

SSPRQ test pattern

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Introduction

P802.3bs D1.3 contains two PAM4 test patterns: PRBS13Q and PRBS31Q with characteristics analysed in [anslow_01_1215_logic](#)

The PRBS13Q pattern is conveniently short (8191 symbols), but is much less stressful than long periods of random data.

The PRBS31Q pattern is too long (2,147,483,647 symbols) for easy capture, but is more stressful than long periods of random data.

This contribution analyses two versions of an SSPRQ pattern that have been specifically chosen to be short enough to be captured (32,766 symbols or 65,535 symbols) and are more stressful than long periods of random data.

SSPRQ pattern

The proposed SSPRQ pattern is constructed from three sections of a PRBS31 binary sequence:

PRBS31 Start = 00000002	PRBS31 Start = 34013FF7	PRBS31 Start = 0CCCCCCC
10922 bits	10922 bits	10922 bits

Where Start is a 31 bit Hex number sent MSB first and represents the first 31 bits of the section.

The complete 32,766 bit binary sequence is sent twice and Gray coded according to 120.5.7, with the PAM4 symbols during the second version inverted (out = 3 – in).

The resulting 32,766 symbol PAM4 sequence is contained in an accompanying file [anslow_02_0416.csv](#)

Baseline wander

Previous NRZ contributions have used a “baseline wander” parameter

This was defined as:

Baseline wander is the instantaneous offset (in %) in the signal generated by AC coupling at the Baud rate / 10,000.

This analysis re-uses this definition unmodified, but it should be noted that for PAM4, the eye height is 1/3 that of NRZ so the effects of a given amount of baseline wander will be greater.

For NRZ contributions see:

P802.3ba [anslow_01_0108](#)

P802.3ba [anslow_06_1108](#)

P802.3bj [anslow_01a_0112](#)

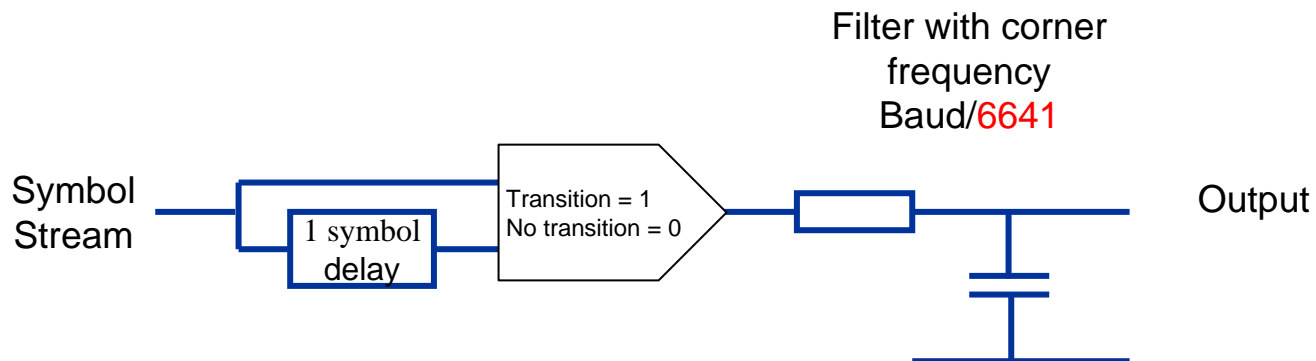
Clock content

The “clock content” parameter is defined here as:

Create a function which is a 1 for a transition and a 0 for no transition and then filter the resulting sequence with a corner frequency of Baud/6641.

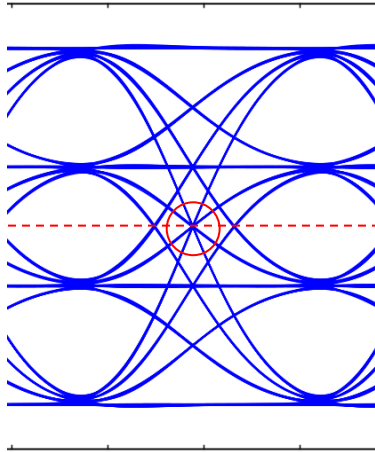
This analysis defines a transition as one of three possibilities (as per [healey_3bs_01_1115](#)):

- Symmetrical transitions through the signal average
- Transitions through the signal average
- All transitions

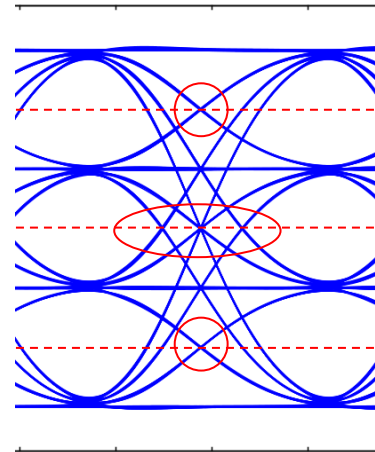
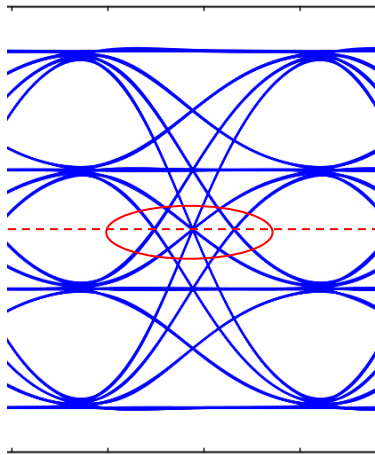


Clock content illustration

Symmetrical
transitions
through the
signal average



Transitions
through the
signal average



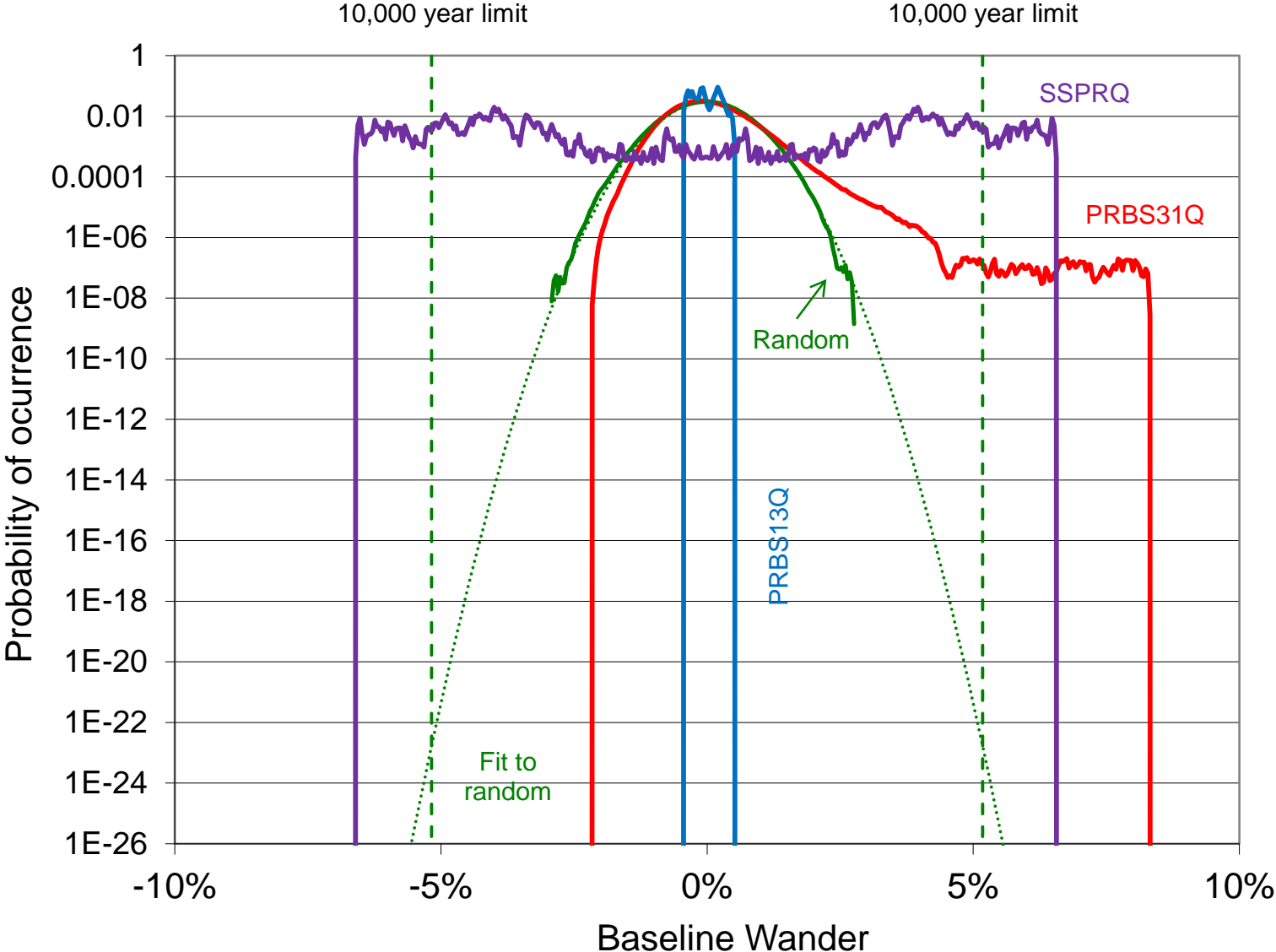
All transitions

PRBS13Q and PRBS31Q

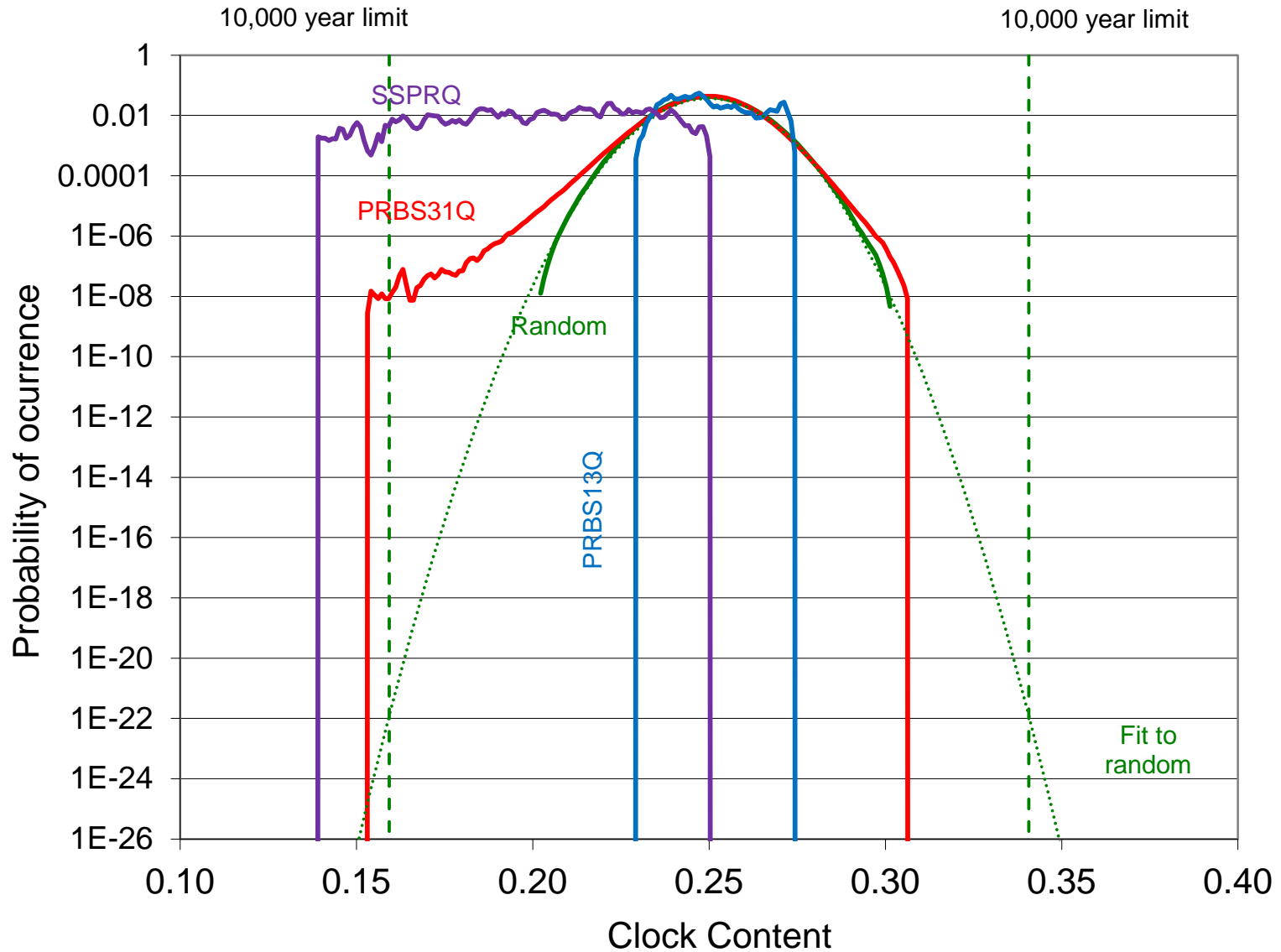
The following slides contain the baseline wander and three clock content probability density plots for:

- Random data (solid green)
- Fit to random data (dotted green)
- PRBS13Q (blue)
- PRBS31Q (red)
- Proposed SSPRQ (purple)

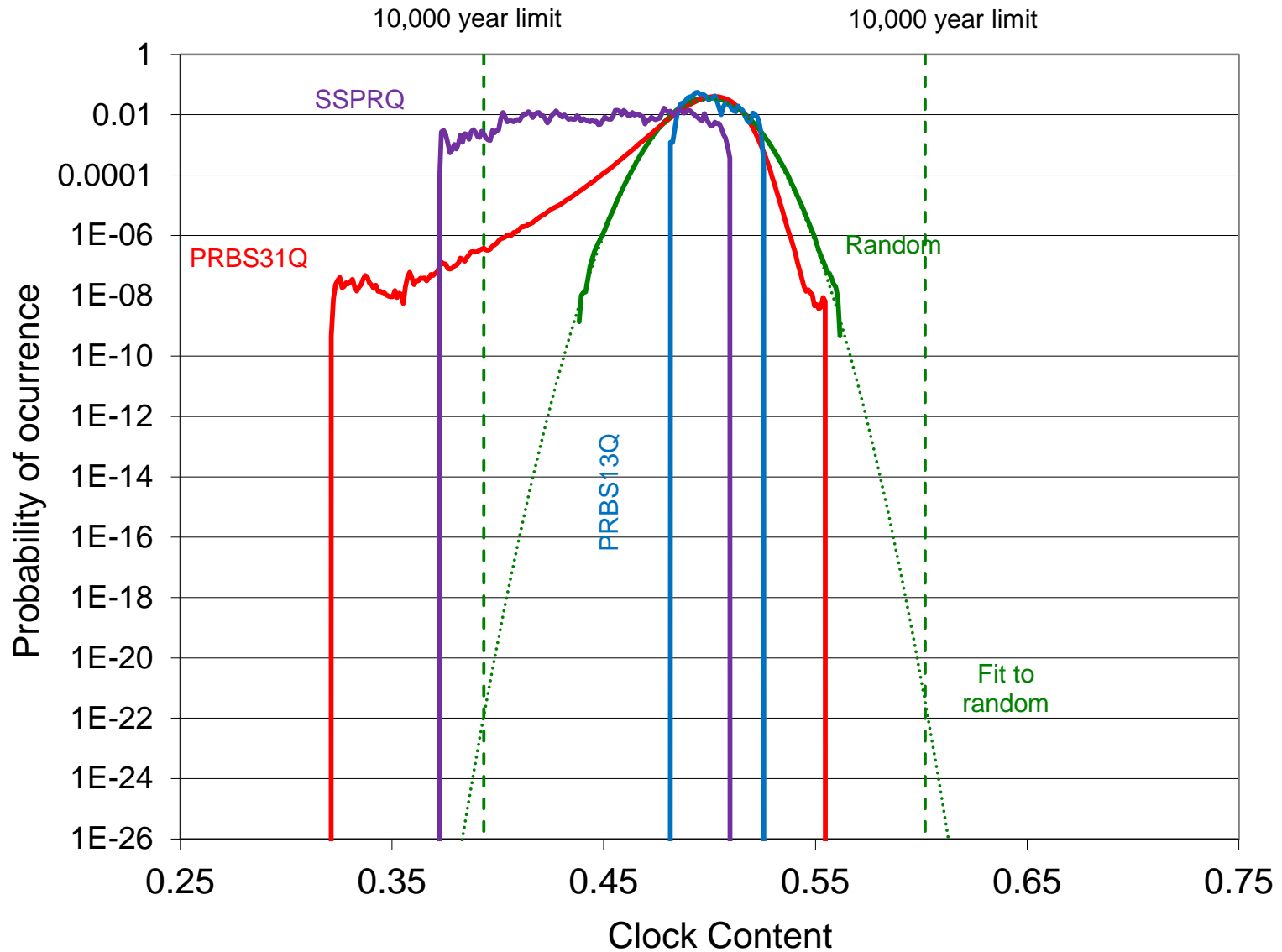
Baseline wander



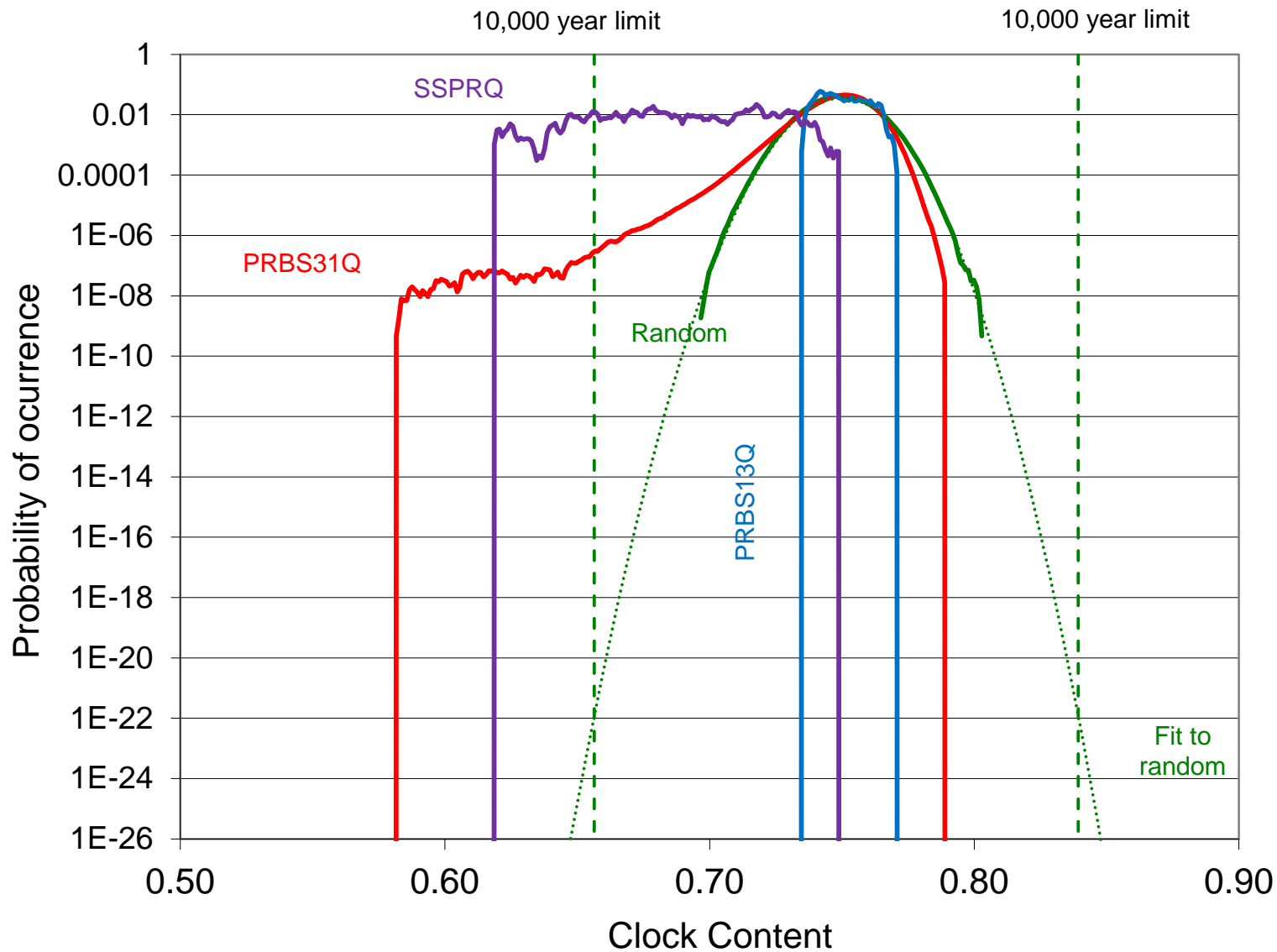
Clock, symmetrical transitions through average



Clock, transitions through average



Clock, all transitions



SSPRQ pattern, phase independent version

The proposed SSPRQ pattern is constructed from three sections of a PRBS31 binary sequence:

PRBS31 Start = 00000002	PRBS31 Start = 34013FF7	PRBS31 Start = 0CCCCCCC
10924 bits	10922 bits	10922 bits

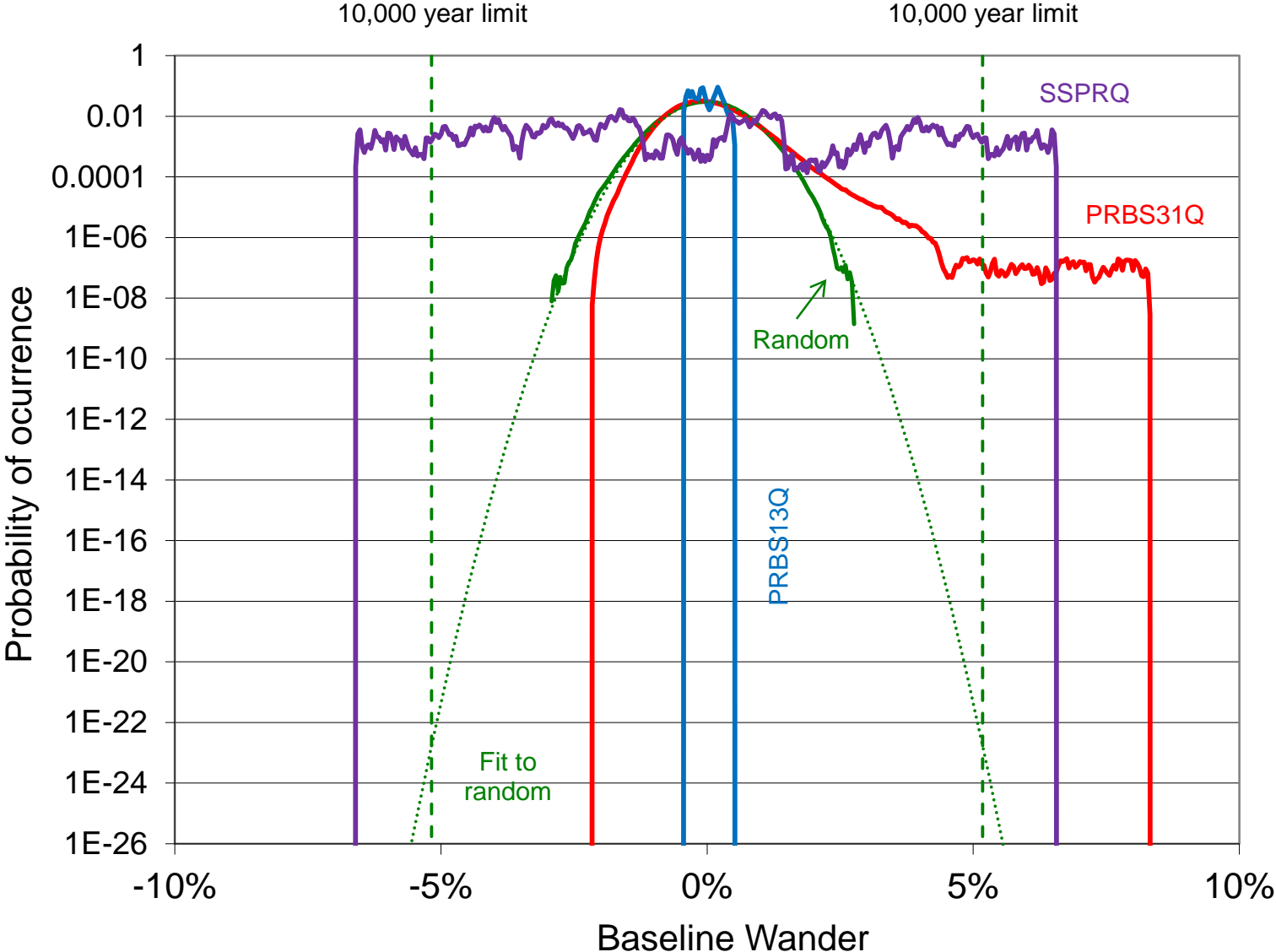
Where Start is a 31 bit Hex number sent MSB first and represents the first 31 bits of the section.

The complete 32,768 bit binary sequence is sent twice and Gray coded according to 120.5.7, with the PAM4 symbols during the second version inverted (out = 3 – in).

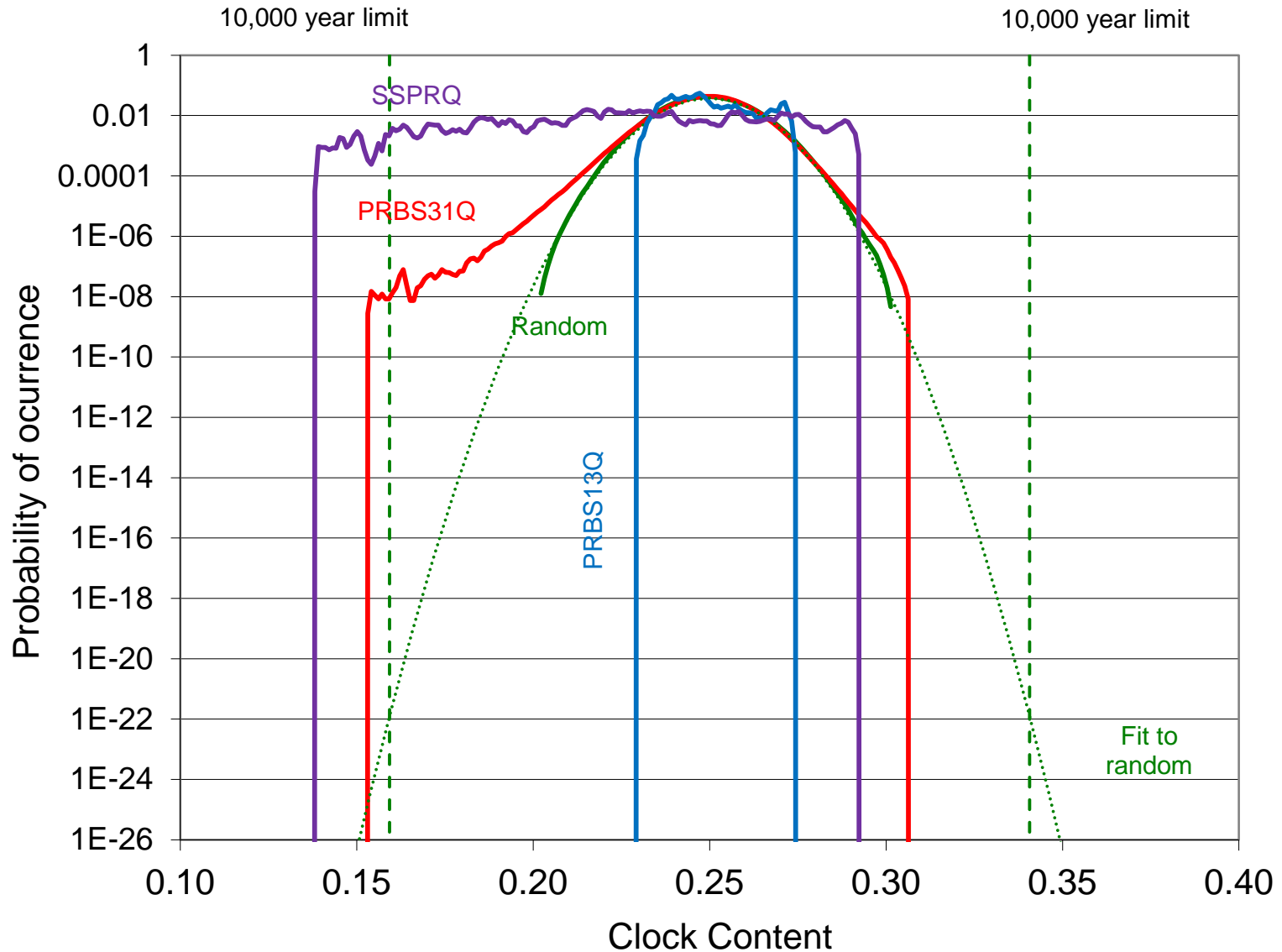
This is followed by the above sequence again with the first and last binary bit removed.

The resulting 65,535 symbol PAM4 sequence is contained in an accompanying file [anslow_03_0416.csv](#)

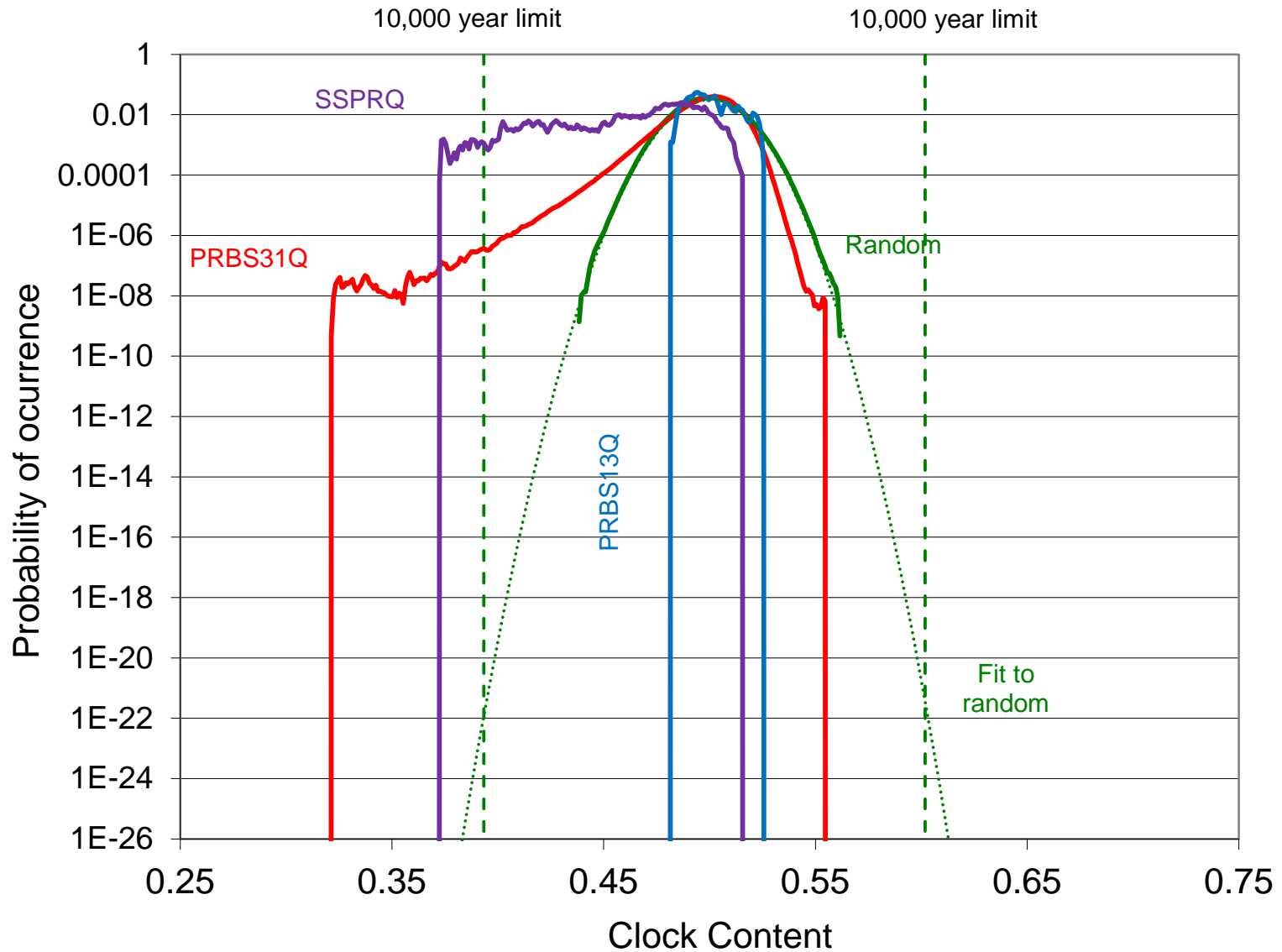
Baseline wander



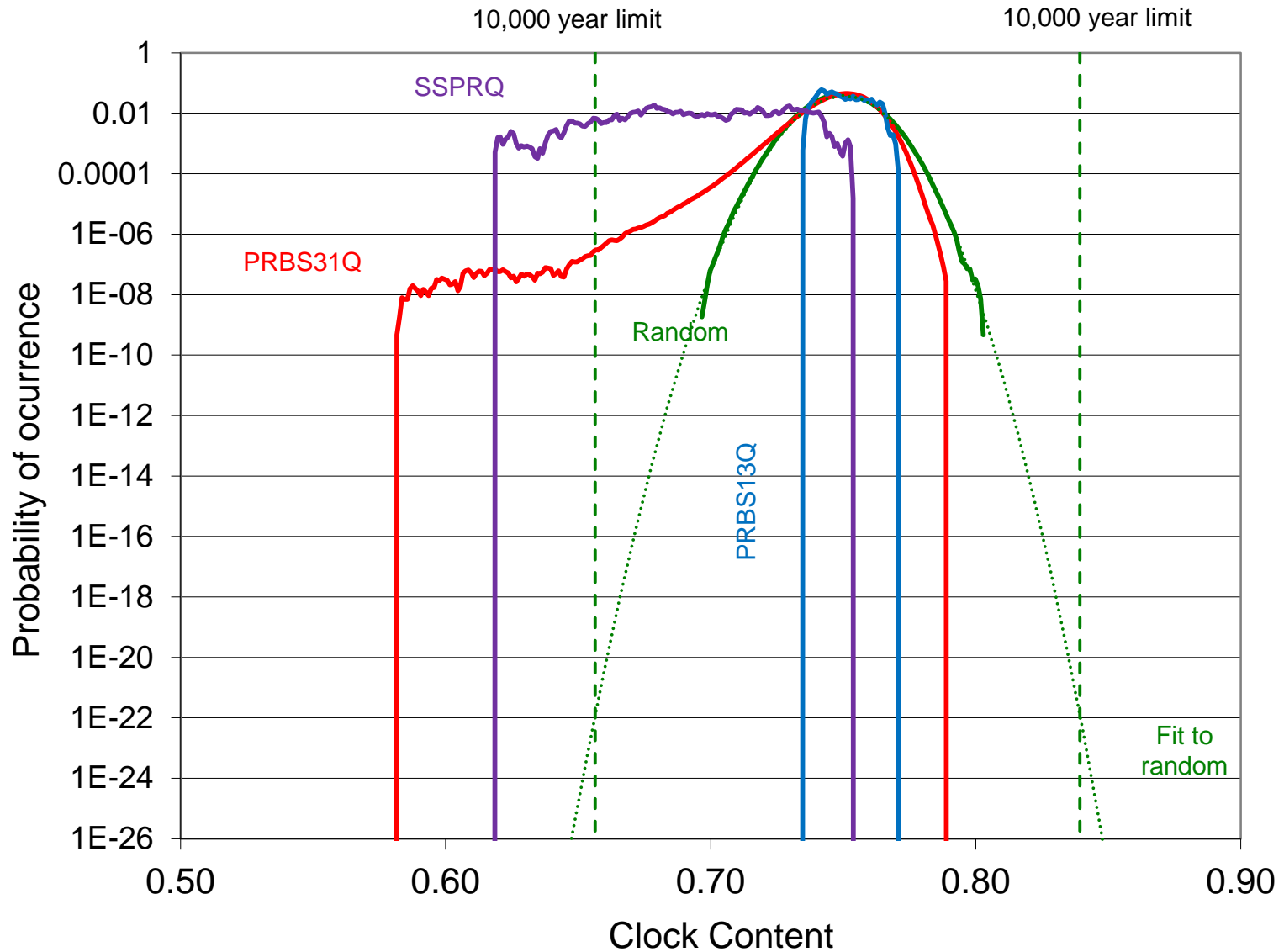
Clock, symmetrical transitions through average



Clock, transitions through average



Clock, all transitions



Conclusion

Two versions of the proposed SSPRQ test pattern have been analysed.

The first version is 32,766 symbols long and only has the required characteristics for one choice of phase for Gray coding.

The second version is 65,535 symbols long and has the required characteristics for either phase for Gray coding.

The baseline wander and clock content for either version of SSPRQ test pattern are more stressful than 10,000 years of random data.

It is therefore proposed to use one of these test patterns for any tests that require a stressful pattern and the symbol sequence to be captured.

Thanks!