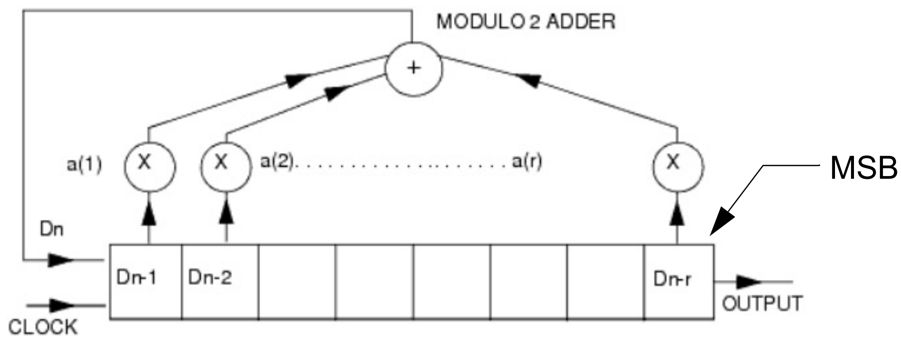
M = 10 PN Code in ADS

Configuring the PN Generator

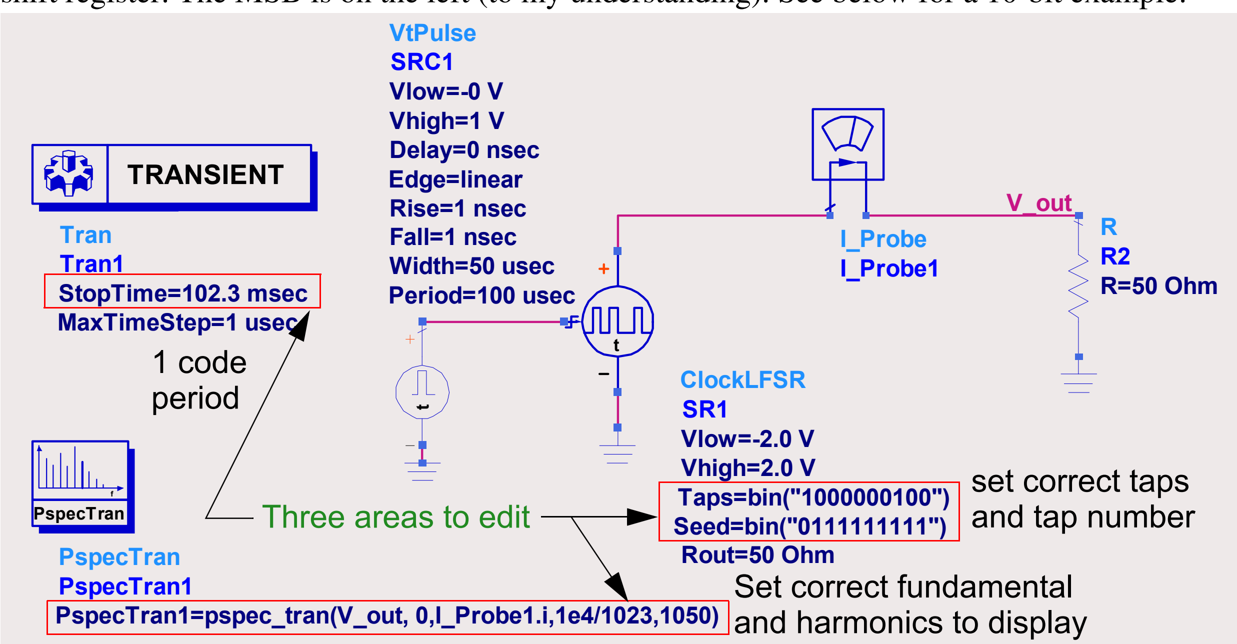
The block ClockLFSR (clocked linear feedback shift register) is responsible for generating the PN code in the ADS schematic PN_Gen. Using the ADS help system we find the following:

Notes/Equations

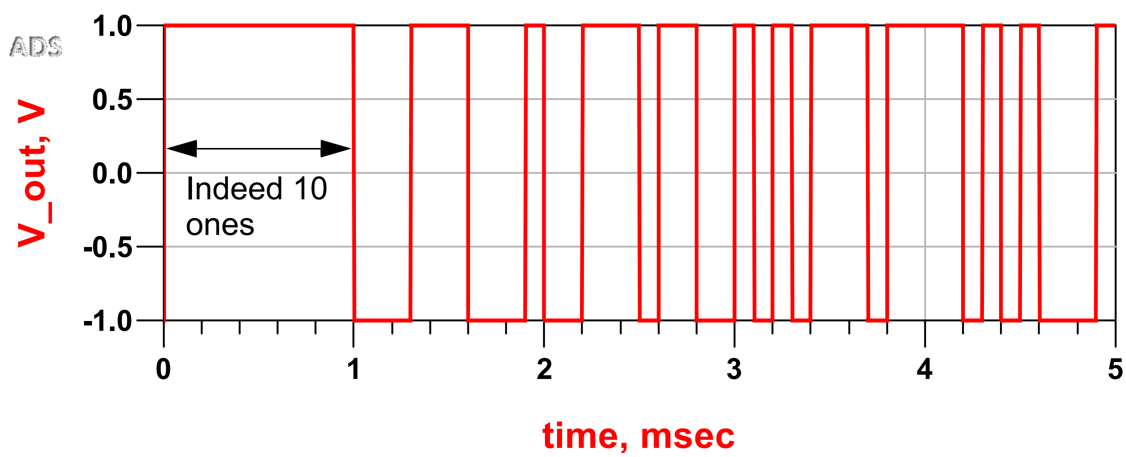
1. ClockLFSR can be used to generate PN sequences with user-defined recurrence relations. The input is a clock signal; with each positive clock edge, the next output bit is calculated. A clock edge occurs any time the baseband input signal rises through 0.5V.
2. This model works in transient and circuit envelope simulation.
3. With each positive clock edge, data is shifted to the right in the shift register. The length of the shift register is determined by the most significant one-bit in the Taps value.



Note in the above it is the most significant bit (MSB) in Taps that determines the length of the shift register. The MSB is on the left (to my understanding). See below for a 10-bit example:



- Taps 10 and 3 (think MSB on left) are turned on to produce the $2^{10} - 1 = 1023$ bit pattern
- The Seed value is set to all ones except for the MSB, thus insuring that the generator will start by producing 10 ones as seen in the time domain output below



The bit rate is 10 kbps so, yes the bit period is 0.1 ms and $10 \times 0.1 = 1$ ms.

Spectrum Plotting

For the spectrum to display properly some understanding of the PspecTran function is needed.

Home > Simulation > Equations and Expressions > Measurement Expressions > Measurement Expression Functions (by category) > Transient Analysis Functions

pspec_tran()

Returns transient power spectrum

Syntax

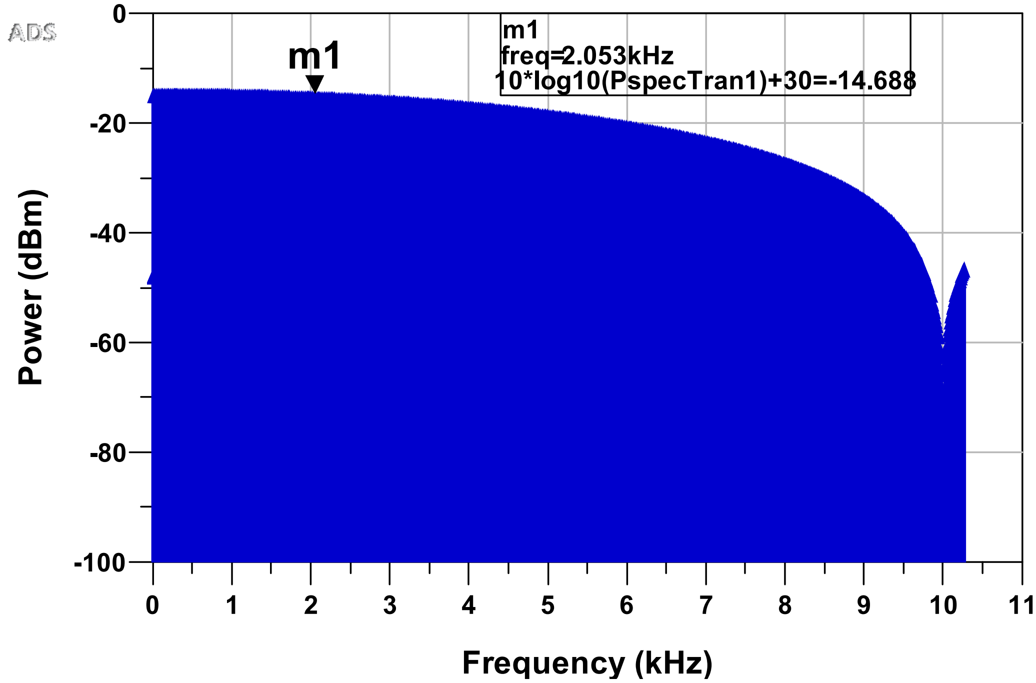
y = pspec_tran(vPlus, vMinus, iOut, fundFreq, numHarm, windowType, windowConst)

Work with these two

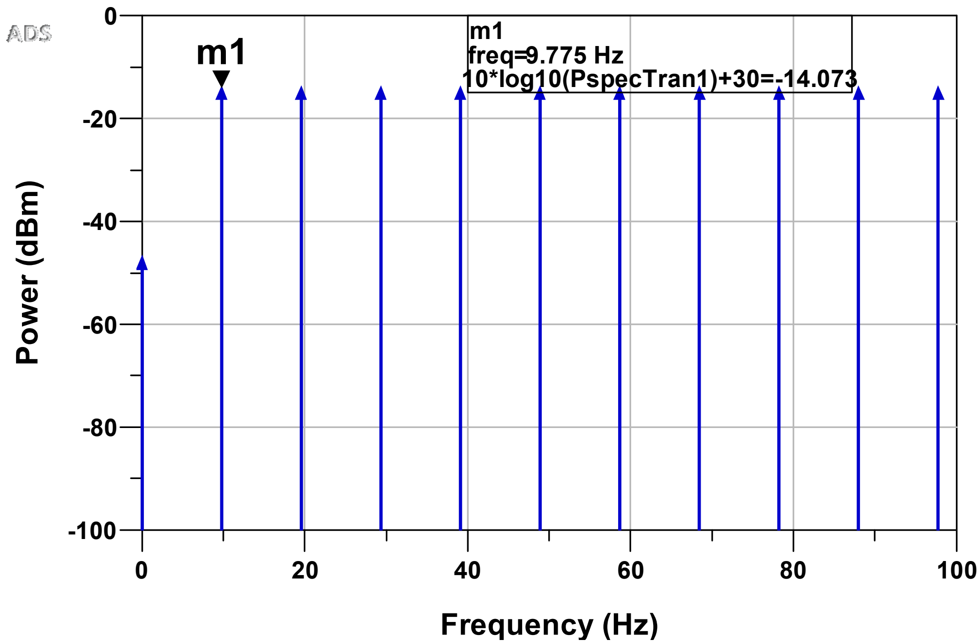
Arguments

Name	Description	Default	Range	Type	Required
vPlus	voltage at the positive terminal	None	(-∞:∞)	Real, Complex	Yes
vMinus	voltage at the negative terminal	None	(-∞:∞)	Real, Complex	Yes
iOut	current through a branch measured for power calculation	None	(-∞:∞)	Real, Complex	Yes
fundFreq	fundamental frequency	None	[0:∞)	Real	Yes
numHarm	number of harmonics of fundamental frequency	None	[0:∞)	Integer	Yes
windowType	type of window to be applied to the data	0	[0:9] †	Integer, string	No
windowConst	window constant †† †	0	[0:∞)	Integer, Real	No

Again we consult the ADS help system. For the length 1023 PN code there are a lot of spectral lines packed into the frequency interval $f \in [0, R_b]$. That number is 1023 as the spectral lines are spaced by $R_b/1023$, there is not a line at $R_b = 10\,\text{kbps}$ (or kHz). So in the schematic we set fundFreq to $10^4/1023$ and display 1050 harmonics. The resulting spectrum after changing some plot scaling, is



Some zooming is required to see the individual spectral lines. All is well at this point, including



the DC component which as expected is below the AC harmonics.