APPENDIX A: EXTENSION OF EXPERIMENT TO GN(MB) SIGNALS

This appendix provides susceptibility and characterization measurements for gated-noise signals that emulate MB-OFDM, i.e., GN(MB) signals. Recall that MB-OFDM is an ultrawideband (UWB) signal that hops between 14 bands according to a specified time-frequency code; it is specified by the number of bands (b) it hops between and the number of consecutive dwells (d) the signal stays in a particular band. To a relatively narrowband victim receiver, MB-OFDM appears as gated interference. Table A-1 provides the MB-OFDM parameters, i.e., b and d, and corresponding gating parameters, i.e., on-time (τ_{on}), off-time (τ_{off}), and fractional on-time (ζ). Gating parameters are illustrated in Figure A-1 for GN(MB)-03.

Table A-1. GN(MB) Gating Parameters

GN (MB)	MB-OFDM Parameters		Gating Parameters		
	b	d	τ_{on} (μs)	τ_{off} (μs)	ζ
01	1	1	0.24	0.07	0.7758
02	3	1	0.24	0.70	0.2586
03	3	2	0.55	1.32	0.2586
04	7	1	0.24	1.95	0.1108
05	7	2	0.55	3.82	0.1108
06	7	6	1.80	11.32	0.1108
07	13	1	0.24	3.82	0.0597
08	13	2	0.55	7.57	0.0597
09	13	12	3.68	45.07	0.0597

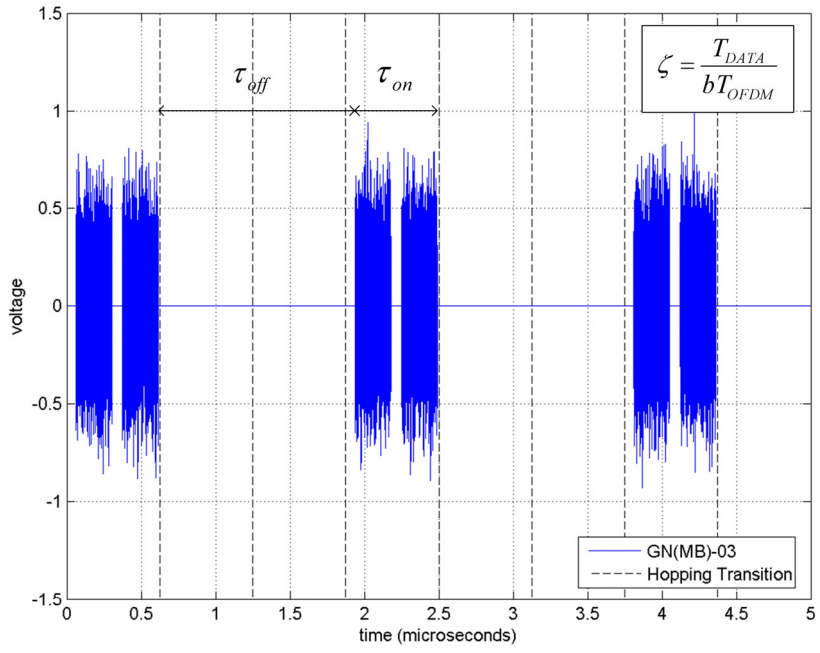

Figure A-1. Simulated gated-noise signal, GN(MB)-03.

From the perspective of a victim receiver, MB-OFDM has two gating processes associated with: (1) hopping and (2) insertion of zero-prefix and guard-intervals in each MB-OFDM symbol. Each MB-OFDM symbol is comprised of a zero-prefix, data block, and guard interval; the MB-OFDM symbol period is the sum of its constituents, i.e., $T_{OFDM} = T_{ZP} + T_{DATA} + T_{GI}$, where T_{ZP} = 60.6 ns, T_{DATA} = 242.4 ns, and T_{GI} = 9.5 ns. Fractional on-time is calculated as $\zeta = T_{DATA} / bT_{OFDM}$. τ_{on} is approximated by including the zero-prefix and guard interval between consecutive dwells and excluding those adjacent to hopping transitions,

$$\tau_{on} \approx dT_{OFDM} - T_{ZP} - T_{GI} \quad .$$

Accordingly, τ_{off} is approximated as

$$\tau_{off} \approx (b-1)dT_{OFDM} + T_{ZP} + T_{GI} \quad .$$

A.1. DTV Susceptibility to GN(MB) Interference

Figures A-2 – A-7 provide measured segment error rate (*SER*) and pre-Viterbi bit error rate (*BER*) versus interference-to-noise ratio (*INR*). These composite graphs for GN(MB) signals correspond to Figures 3 – 8 for GN signals in the main text.

Figures A-8 – A-13 plot INR_{TOV} and BER_{TOV} versus $1/\zeta$ in dB, where ζ = {0.78, 0.26, 0.11, 0.06} correspond to $10\log(1/\zeta)$ = {1.10, 5.87, 9.55, 12.24} dB. These composite graphs for GN(MB) signals correspond to Figures 10 – 15 for GN signals. Table A-2 provides INR_{TOV} and BER_{TOV} for GN(MB) signals as Table 2 does for GN signals.

There is no one-to-one correspondence for gating parameters between the two sets. For example, $\tau_{on} \approx$ {0.24, 0.55, 1.80, 3.68} μs for GN(MB) are different than τ_{on} = {0.01, 0.10, 1.00, 10.00} μs for GN and $10\log(1/\zeta)$ = {1.10, 5.87, 9.55, 12.24} dB for GN(MB) are different than $10\log(1/\zeta)$ = {0.00, 3.01, 6.02, 9.03, 12.04} dB for GN. In spite of these discrepancies, GN(MB) results lie where expected in the region bounded by 0.10- to 10.00-μs τ_{on} curves.

Table A-2. Measured DTV Susceptibility and FEC Performance for GN(MB) Interference

GN (MB)	Gating Parameters			*SNR* = 9 dB		*SNR* = 12 dB		*SNR* = 15 dB	
	τ_{on} (μs)	τ_{off} (μs)	ζ	INR_{TOV} (dB)	BER_{TOV}	INR_{TOV} (dB)	BER_{TOV}	INR_{TOV} (dB)	BER_{TOV}
01	0.24	0.07	0.7758	0.5	0.037	5.2	0.036	8.5	0.036
02	0.24	0.70	0.2586	-0.7	0.030	3.7	0.027	7.0	0.028
03	0.55	1.32	0.2586	-0.9	0.028	3.5	0.025	6.5	0.025
04	0.24	1.95	0.1108	-1.9	0.022	2.3	0.018	5.8	0.019
05	0.55	3.82	0.1108	-3.2	0.018	0.8	0.013	4.2	0.013
06	1.80	11.32	0.1108	-5.0	0.015	-1.2	0.009	2.3	0.009
07	0.24	3.82	0.0597	-3.3	0.016	0.7	0.012	4.3	0.011
08	0.55	7.57	0.0597	-5.1	0.014	-1.1	0.009	2.3	0.008
09	3.68	45.07	0.0597	-7.4	0.011	-3.3	0.005	-0.3	0.005

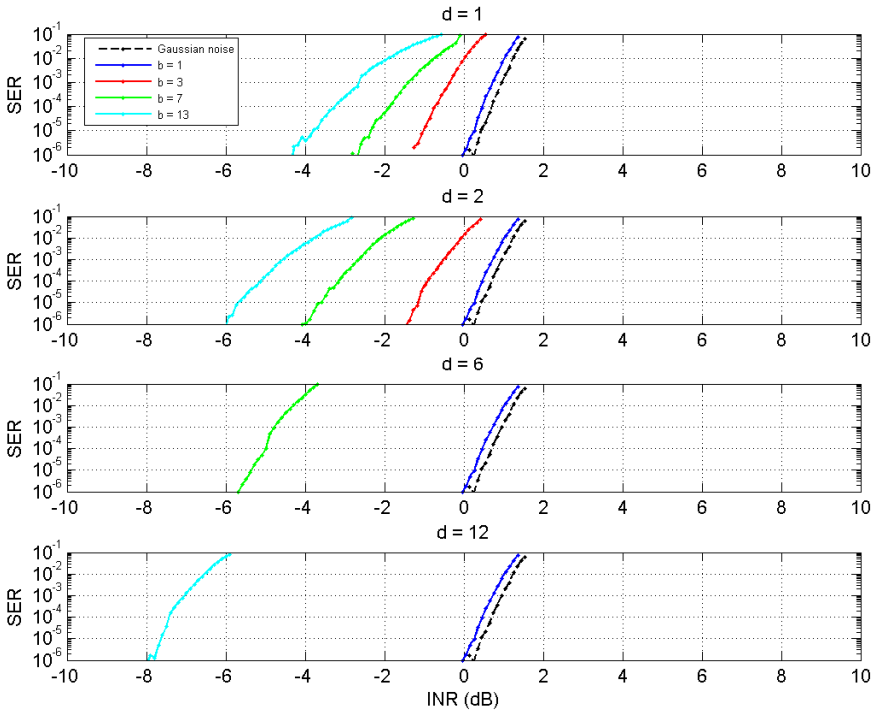

Figure A-2. *SER* versus *INR* for a DTV receiver operating at *SNR* = 9 dB and exposed to GN(MB) interference.

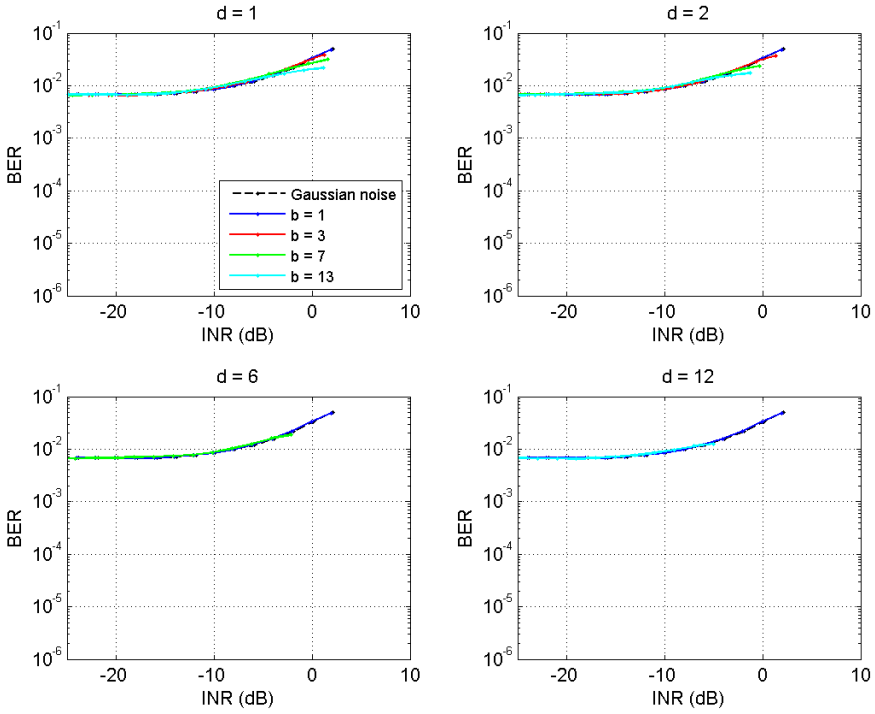

Figure A-3. *BER* versus *INR* for a DTV receiver operating at *SNR* = 9 dB and exposed to GN(MB) interference.

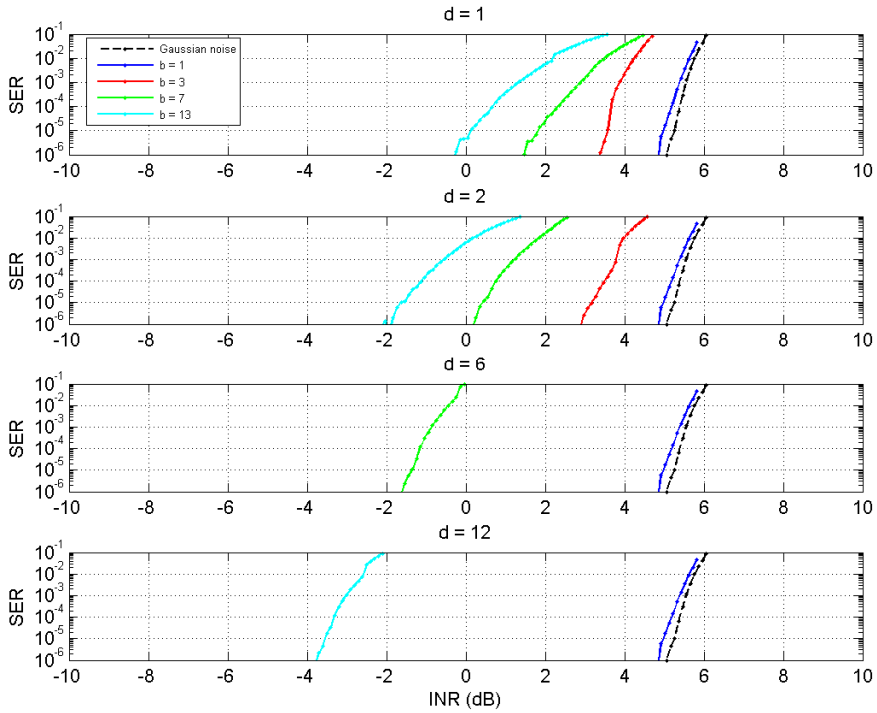

Figure A-4. *SER* versus *INR* for a DTV receiver operating at *SNR* = 12 dB and exposed to GN(MB) interference.

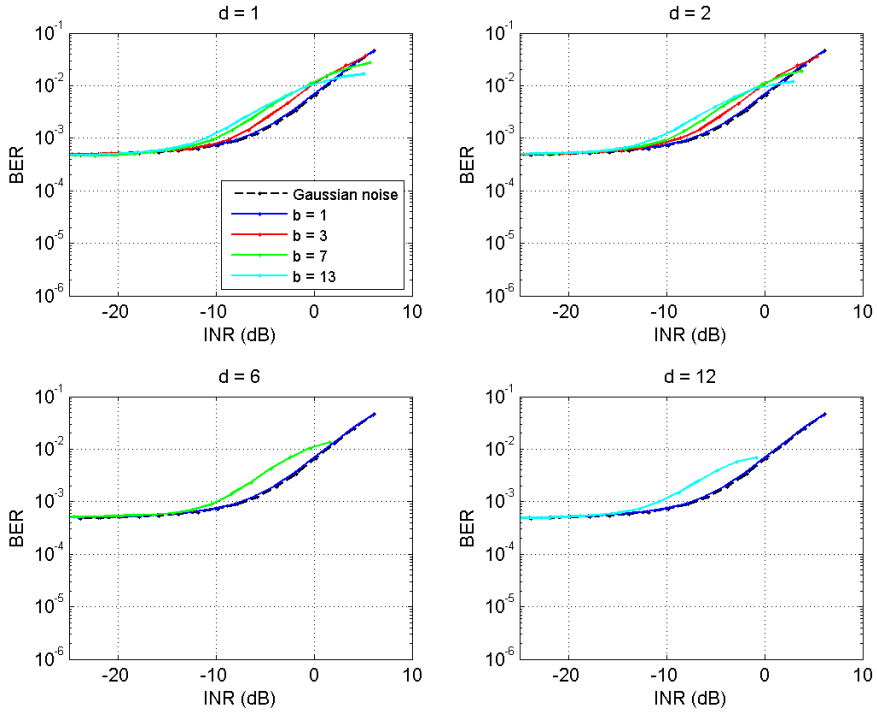

Figure A-5. *BER* versus *INR* for a DTV receiver operating at *SNR* = 12 dB and exposed to GN(MB) interference.

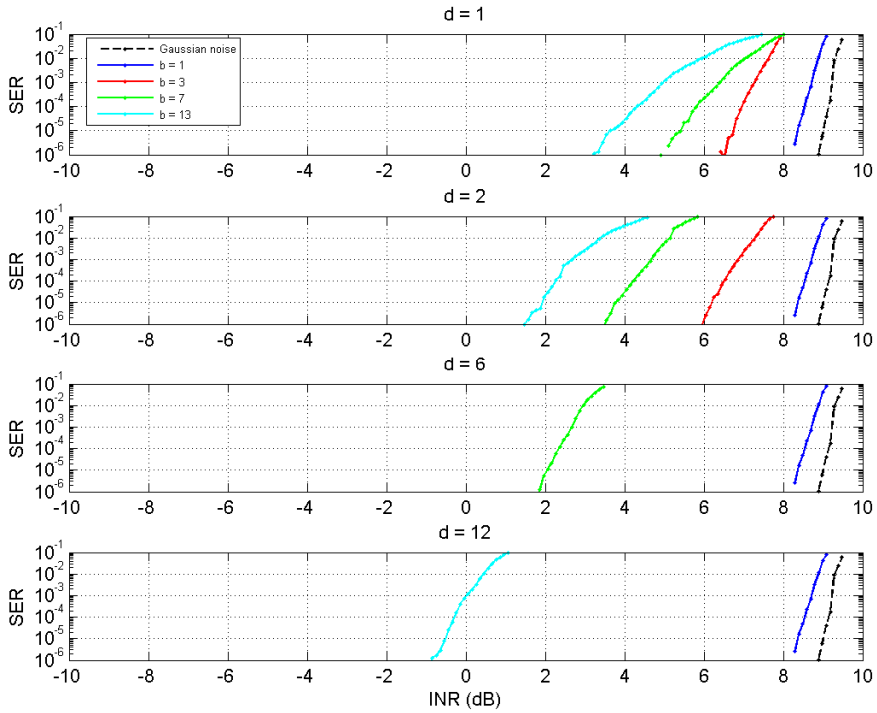

Figure A-6. *SER* versus *INR* for a DTV receiver operating at *SNR* = 15 dB and exposed to GN(MB) interference.

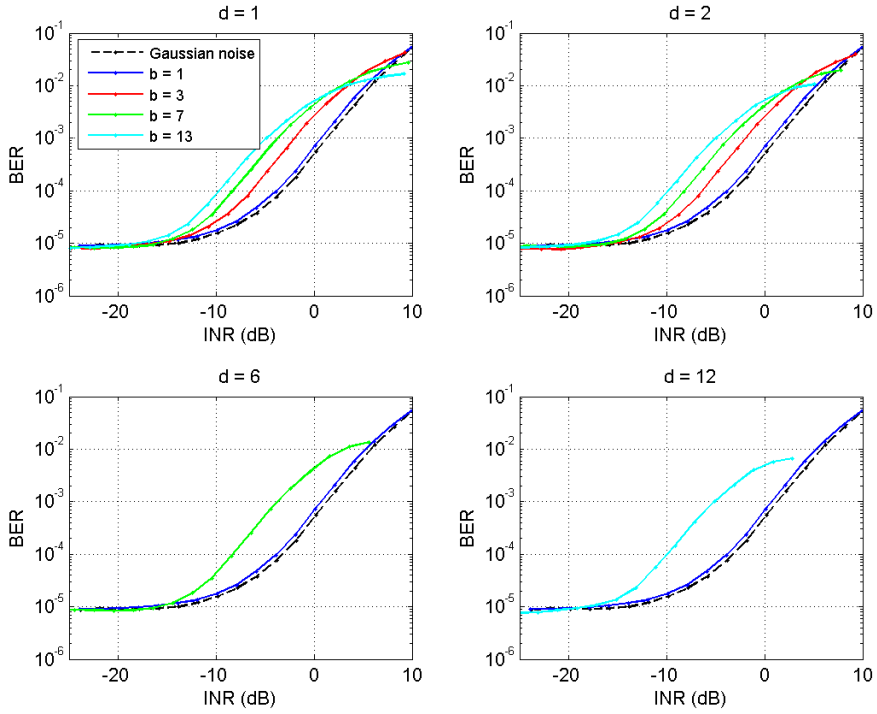

Figure A-7. *BER* versus *INR* for a DTV receiver operating at *SNR* = 15 dB and exposed to GN(MB) interference.

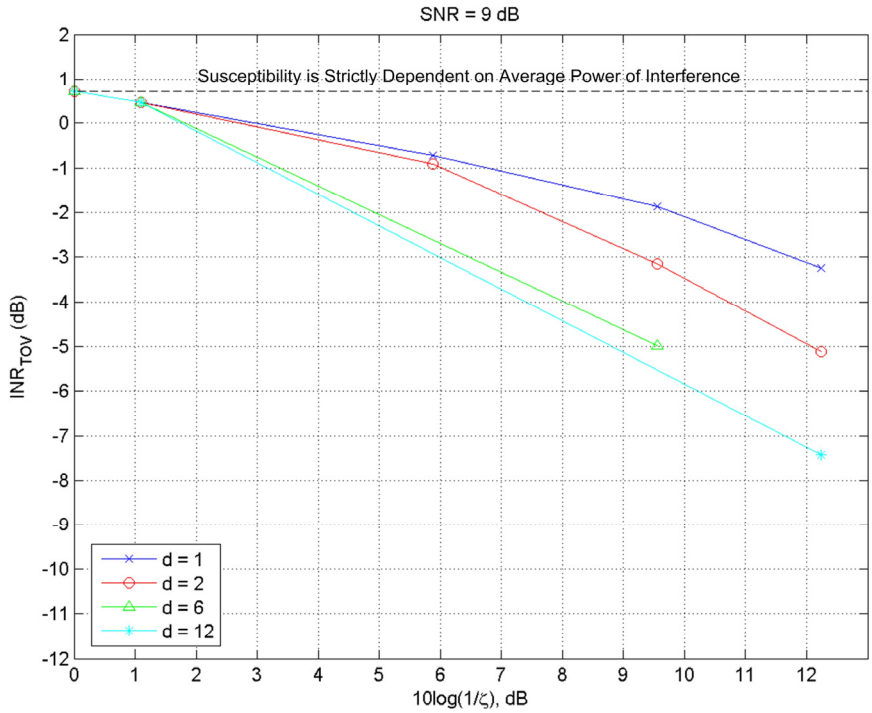

Figure A-8. INR_{TOV} versus 10log(1/ζ) for a DTV receiver operating at SNR = 9 dB and exposed to GN(MB) interference.

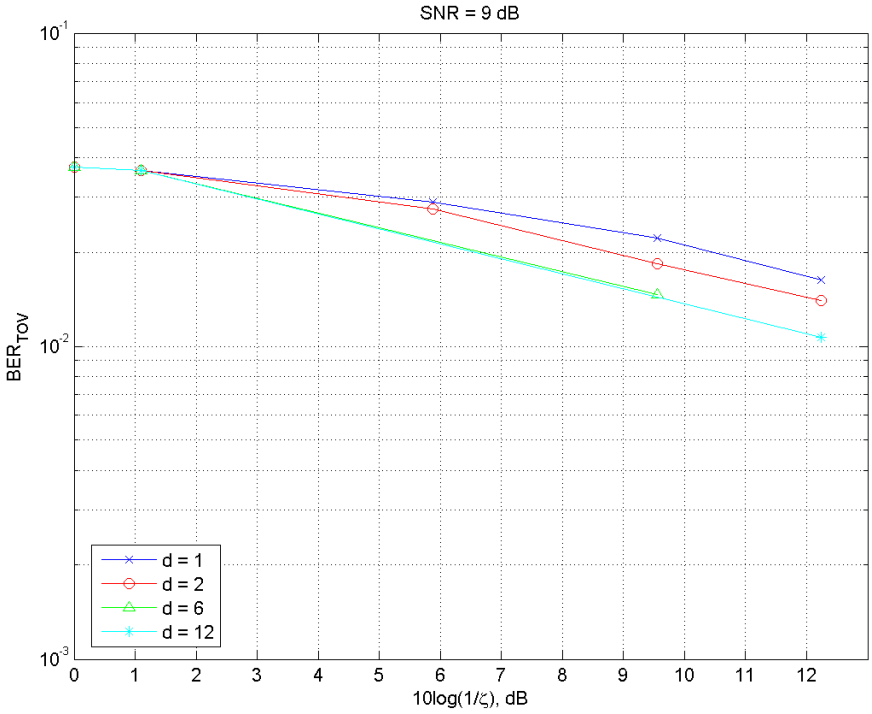

Figure A-9. BER_{TOV} versus 10log(1/ζ) for a DTV receiver operating at SNR = 9 dB and exposed to GN(MB) interference.

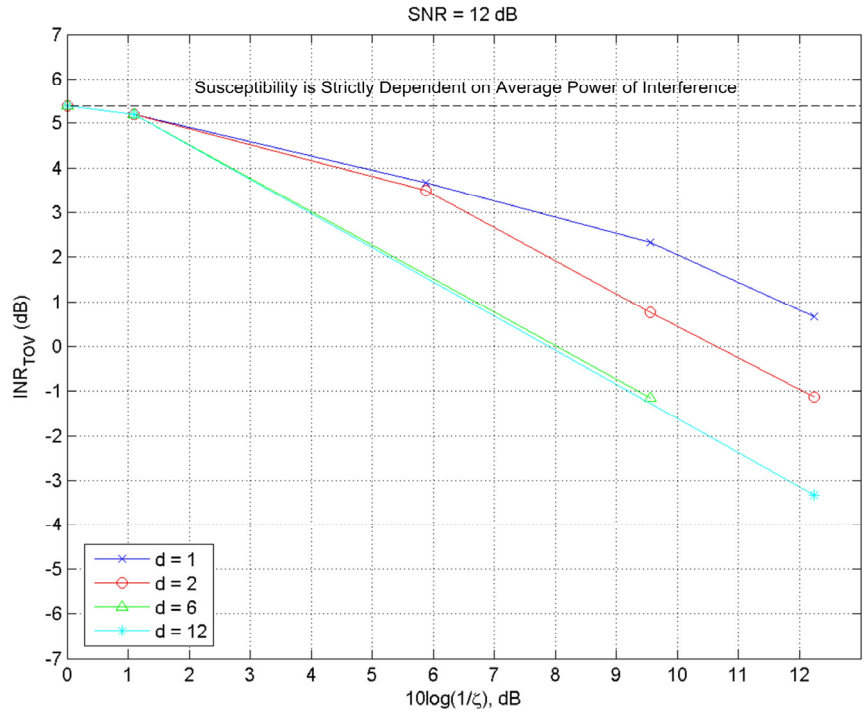

Figure A-10. INR_{TOV} versus 10log(1/ζ) for a DTV receiver operating at SNR = 12 dB and exposed to GN(MB) interference.

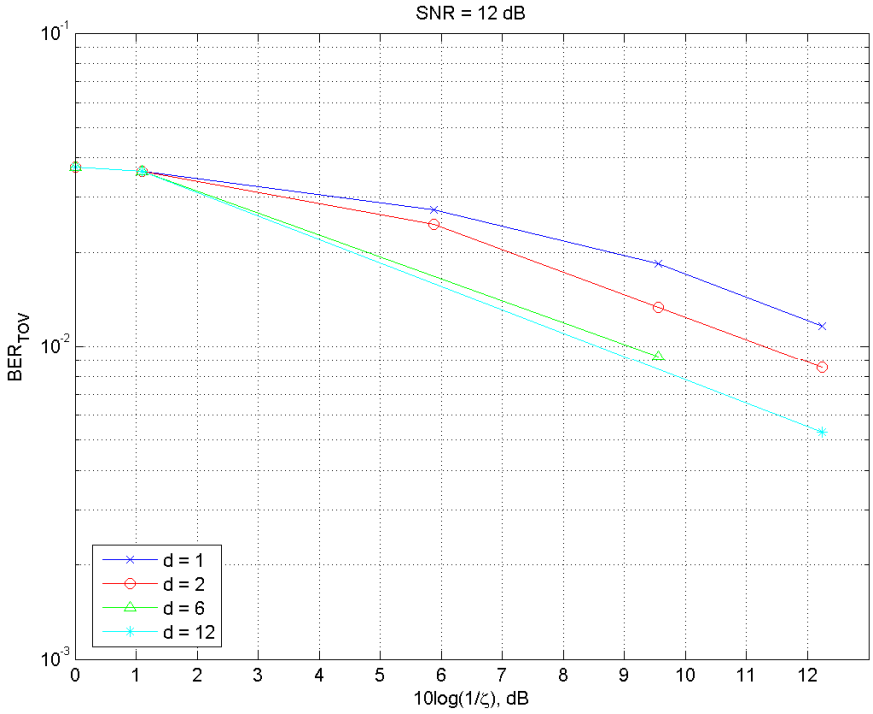

Figure A-11. BER_{TOV} versus 10log(1/ζ) for a DTV receiver operating at SNR = 12 dB and exposed to GN(MB) interference.

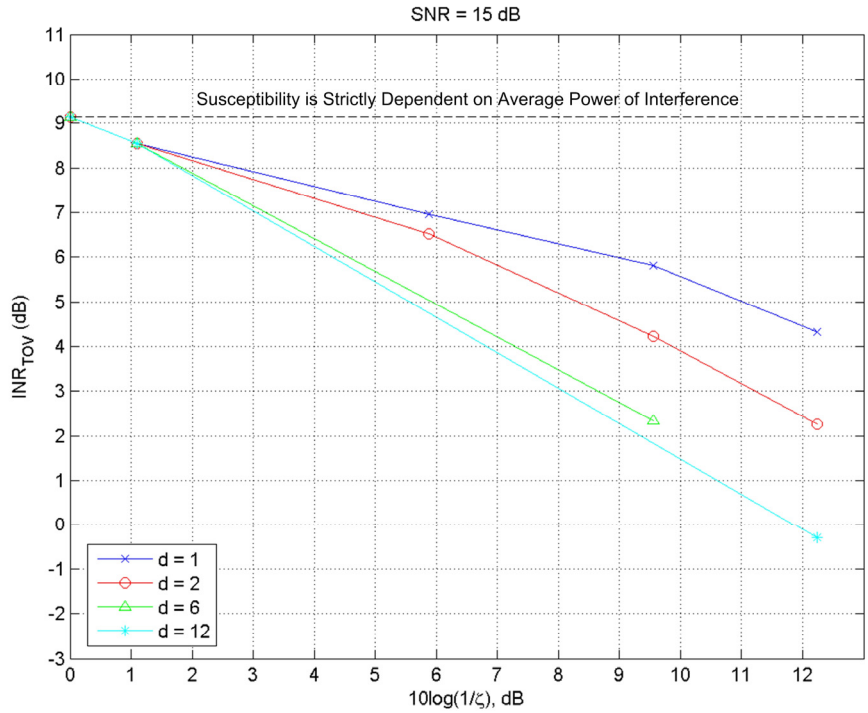

Figure A-12. INR_{TOV} versus 10log(1/ζ) for a DTV receiver operating at SNR = 15 dB and exposed to GN(MB) interference.

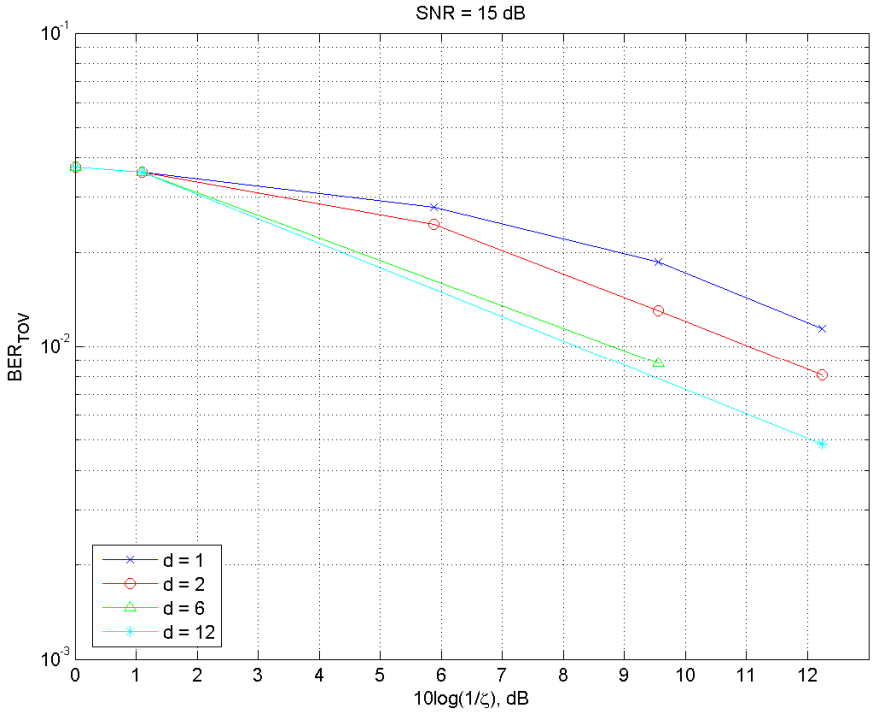

Figure A-13. BER_{TOV} versus 10log(1/ζ) for a DTV receiver operating at SNR = 15 dB and exposed to GN(MB) interference.

A.2. Characterization of GN(MB) Signals

Table A-3 provides band-limited temporal metrics compared to the approximate gating parameters of the GN(MB) signals. Table A-3 provides temporal characteristics of GN(MB) signals as Table 3 does for GN signals.

Table A-3. Temporal Characteristics of GN(MB) Signals Band-Limited to B_{DTV}

GN (MB)	Gating Parameters			Band-Limited Metrics		
	τ_{on} (μs)	τ_{off} (μs)	ζ	BD (μs)	BI (μs)	ζ_{DTV}
01	0.24	0.07	0.7758			
02	0.24	0.70	0.2586	0.4	0.6	0.40
03	0.55	1.32	0.2586	0.7	1.2	0.37
04	0.24	1.95	0.1108	0.4	1.8	0.18
05	0.55	3.82	0.1108	0.7	3.7	0.16
06	1.80	11.32	0.1108	1.9	11.2	0.15
07	0.24	3.82	0.0597	0.4	3.7	0.10
08	0.55	7.57	0.0597	0.7	7.4	0.09
09	3.68	45.07	0.0597	3.8	44.9	0.08

Figures A-14 and A-15 provide amplitude probability distributions (*APD*s) of single- and multi-dwell GN(MB) signals, respectively. Table A-4 provides band-limited amplitude metrics compared to the corresponding ultra-wide bandwidth limits. Table A-4 provides amplitude characteristics of GN(MB) signals as Table 4 does for GN signals.

Table A-4. Amplitude Characteristics of GN(MB) Signals Band-Limited to B_{DTV}

GN (MB)	Ultra-wide Bandwidth Limits		Band-Limited Metrics	
	P/A (dB)	*APD*	*P/A* (dB)	*APD*
01	10.6	RG	10.5	
02	14.8	RG	14.7	RG
03	14.8	RG	14.6	RG
04	18.0	RG	18.0	RG
05	18.0	RG	17.9	RG
06	18.0	RG	17.8	RG
07	20.3	RG	20.2	RG
08	20.3	RG	20.1	RG
09	20.3	RG	19.9	RG

Figures A-16 – A-17 provide power spectral densities (*PSD*s) for the GN(MB) signals. *PSD*s were calculated as described in Section 3.3. Block length was chosen as 170.6 μs (Δf = 5.9 kHz), which allowed 500 averages. The *PSD* of GN(MB)-09 (b = 13, d = 12) was excluded because it would have forced the number of averages to be less than 500. In Figure A-17, the *PSD* of GN(MB)-05 (b = 7, d = 2) is directly beneath GN(MB)-06 (b = 7, d = 6).

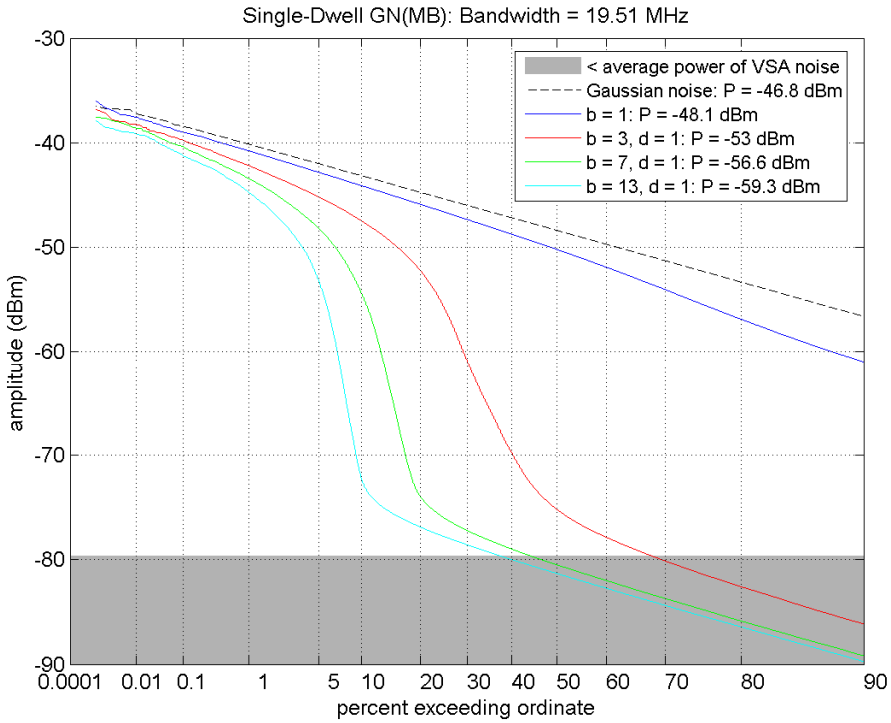

Figure A-14. *APD*s of single-dwell GN(MB) signals band-limited to B_{DTV}.

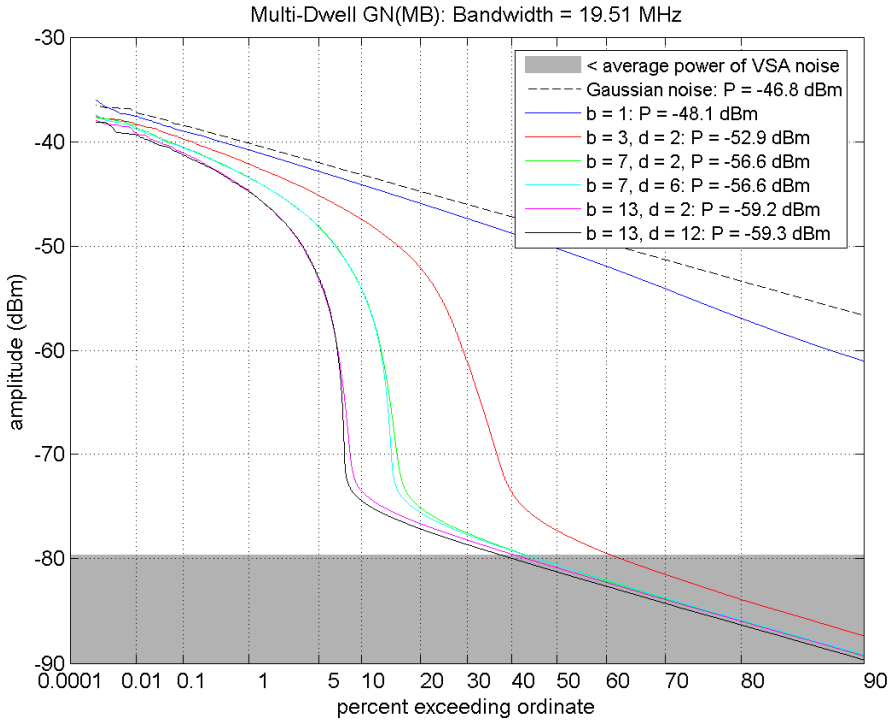

Figure A-15. *APD*s of multi-dwell GN(MB) signals band-limited to B_{DTV}.

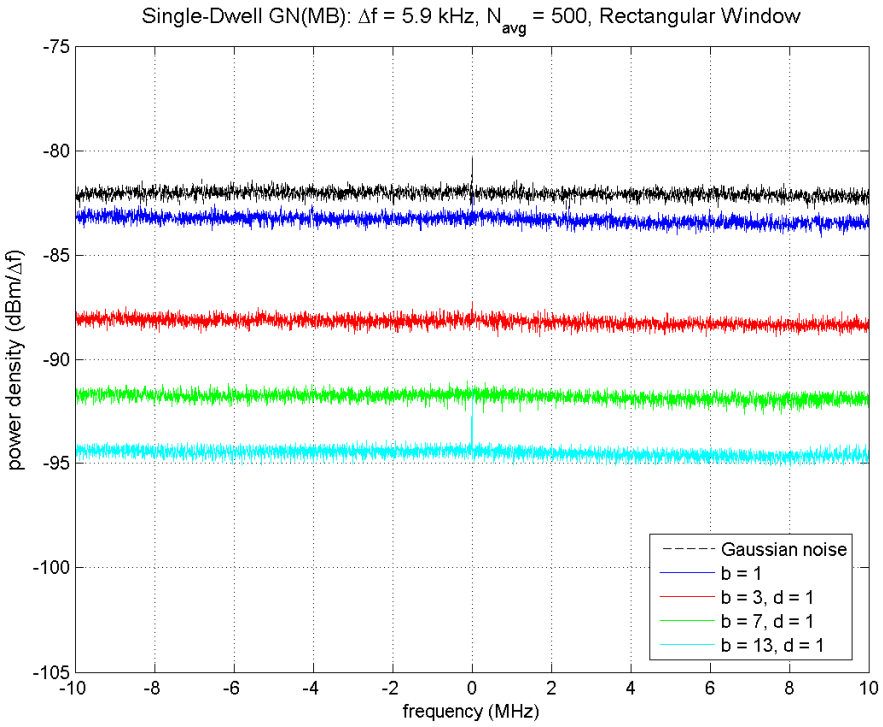

Figure A-16. *PSD*s of single-dwell GN(MB) signals.

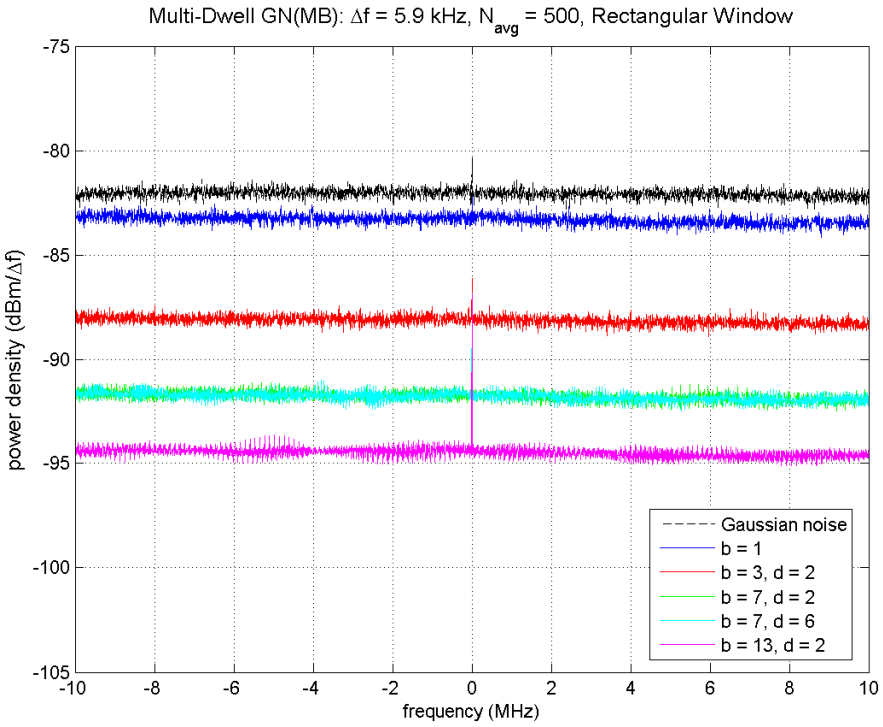

Figure A-17. *PSD*s of multi-dwell GN(MB) signals.