



MICROCHIP

10SPE Encoding Comparison

Microchip Technology Inc.

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Outline

- Biphas encoding
- Manchester encoding
- Differential Manchester encoding
- 4b5b and 8b10b encoding
- DCA encoding
- Comparison of NRZ, ME, DME, DCA, 8B10B, 4b5b+MLT3, 4b5b+ME, 4b5b+DMC, DCA50

Biphase Encoding

- At least one transition per bit time up to two
- self-clocking, synchronization
- DC balanced
- Error detection with violation
- Noise immunity
- Most commonly used Manchester and differential Manchester Coding
 - Manchester (802.3 Ethernet)
 - Transition occurs at the middle of each bit period
 - Middle transition serves as clock and data
 - Transition at beginning of the bit has no means
 - Differential Manchester (802.5 token ring LAN)
 - Transition occurs at the middle of each bit period for clocking only
 - Transition at beginning of a bit represents 0
 - No Transition at beginning of a bit represents 1

DCA Encoding

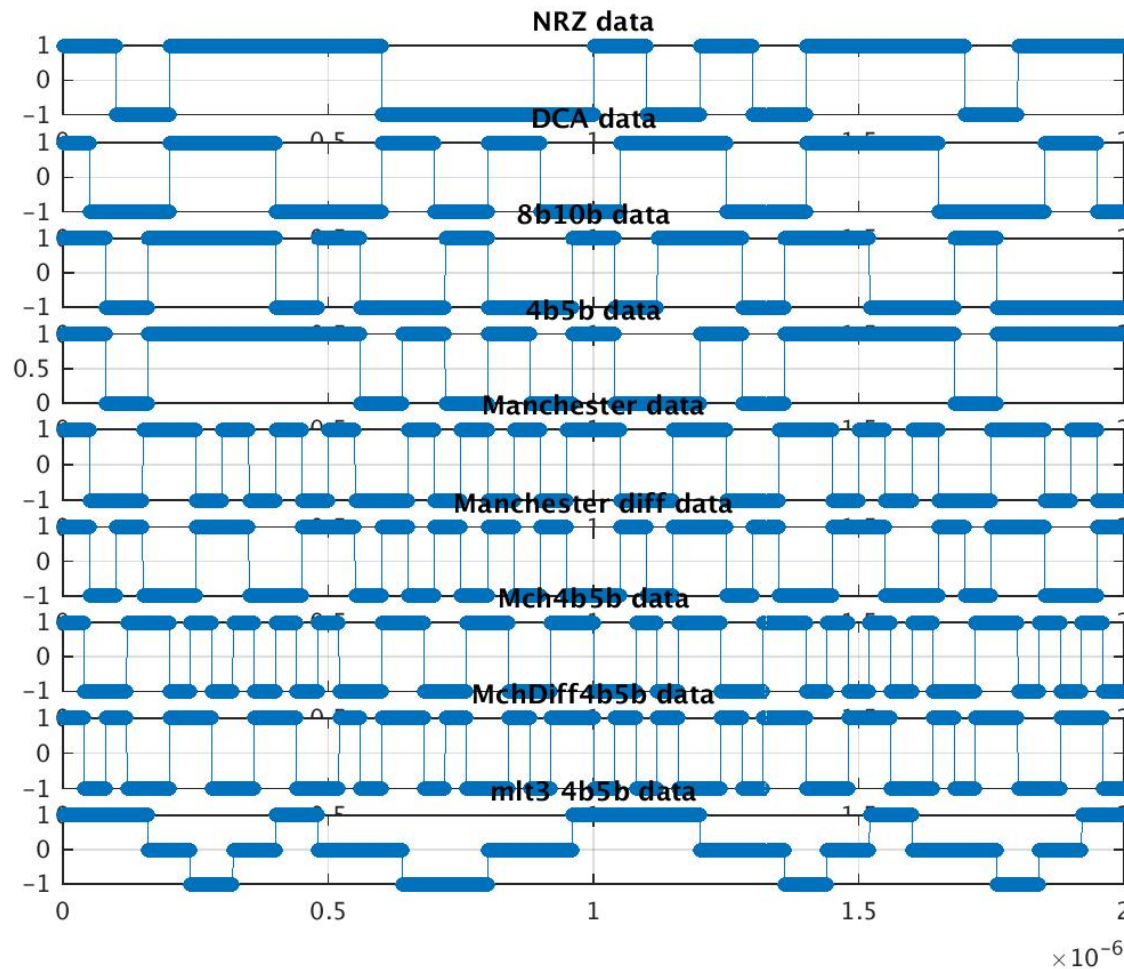
- **DCA Coding**
 - Phase encoding
 - Minimum pulse = source data period
 - Min pulse is 1 bit, max pulse is 2.5bits , max rising(falling)edge separation is 4.5 bits
 - DC balance
 - Support identifier
 - Mult-bits needed for encode/decode: bitn , $\text{bitn}+1$, and $\text{DSVn}-1$
 - Encoded data rate is the same as source data rate

10SPE Coding - Compare

Items		Coding Schemem		
		Diff or Manchester	DCA	4b5b/8b10b
Data rate/Mbps		10		
Minimum Pulse/UI @ 10MHz		0.5	1	0.8
DC balance		Y		
Latency		1 bit	5bit	4/8 bit
encoder/decoder complexity		Low	Med High	High
CDR	Complexity	Very Low	Med	High
	Need train	N	Y	Y
Support Identifier (Control code/K code)		N	Y	Y

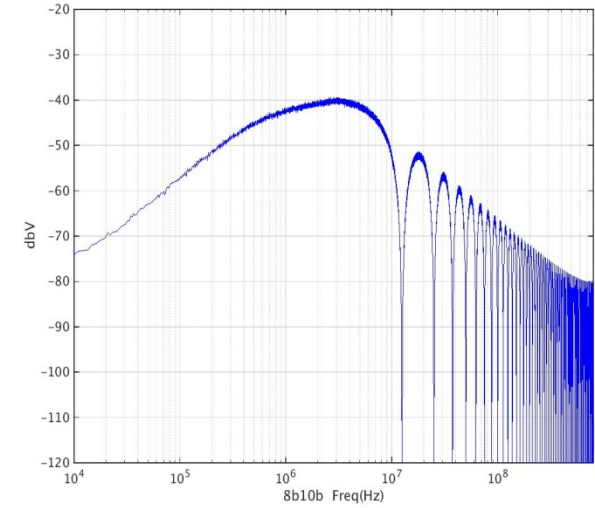
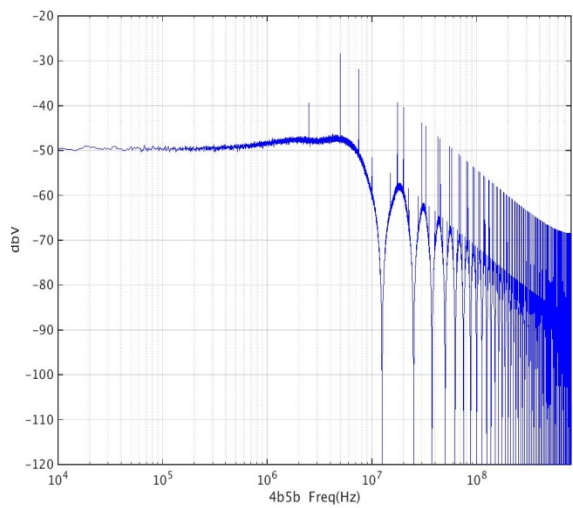
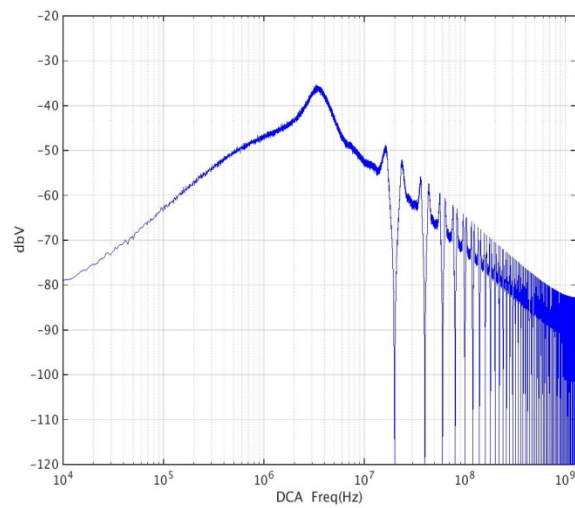
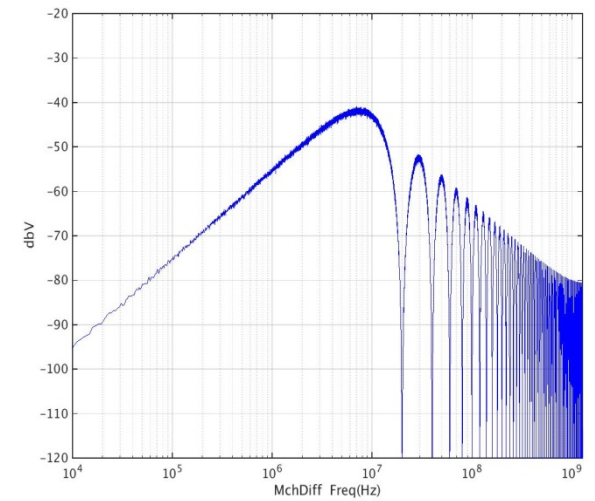
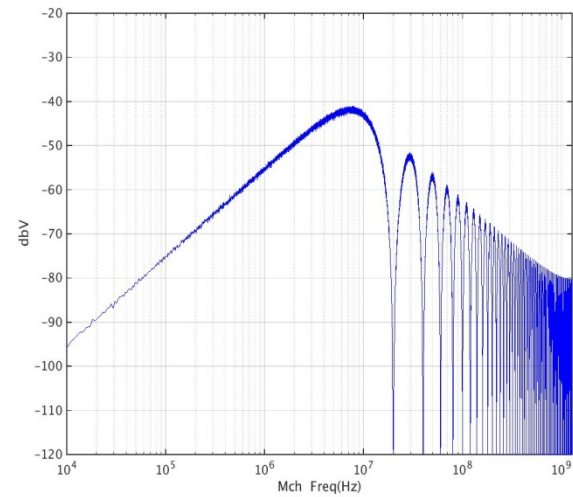
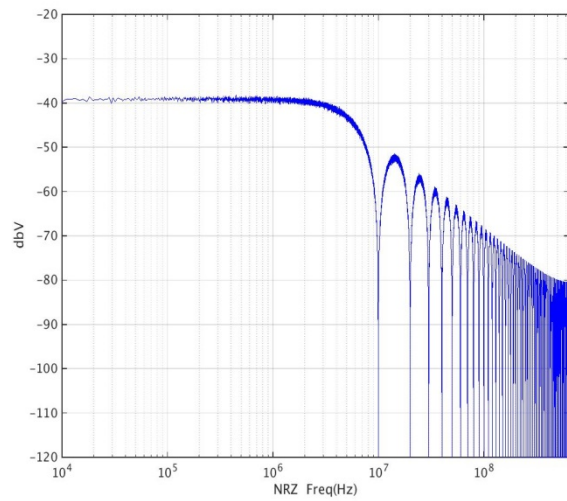
10SPE Coding - Spectrum

● Source Data & Encoded Data

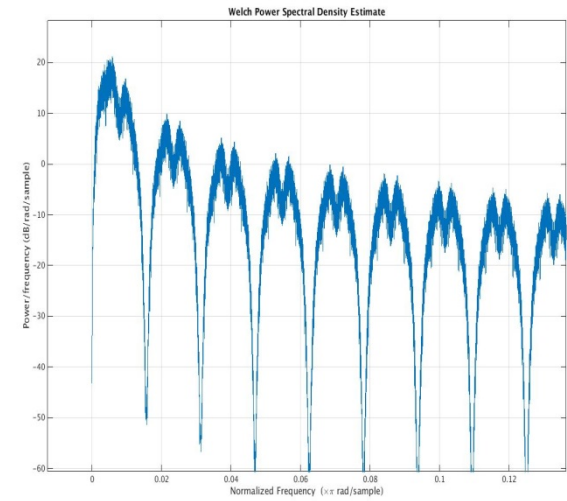
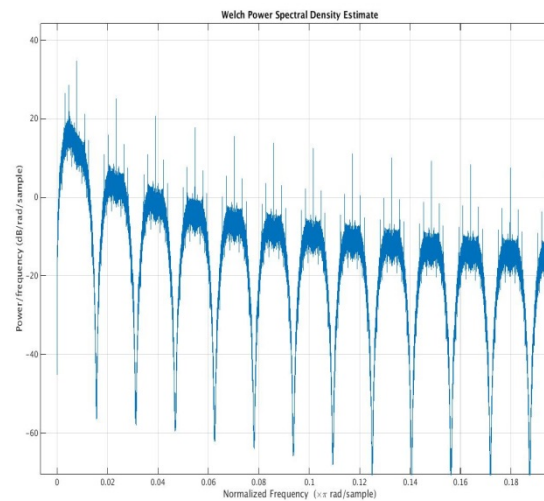
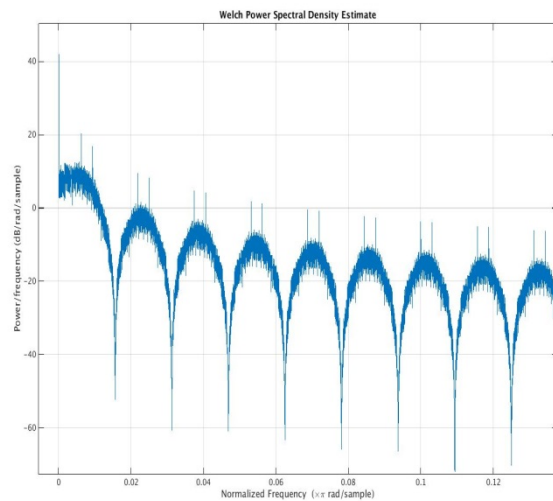
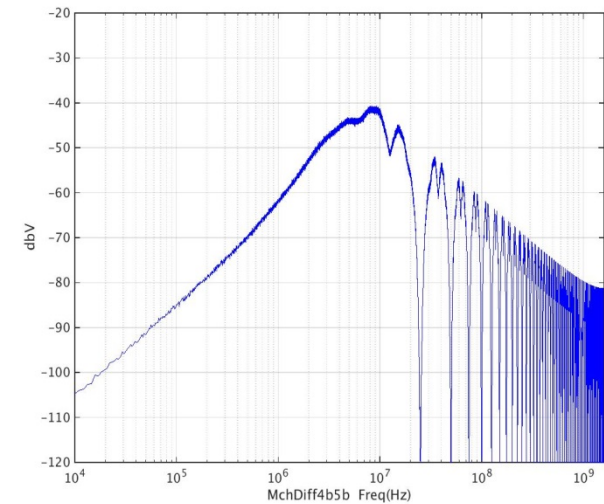
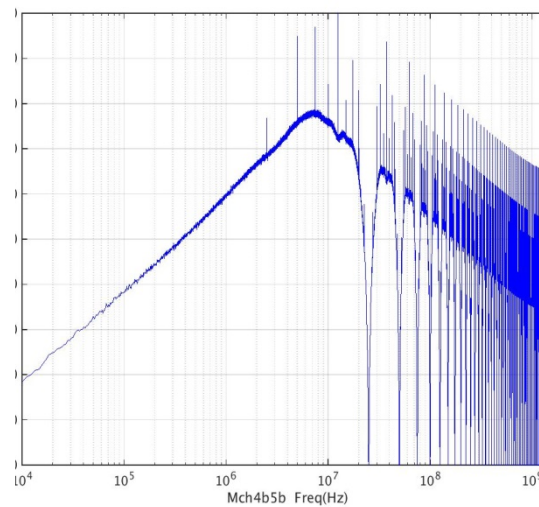
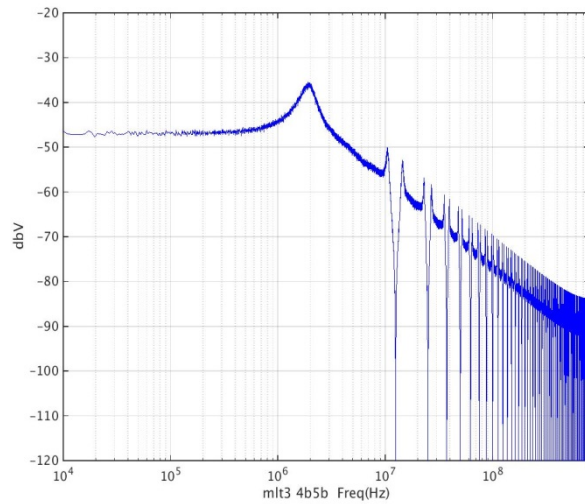




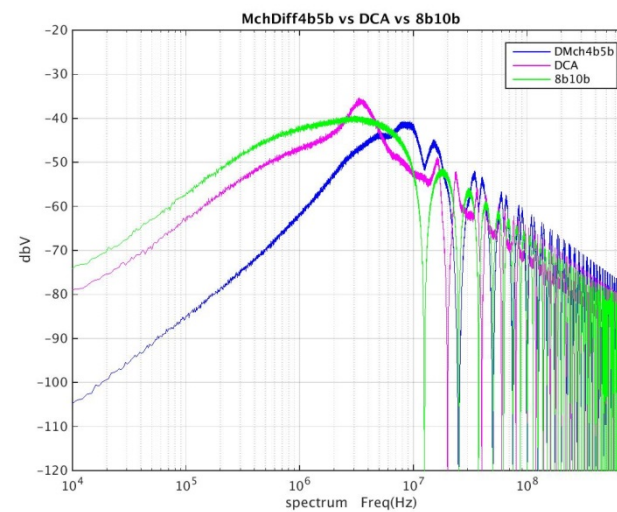
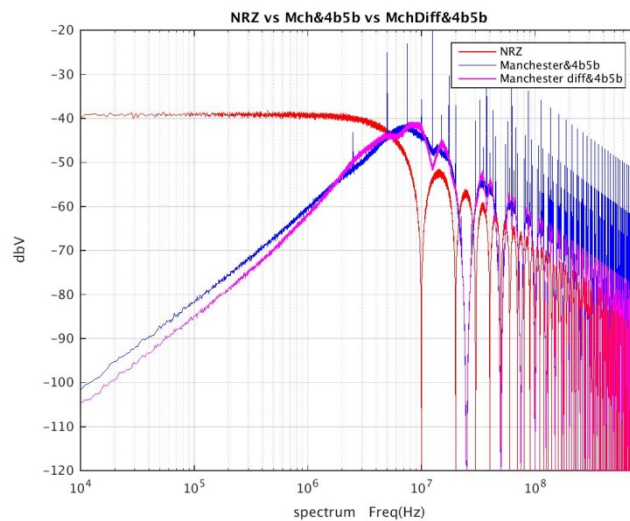
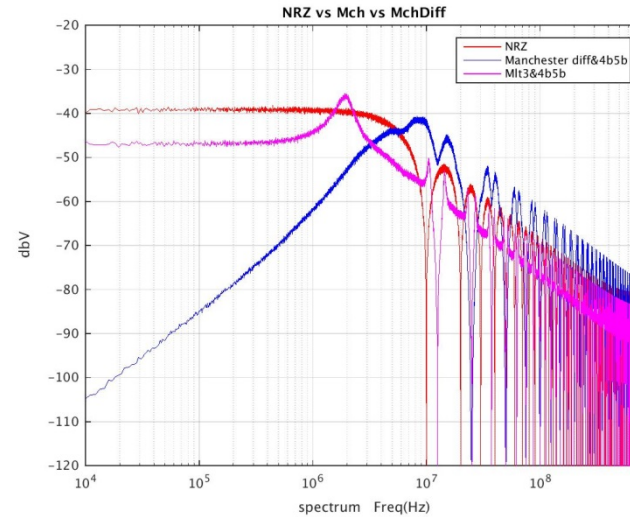
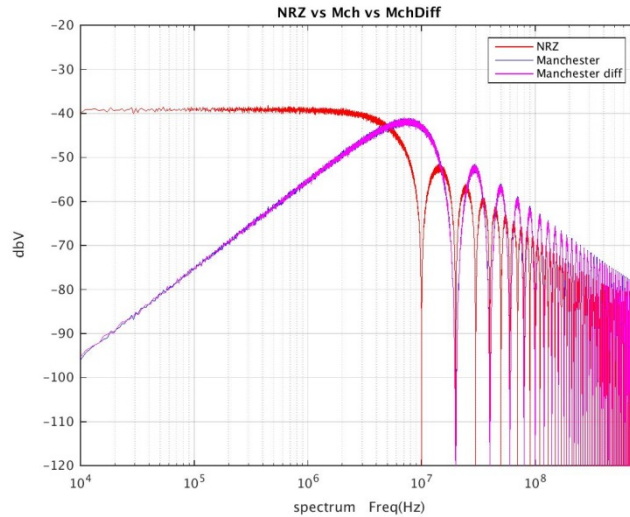
Spectrum (no Filter)



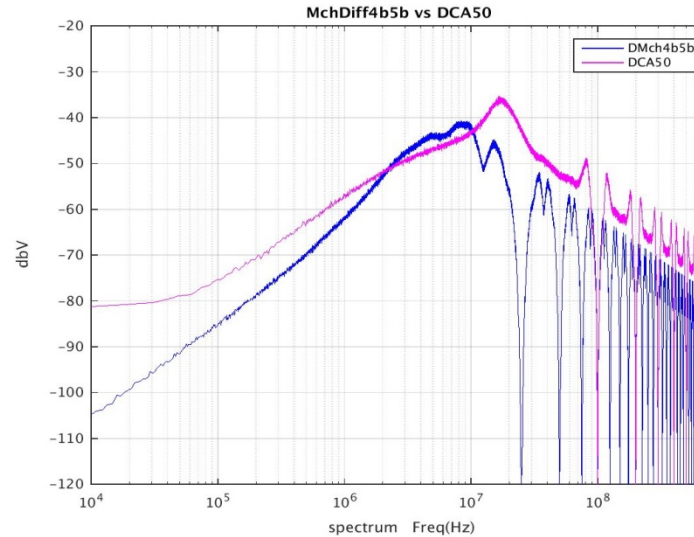
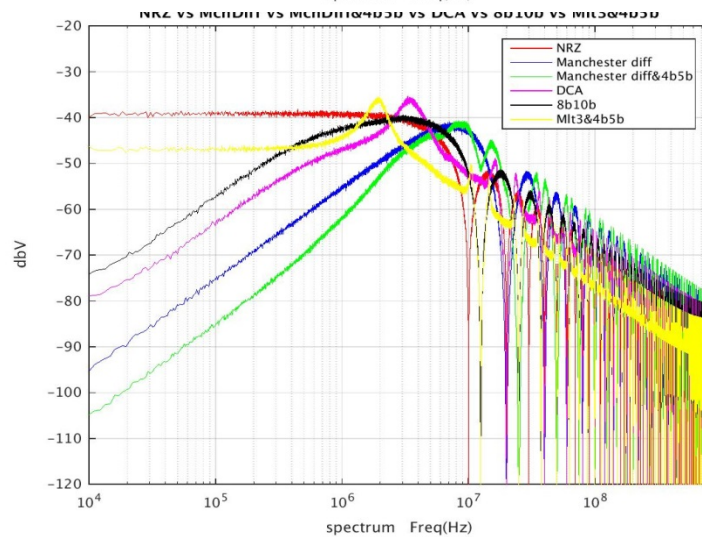
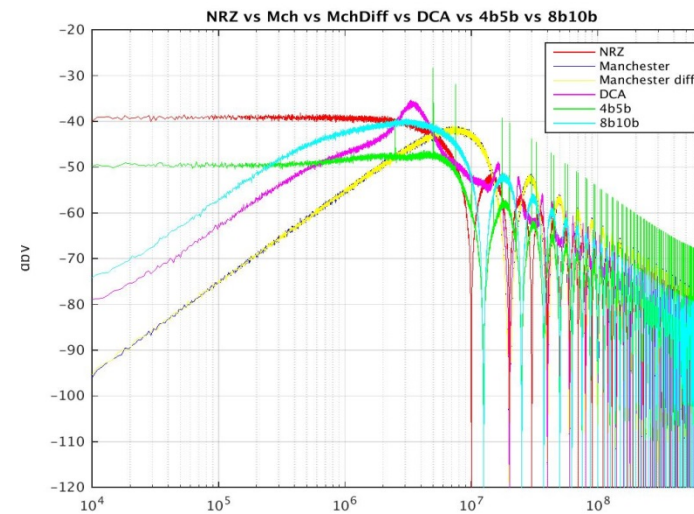
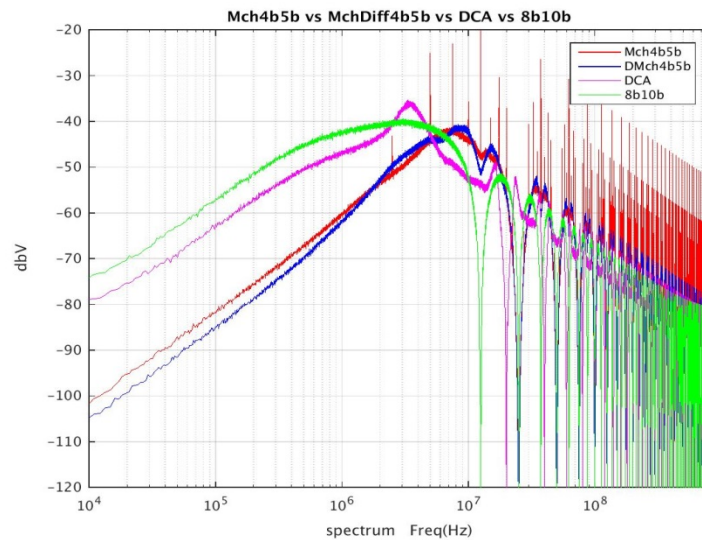
Spectrum (no Filter)



Spectrum (no Filter)

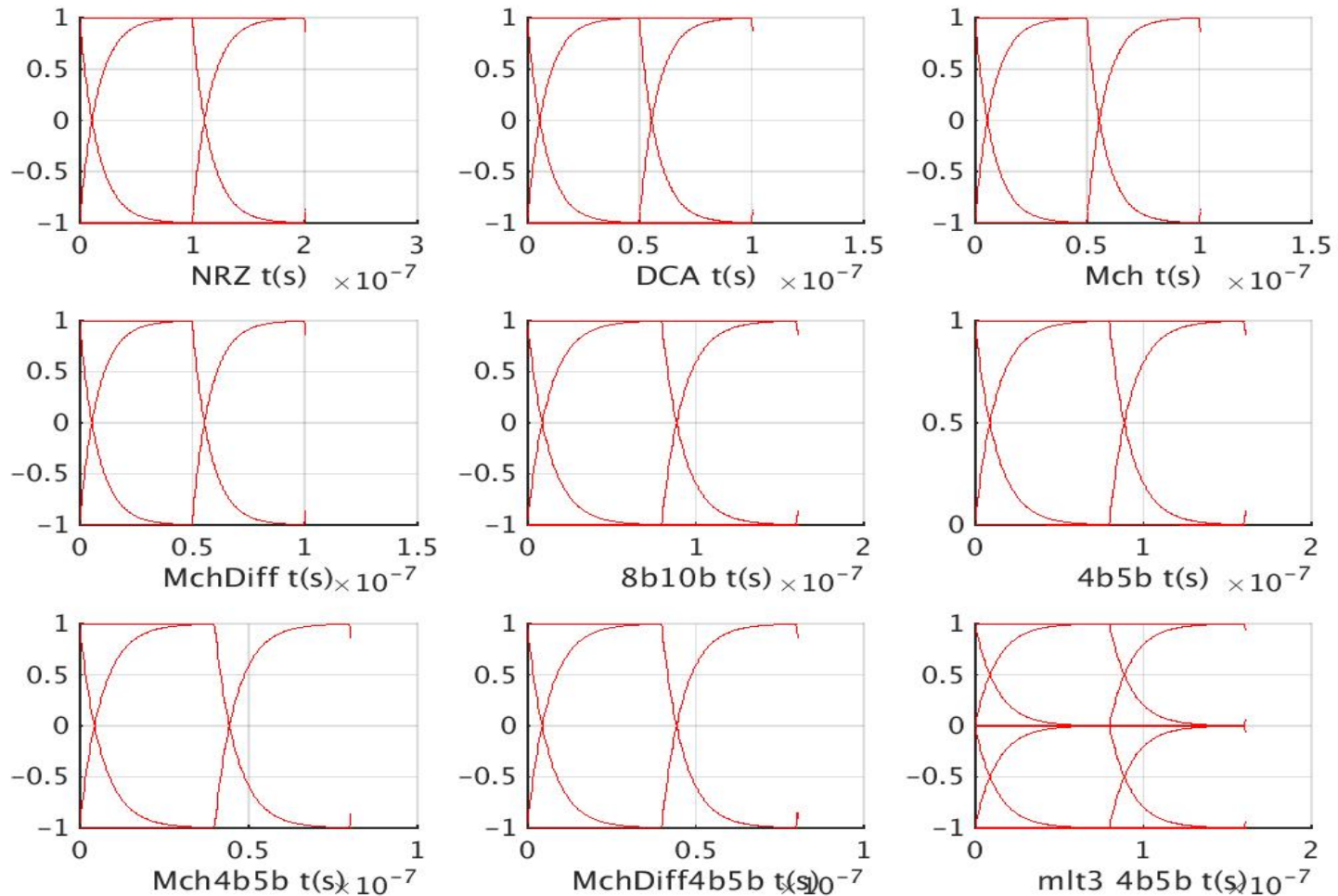


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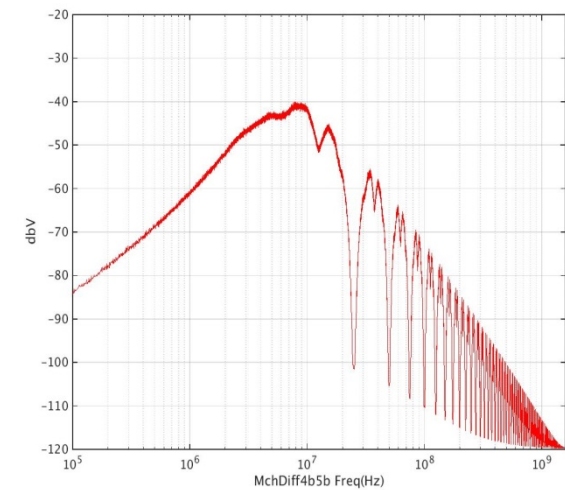
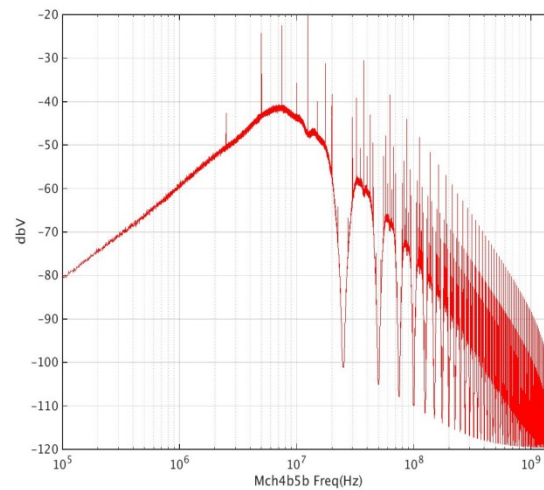
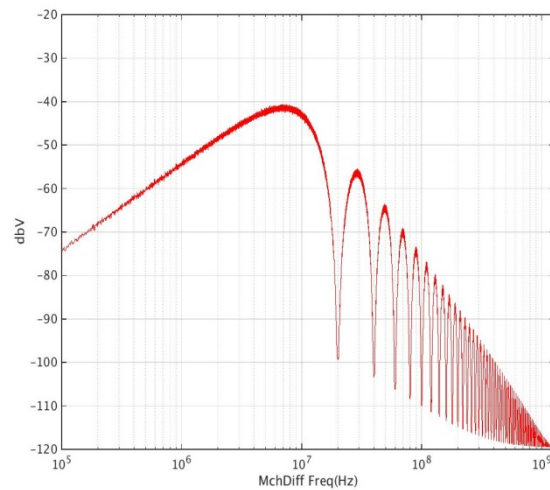
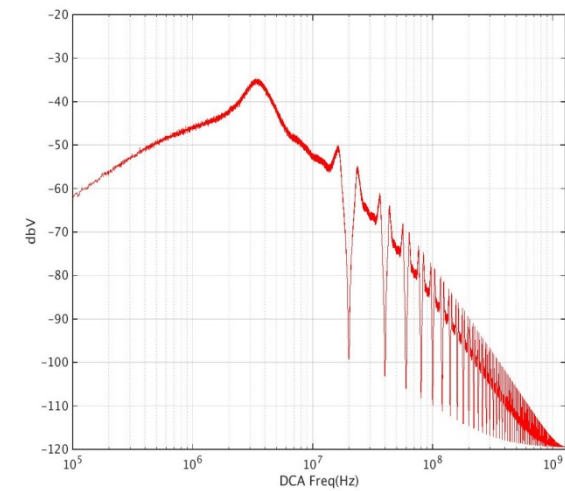
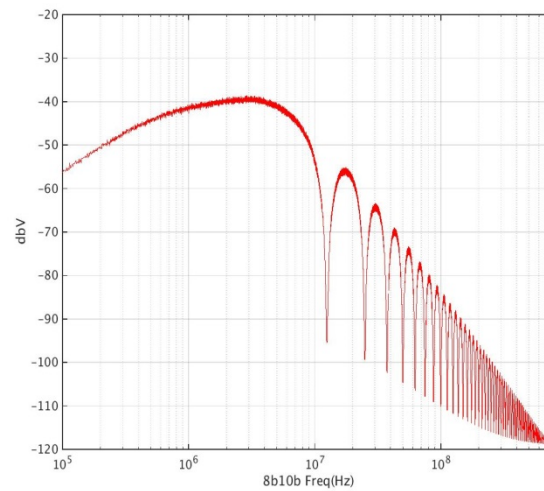
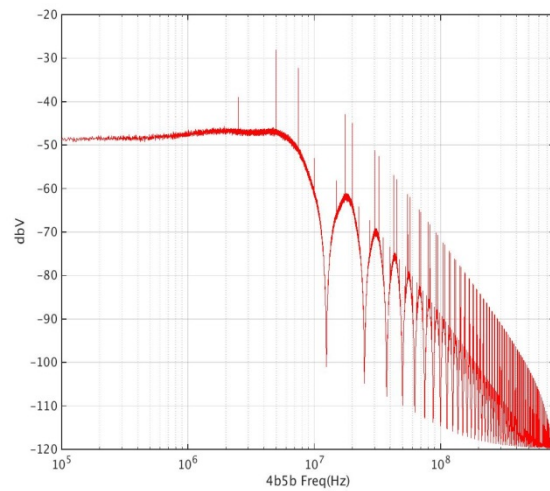


Eyes with 1st order LP filter (3 dB Baud rate LP corners)



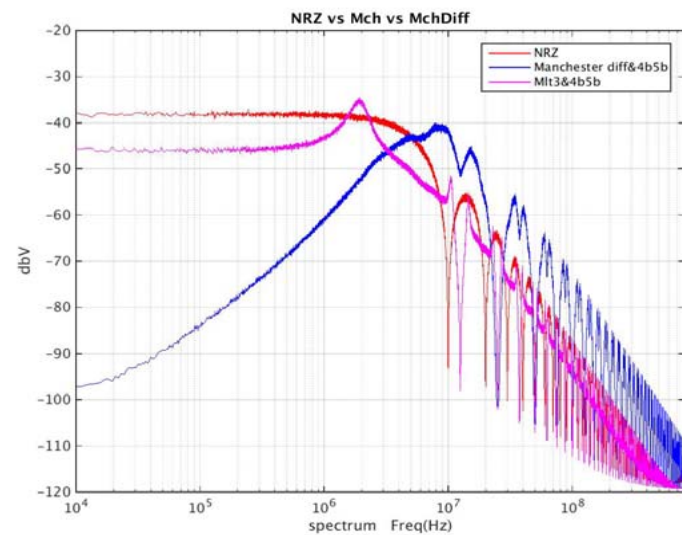
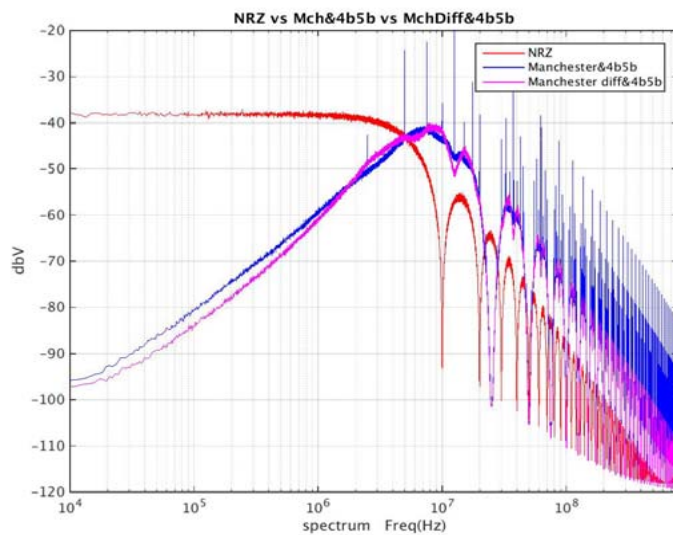
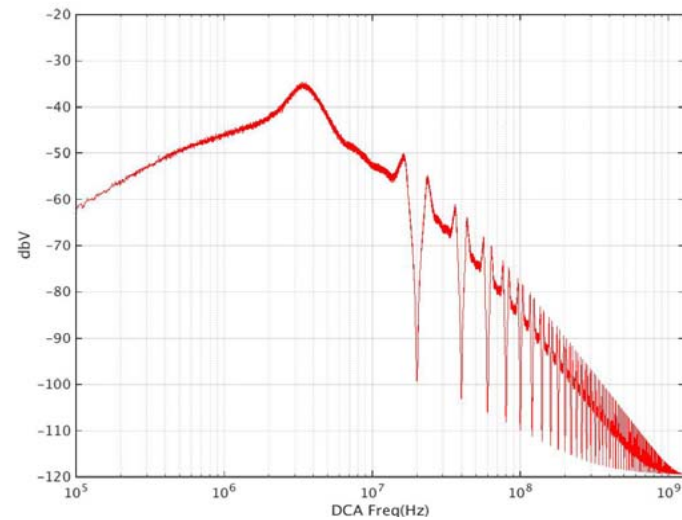
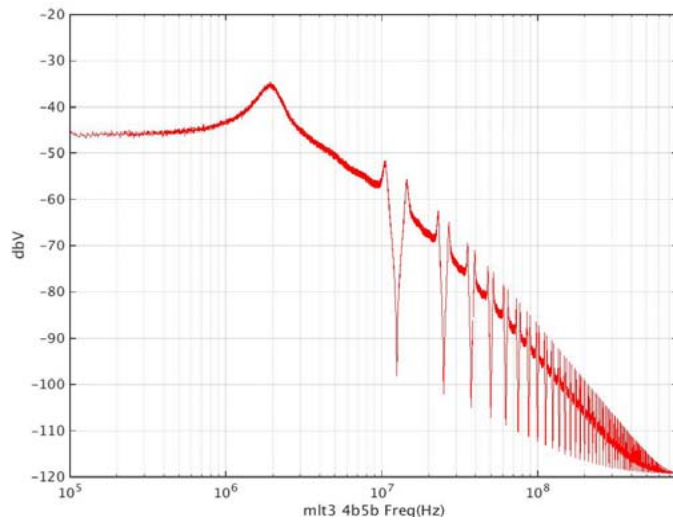


Spectrum with 1st order LP filter (3 dB Baud rate LP corners)



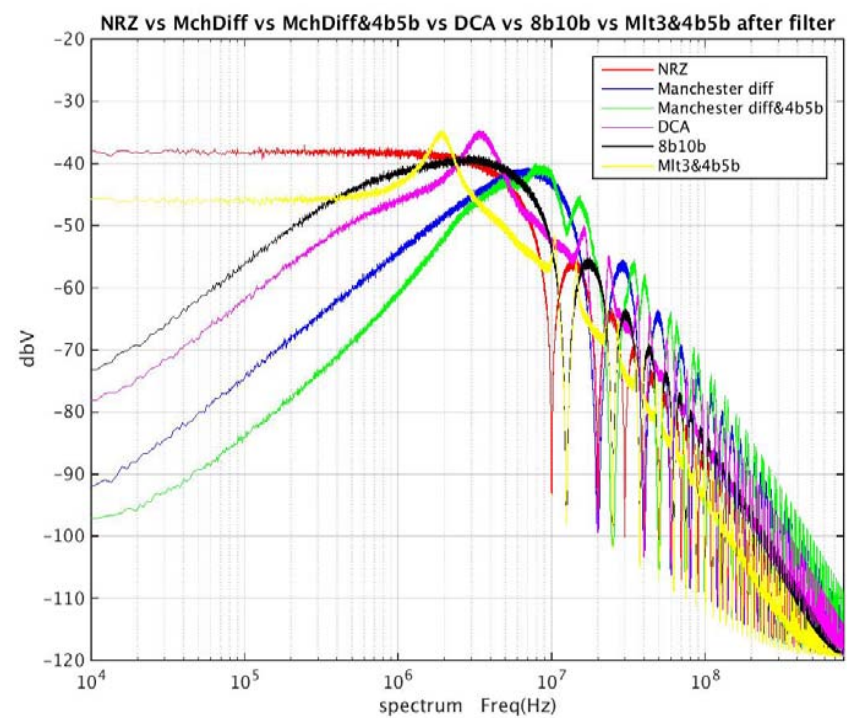
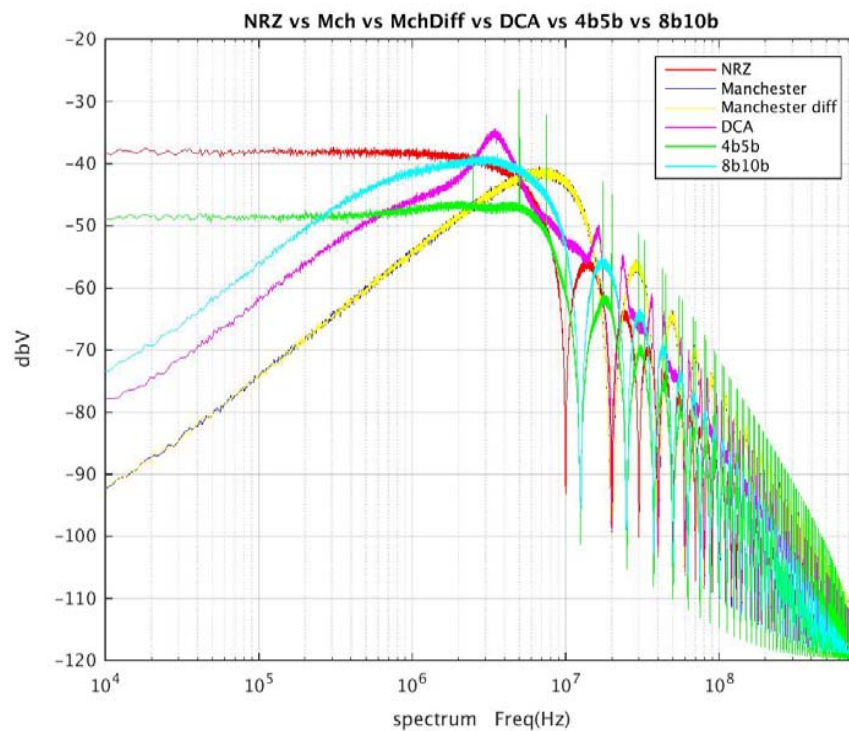


Spectrum with 1st order LP filter (3 dB Baud rate LP corners)



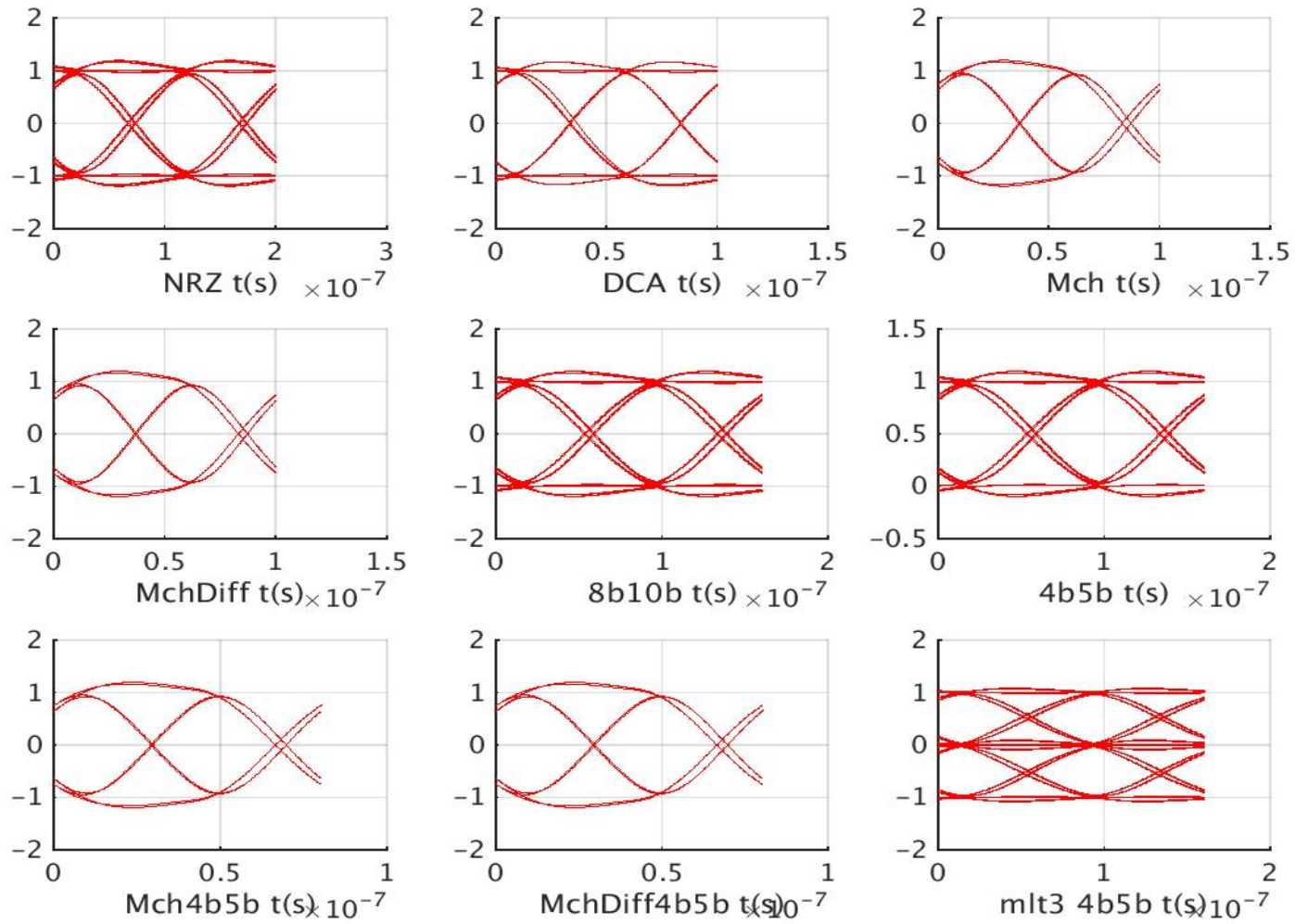


Spectrum with 1st order LP filter (3 dB Baud rate LP corners)



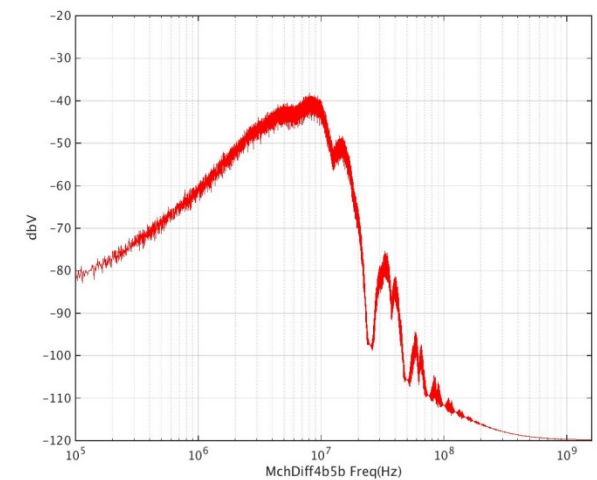
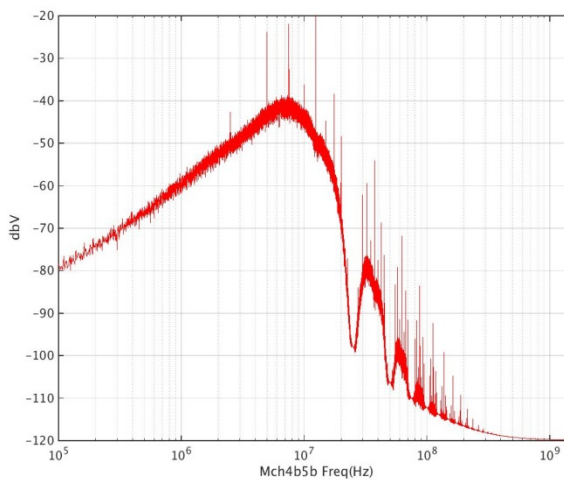
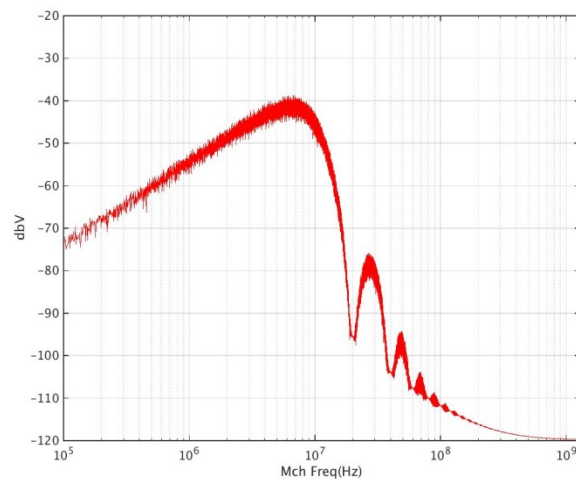
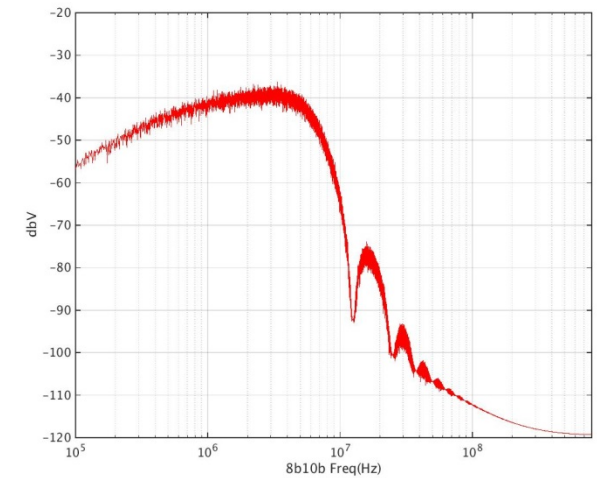
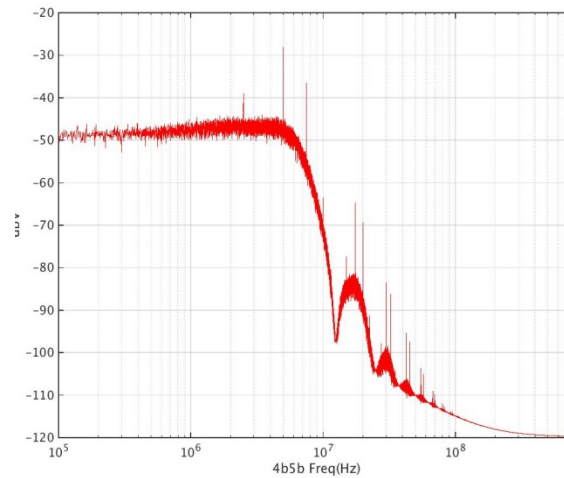
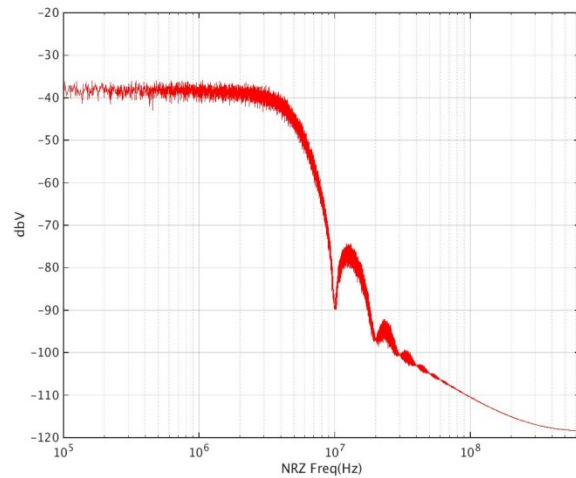


Eyes with 3rd order IIR LP filter (3 dB Baud rate LP corners)



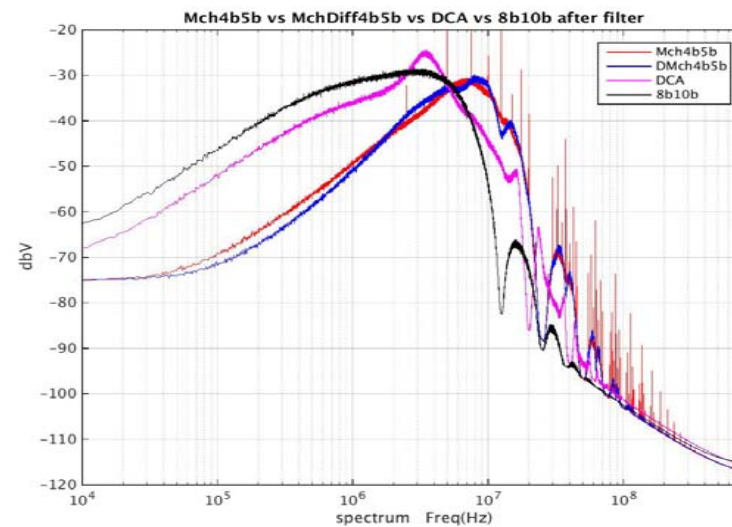
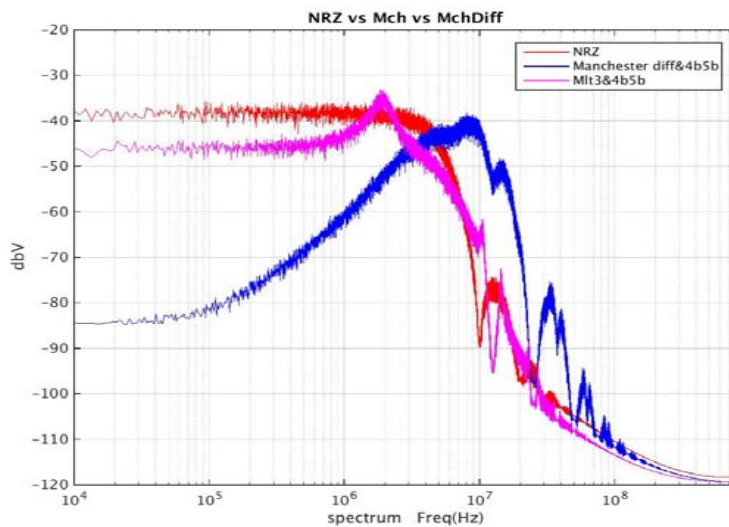
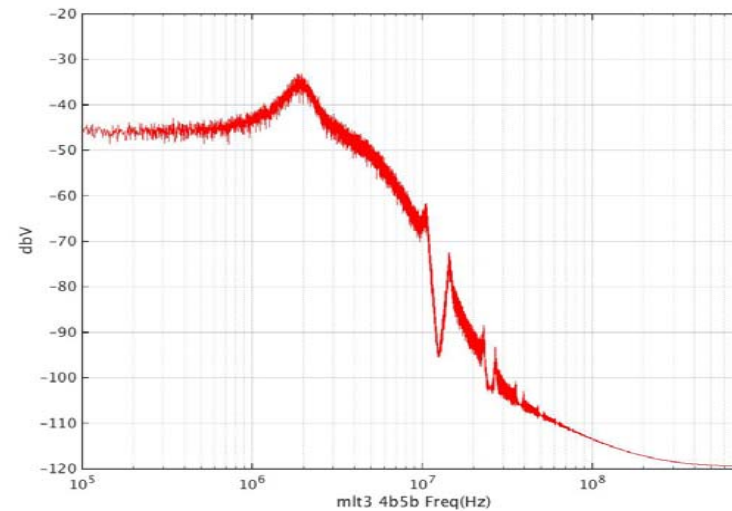
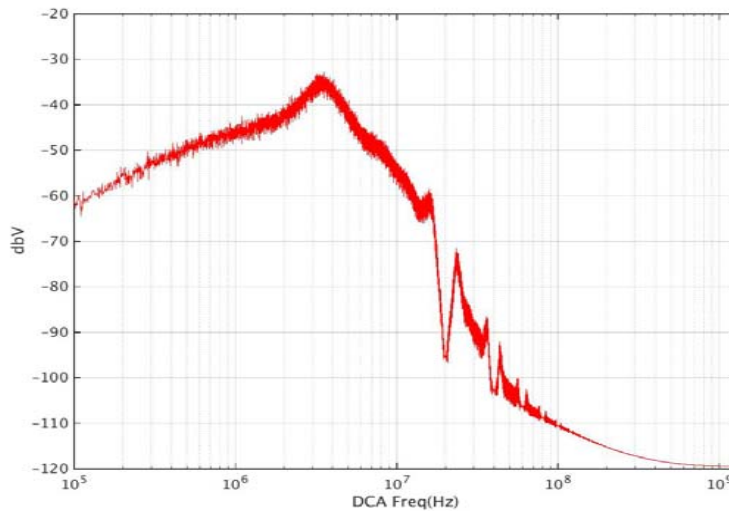


Spectrum with 3rd order IIR LP filter (3 dB Baud rate LP corners)



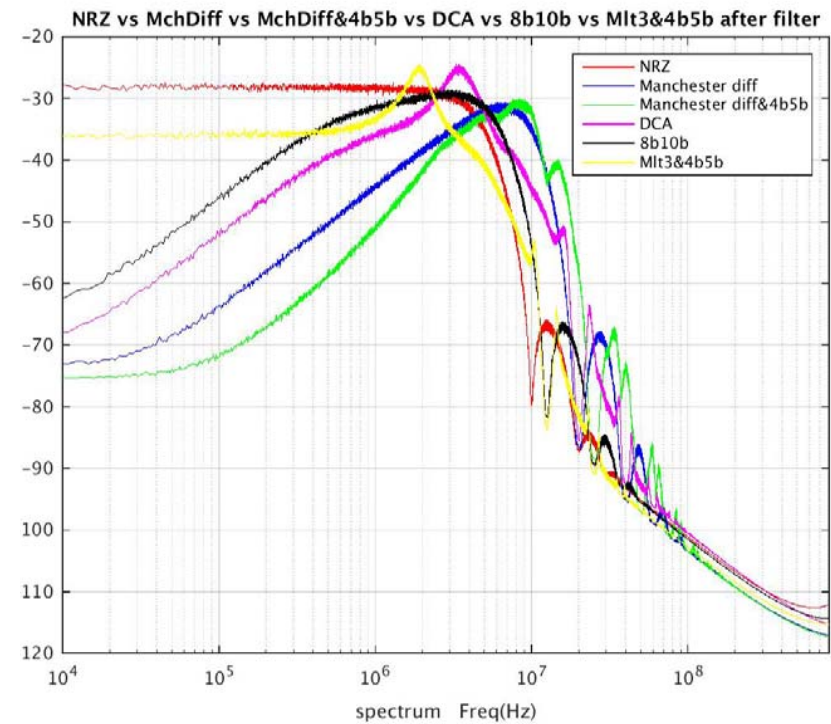
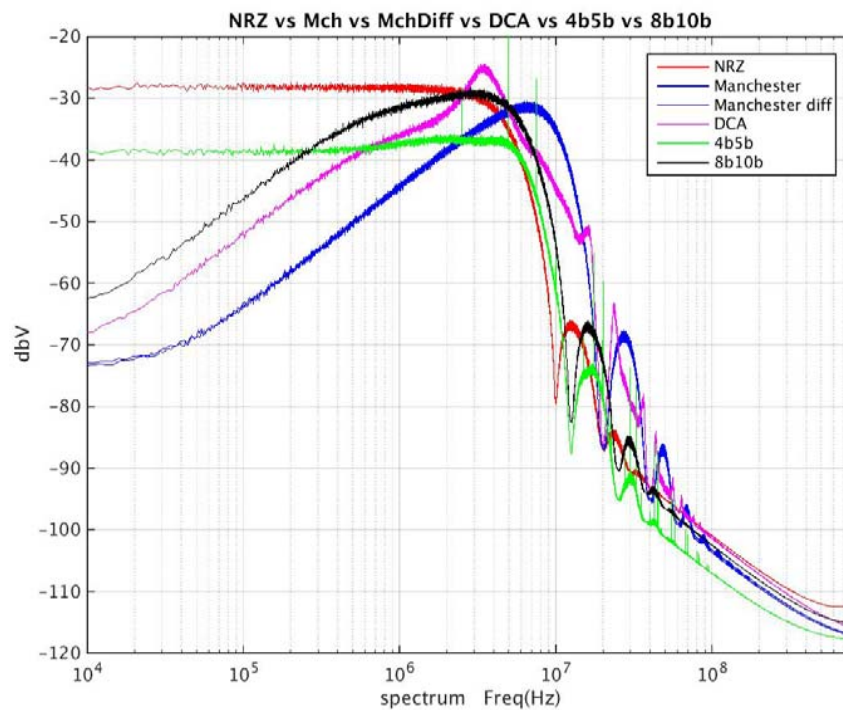


Spectrum with 3rd order IIR LP filter (3 dB Baud rate LP corners)

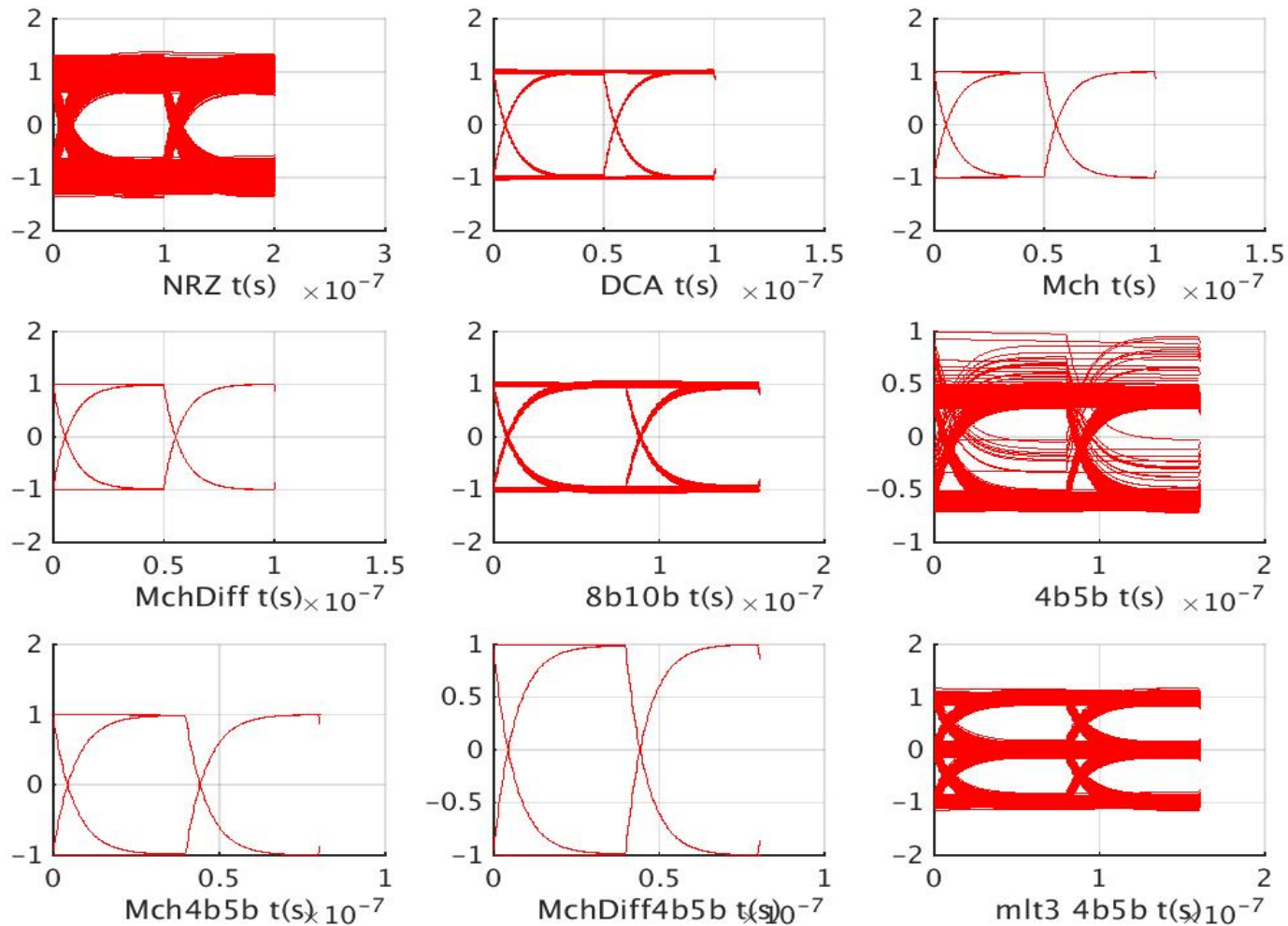




Spectrum with 3rd order IIR LP filter (3 dB Baud rate LP corners)

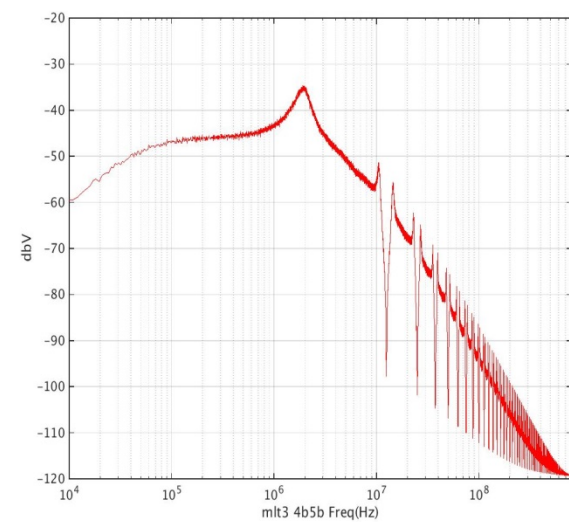
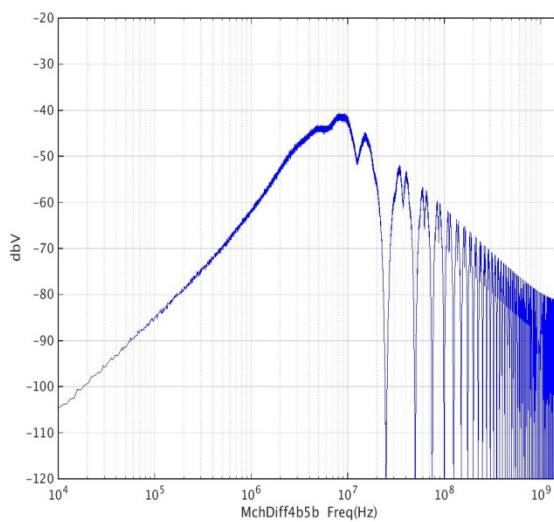
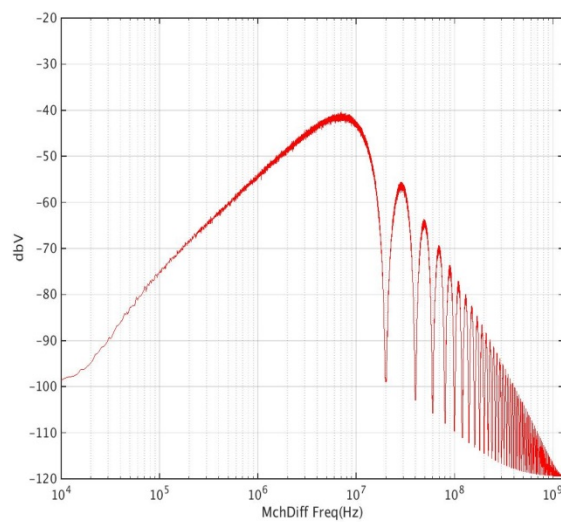
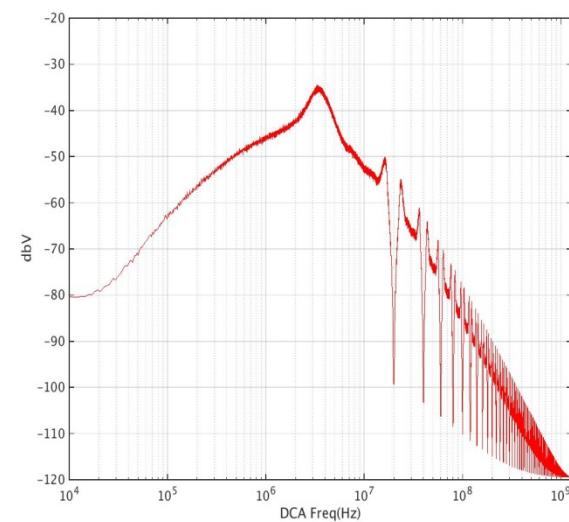
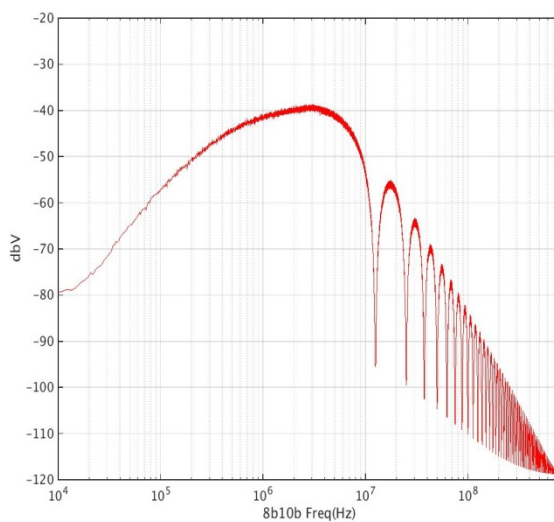
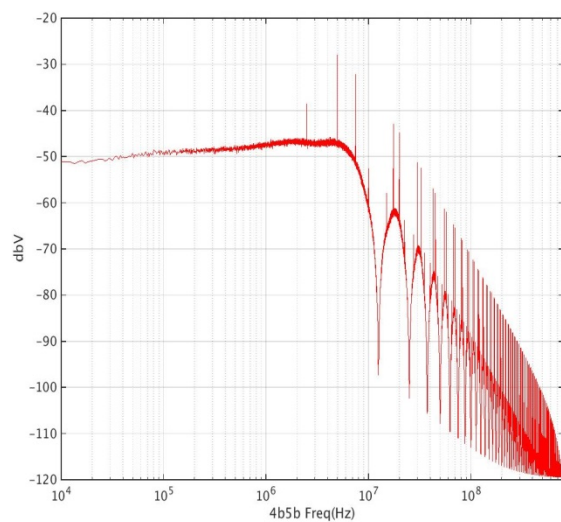


Eyes with 1st order LP/HP filter (3 dB 100kHz HP & Baud rate LP corners)



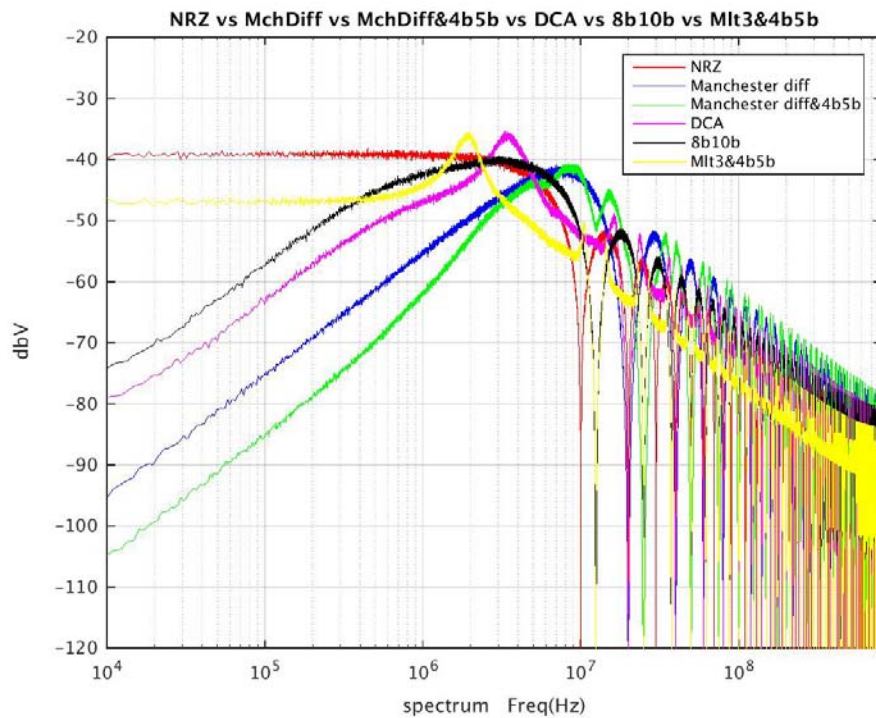


Eyes with 1st order LP/HP filter (3 dB 100k HP & Baud rate LP corners)

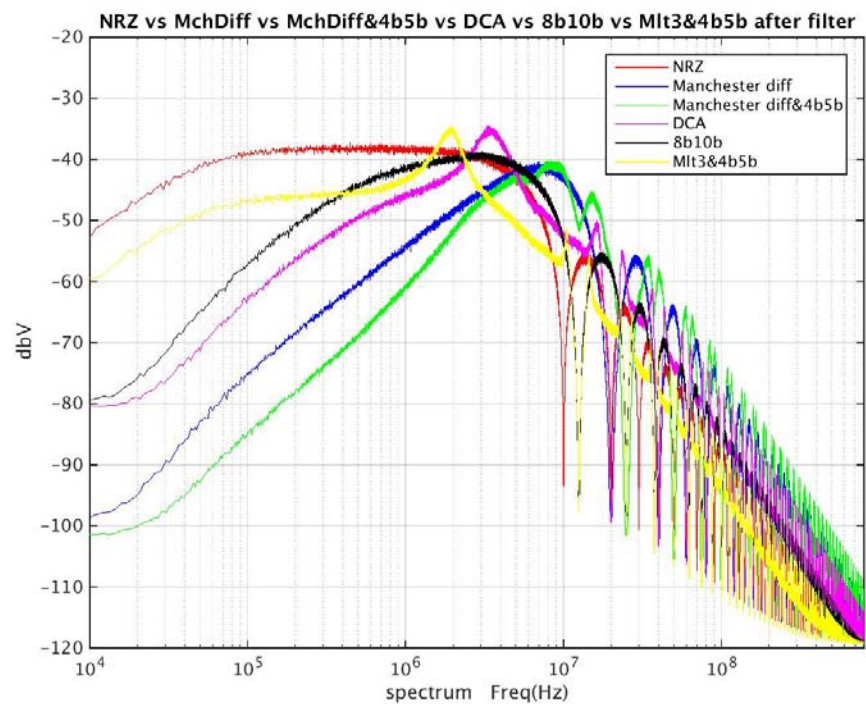




Spectrum with 1st order LP/HP filter (3 dB 100k HP & Baud rate LP corners)



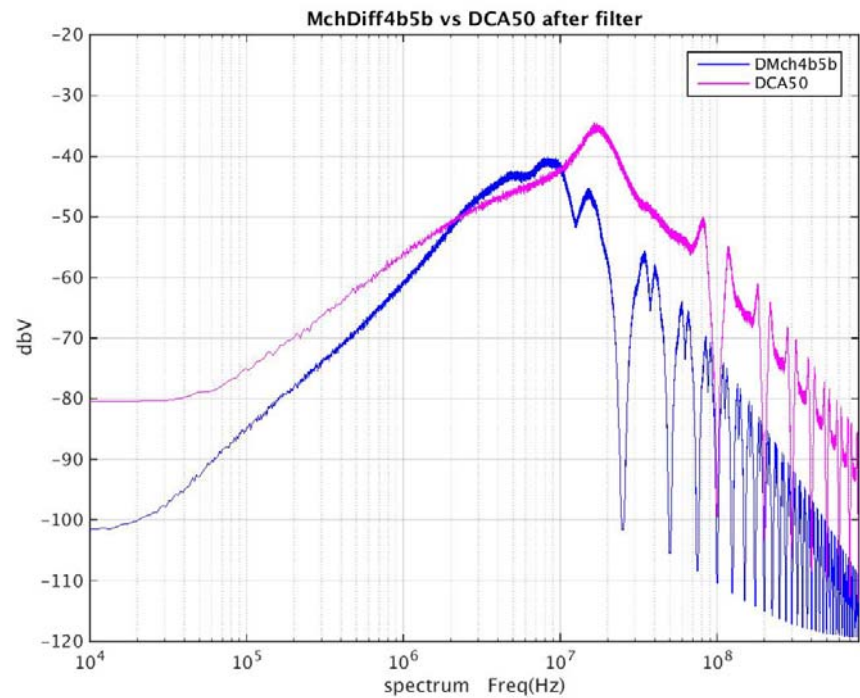
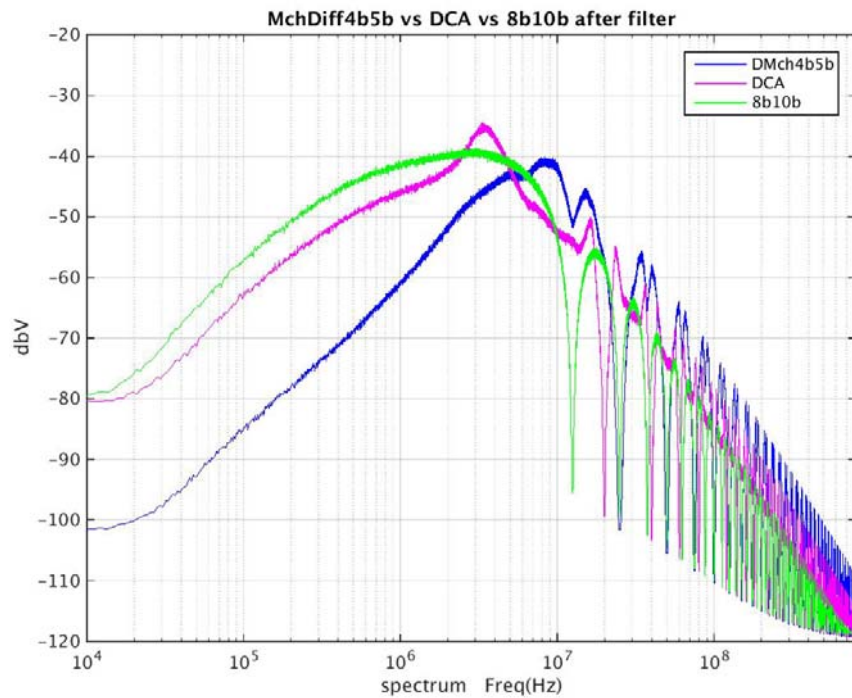
With filter



Without filter



Spectrum with 1st order LP/HP filter (3 dB 100k HP & Baud rate LP corners)



10SPE Encoding – Multi-drop

- Recommend Manchester or differential Manchester encoding
 - better for multi-drop link
 - self-clocking
 - Rapid CDR locking
 - easy implementation
 - Low latency
 - DME can be combined with 4b5b for control bits
 - EMI performance promising
 - Bi-level encoding makes EMC more robust