**. The focus is to ensure accurate detection and reporting of **Pulse Descriptor Words (PDWs)** for detected pulses and continuous waves (CWs). Additionally, the document describes tests to evaluate key SDR parameters including sensitivity, dynamic range, ADC noise level, and PDW measurement accuracy.

**Test Setup**

1. **Equipment Required**:
   * Signal Generator capable of producing CWs and pulses in the range **2750–4750 MHz**.
   * High-precision Oscilloscope for verification.
   * Spectrum Analyzer for dynamic range tests.
   * Power Supply for the SDR.
   * Digital Storage Device for recording raw samples and FFT outputs.
   * Software tools for PDW analysis.
2. **SDR Configuration**:
   * Enable **all 4 channels** in interferometer mode.
   * Configure FFT lengths: **80, 160, 320, 640, 1280 points**.
   * Set input sampling rate and ADC resolution as per SDR specifications.
   * Verify that the SDR can record both **raw samples** and **FFT results**.
3. **Parameters to Test**:
   * Sensitivity
   * Single-tone dynamic range
   * Two-tone dynamic range
   * ADC Spurious-Free Dynamic Range (SFDR) at **Full Scale - 6 dB (FS-6 dB)**.
   * ADC noise level post-FFT.
   * PDW measurement accuracy:
     + **Time of Arrival (ToA)**
     + **Pulse Width (PW)**
     + **Pulse Amplitude**
     + **Delta Phase** between channels.

**Test Cases**

**1. Sensitivity Test**

* **Objective**: Verify the minimum detectable signal level for pulses and CWs.
* **Procedure**:
  1. Set the signal generator to a known frequency within the range.
  2. Generate a CW signal and vary its power level from **-120 dBm to 0 dBm**.
  3. Record PDWs for detected CWs and pulses.
  4. Repeat the test for pulse signals with varying pulse widths (e.g., 1 µs to 100 µs).
* **Acceptance Criteria**:
  1. The SDR should detect pulses and CWs at the specified sensitivity level (e.g., **-100 dBm** for CWs and **-95 dBm** for pulses).

**2. Single-Tone Dynamic Range**

* **Objective**: Measure the SDR's dynamic range with a single-tone input.
* **Procedure**:
  1. Generate a single-tone CW signal and sweep the input power from **-120 dBm to 0 dBm**.
  2. Record the SDR’s FFT output and analyze the detected power levels.
  3. Verify that no spurious responses are present within the passband.
* **Acceptance Criteria**:
  1. The SDR should maintain linearity and detect the tone across the full dynamic range without spurs exceeding **-60 dBc**.

**3. Two-Tone Dynamic Range**

* **Objective**: Evaluate the SDR's performance with two closely spaced tones.
* **Procedure**:
  1. Generate two CW tones with a separation of 1 MHz.
  2. Sweep the power of both tones simultaneously from **-120 dBm to 0 dBm**.
  3. Record FFT outputs and analyze intermodulation distortion (IMD).
* **Acceptance Criteria**:
  1. IMD products should remain at least **60 dBc** below the tones.

**4. ADC SFDR (at FS-6 dB)**

* **Objective**: Validate the ADC’s spurious-free dynamic range at full scale minus 6 dB input.
* **Procedure**:
  1. Input a CW signal with an amplitude set to **Full Scale - 6 dB**.
  2. Measure spurious signal levels in the SDR’s FFT output.
* **Acceptance Criteria**:
  1. SFDR should exceed **70 dB**.

**5. ADC Noise Level (Post-FFT)**

* **Objective**: Measure the noise level after FFT processing.
* **Procedure**:
  1. Disconnect any input signal to the SDR.
  2. Record the FFT outputs for all configured lengths (80, 160, 320, 640, 1280 points).
  3. Calculate the noise floor for each FFT configuration.
* **Acceptance Criteria**:
  1. Noise floor should align with theoretical expectations based on the ADC specifications and FFT lengths.

**6. PDW Measurement Accuracy**

* **Objective**: Verify the correctness of PDWs for detected pulses and CWs.
* **Parameters to test**:
  + **Time of Arrival (ToA)**: Verify timestamps against the known signal generation time.
  + **Pulse Width (PW)**: Validate pulse width measurements against signal generator settings.
  + **Pulse Amplitude**: Compare reported amplitudes to actual input power levels.
  + **Delta Phase**: Test the phase difference between channels using known delay lines.
* **Procedure**:
  + Generate test signals (CWs and pulses) with varying parameters.
  + Record and analyze the SDR's reported PDWs.
* **Acceptance Criteria**:
  + Reported values should match input parameters within the SDR's specified tolerance.

**7. Recording and Analysis Validation**

* **Objective**: Ensure the SDR accurately records raw samples and FFT results.
* **Procedure**:
  1. Enable recording mode in the SDR.
  2. Generate test signals and collect both raw and FFT data.
  3. Compare recorded results to expected outputs using offline analysis.
* **Acceptance Criteria**:
  1. Recorded data should match expected signal characteristics.

**Expected Deliverables**

1. Test logs and captured data files.
2. PDW reports for all test cases.
3. Noise floor and dynamic range plots.
4. Performance summary with pass/fail results for each parameter.

**Conclusion**

This test document provides a structured approach to thoroughly evaluate the SDR's ability to detect and process signals accurately. By following these test procedures, the SDR's performance can be validated, ensuring it meets operational requirements.

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