Jitter Distributions for 86 & 86A Comments 872, 873, 886 & 793

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Presentation Overview

Comments 873 & 886

Split Binominal Distribution Introduction

TP3 Jitter Discussion

TP4 Jitter Discussion

Comment 872 & Discussion

Comment 793 & Discussion

Post comment notes:

- After submitting comment 872 to change Y2 from 0.33 to 0.35, it was found that 0.36 would be a better choice.
- After a series of meetings to reach consensus, a proposal to change TP1 J2 from 0.18 UI to 0.17 UI and J9 from 0.26 UI to 0.29 UI was brought forward with an associated set of changes to TP4 that were also proposed in comment 886. The proposal was intended to support LR4 in XLPPI and also to provide relief to the host at TP1. The proposed change in TP1 J9 can be supported without a change in clause 86 optical requirements. The change in TP1 J2 is not required for SR devices, may not be required for LR devices and, as it presents an unneeded burden on the host at TP1, keeping TP1 J2 at 0.18 UI is recommended.

Comments 873 & 886

Comment 873: In Table 86-8 the values of J2 and J9 have been found difficult to simultaneously meet as called for in 86.8.4.7. This appears due to the lengthy DDJ distribution tails that occurs with a PRBS31 or similarly long-run-length, richly-structured test patterns after passing through a VCSEL and inducing VECP. In these cases a significant portion of the peak-to-peak DDJ in the signal is not included in J2 but is included in J9. This was not fully appreciated when the existing J2 and J9 values were proposed for the SRS condition. The J2 and J9 values for the SRS test should be changed to reflect actual operating conditions as well as being more readily implemented. The existing J2 and J9 values are based on a dual-Dirac - Gaussian combination where peak-to-peak DJ equals dual-Dirac DJ of 0.274 UI, RJ(@1E-12) = 0.229 UI and TJ(@1E-12) = 0.498 UI. The proposed new values are based on an approximate binominal - Gaussian combination where peak-to-peak DJ ~ 0.330 UI, RJ(@1E-12) ~ 0.225 UI and TJ(@1E-12) ~ 0.502 UI.

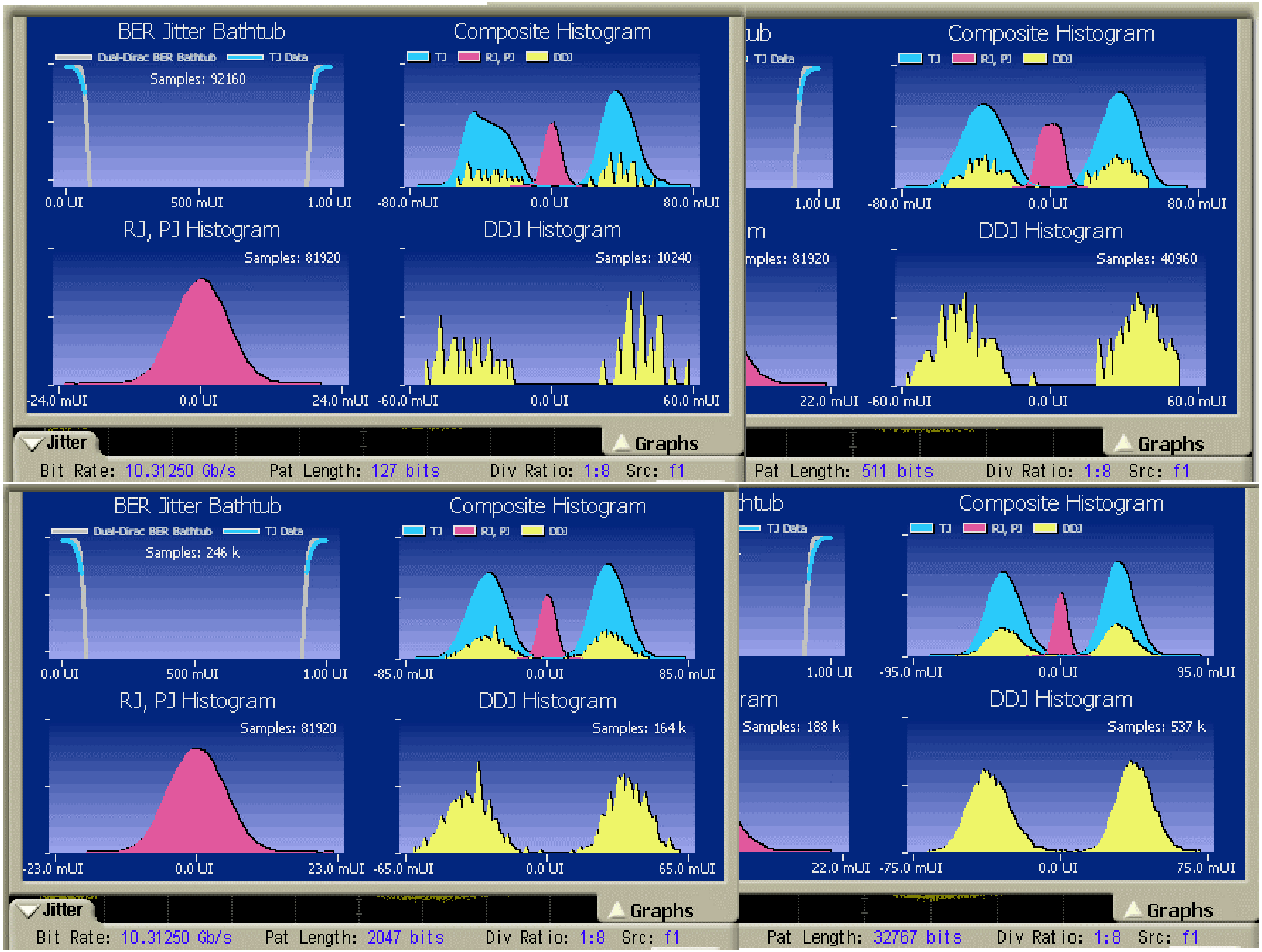
Proposal: In Table 86-8, change the value of J2 from 0.35 to 0.3.

Comment 886: The values of J2 and J9 are not well-aligned with the currently proposed TP4 output TJ(BER=1E-12) = 0.70 UI target. It also appears that lengthy DDJ distribution tails occur with a PRBS31 or similarly long-run-length, richly-structured test patterns after passing through a VCSEL and inducing VECP. In these cases a significant portion of the peak-to-peak DDJ in the signal is not included in J2 but is included in J9. This was not fully appreciated when the existing J2 and J9 values were proposed for TP4. Further, there's interest in adjusting nPPI requirements to accommodate 40GBASE-LR4 in small footprint form factors. The J2 and J9 values for TP4 should be changed to reflect expected jitter distributions and reasonably accommodate LR4. The existing J2 and J9 values are based on a dual-Dirac - Gaussian combination where peak-to-peak DJ equals dual-Dirac DJ of 0.328 UI, RJ(@1E-12) = 0.332 UI and TJ(@1E-12) = 0.661 UI. The proposed new values are based on an approximate binominal - Gaussian combination where peak-to-peak DJ ~ 0.362 UI, RJ(@1E-12) ~ 0.332 UI and TJ(@1E-12) ~ 0.694 UI. This also applies to J2 and J9 jitter tolerance requirements in Table 86A-4.

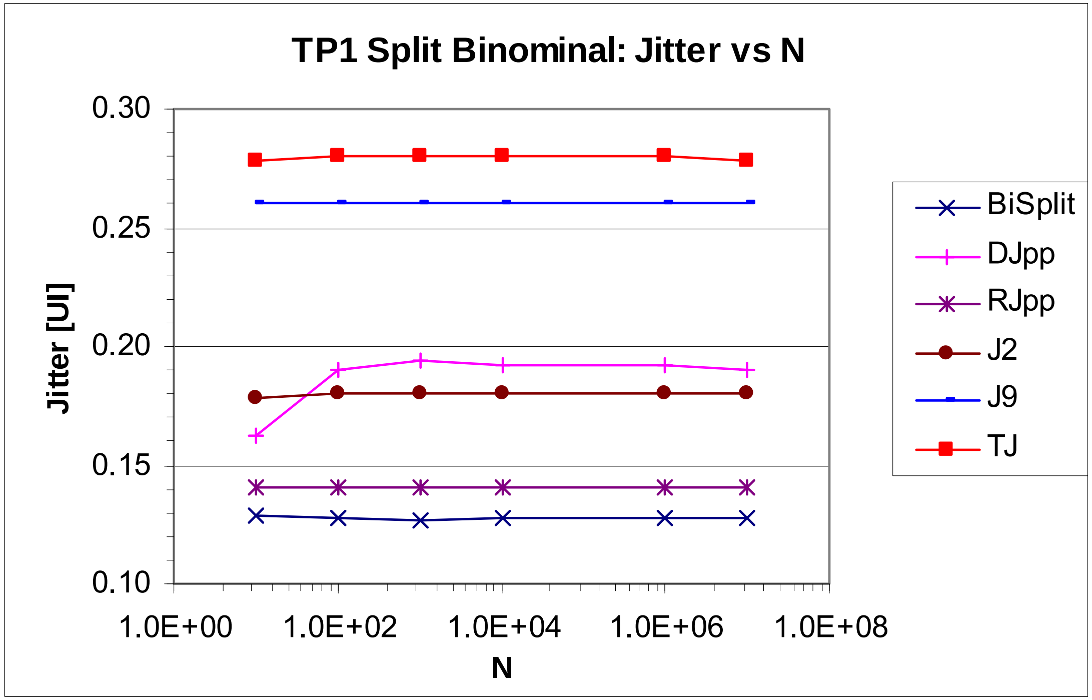
Proposal: In Tables 86A-3 and 86A-4 change J2 from 0.46 to 0.42 and J9 from 0.62 to 0.65.

TP1 Jitter Distribution Analysis: DDJ vs Pattern Length

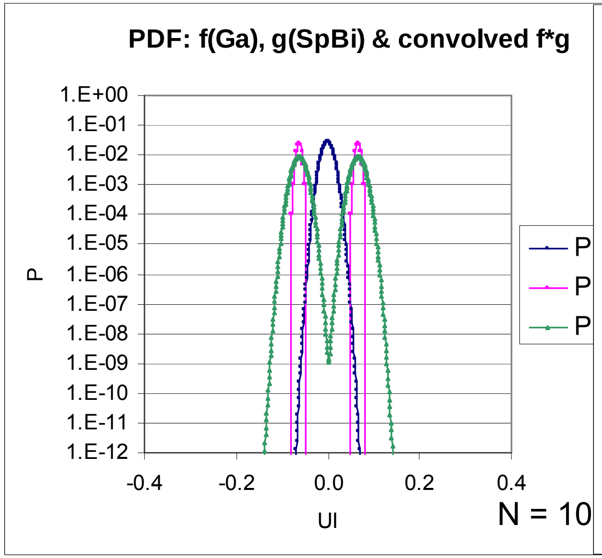
Screen shots of jitter distributions at TP1 where the only difference was the test pattern and associated pattern length. Patterns included PRBS7, PRBS9, PRBS11 and PRBS15. The channel and signal characteristics were chosen to emphasize a bimodal DDJ distribution and may not represent expected practice.

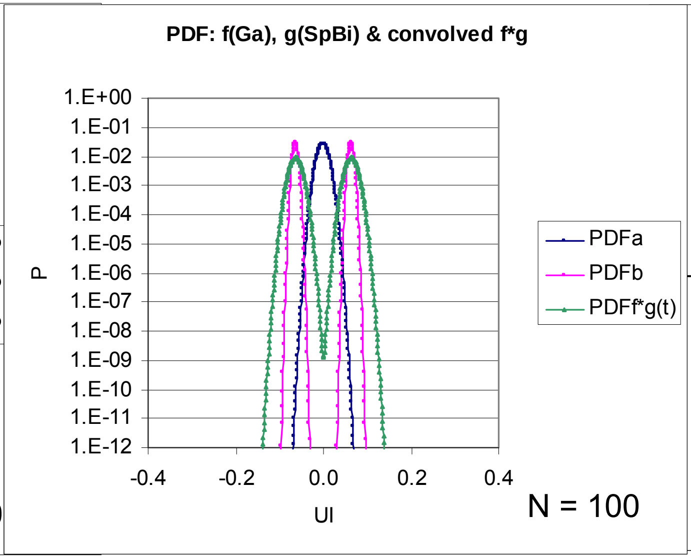


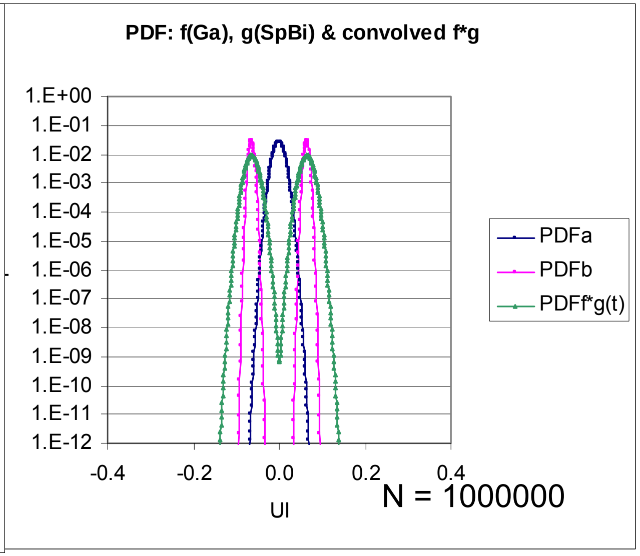
TP1 Jitter Distribution Analysis: Trial Size (N)



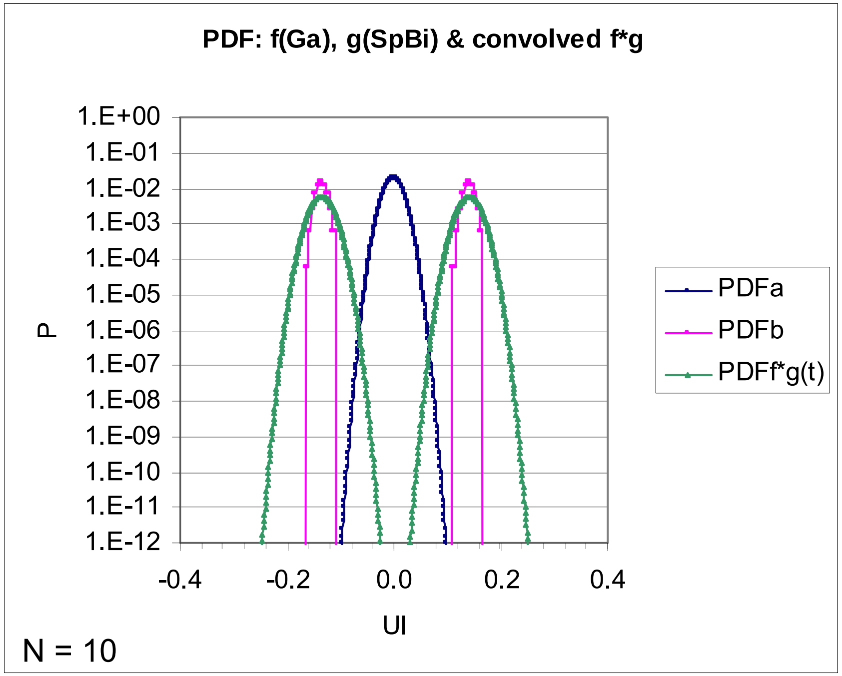
Split binominal jitter metrics are shown as a function of N, the number of independent trails for split binominal distributions. Here RJpp was fixed at 0.141 UI, and the split binominal was adjusted to yield J2 = 0.18 UI and J9 = 0.26 UI. Little difference is seen for N > 100. Each edge in the test pattern may be considered a trial. While N ≤ 10 may be appropriate for TP1 and short test patterns, N ≥1000 is recommended for TP2, TP3 and TP4 and longer test patterns.







TP3 Jitter Distributions: Existing Stressed Eye Conditions



N = 10

BiSplit = 0.276 UI

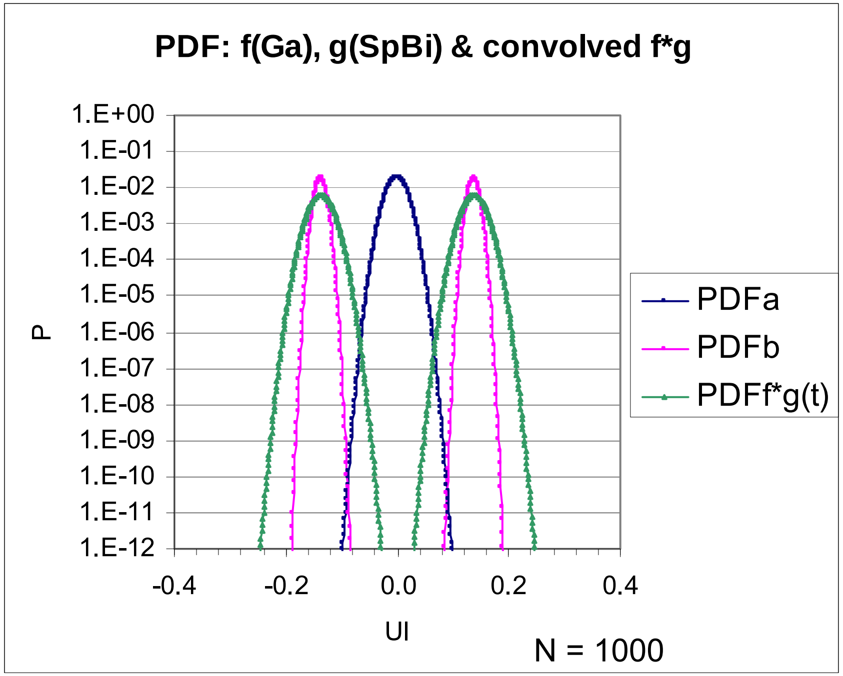
DDJpp = 0.334 UI

RJpp = 0.20 UI

J2 = 0.35 UI

J9 = 0.47 UI

TJ = 0.498 UI



N = 1000

BiSplit = 0.275 UI

DDJpp = 0.380 UI

RJpp = 0.20 UI

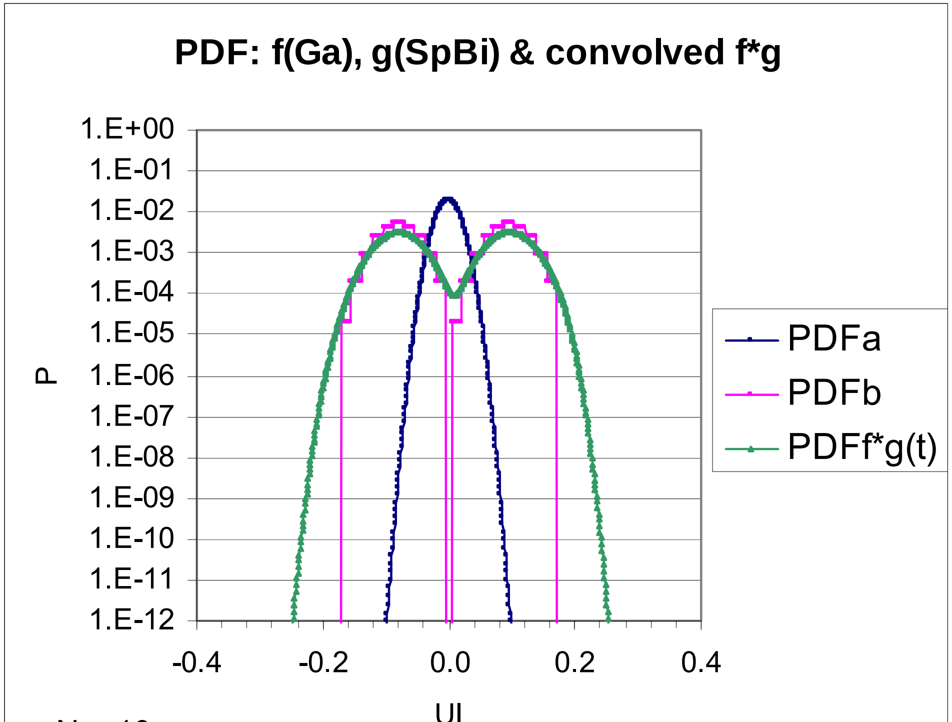
J2 = 0.35 UI

J9 = 0.47 UI

TJ = 0.496 UI

For SR4 and SR10 receivers, receiver tolerance calls for a stressed eye where J2 = 0.35 UI and J9 = 0.47 UI simultaneously. As can be seen in the above charts, this requirement when modeled using split binominal DDJ and Gaussian RJ appears extreme and may actually be very difficult to generate.

TP3 Jitter Distribution: Proposed Stressed Eye Conditions



N = 10

BiSplit = 0.176 UI

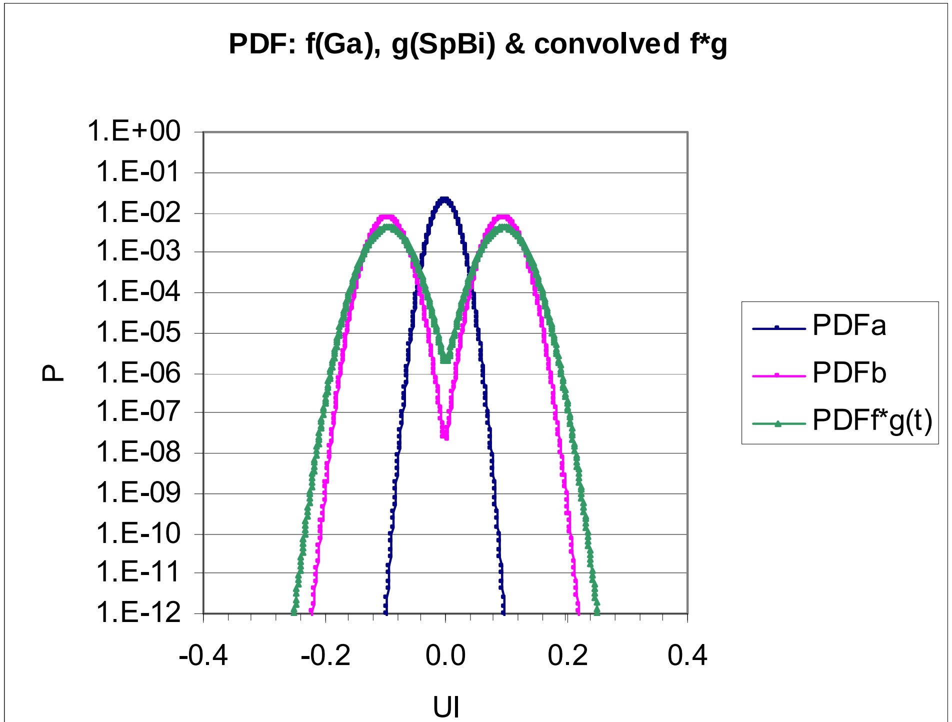
DDJpp = 0.346 UI

RJpp = 0.20 UI

J2 = 0.30 UI

J9 = 0.47 UI

TJ = 0.500 UI



N = 1000

BiSplit = 0.191 UI

DDJpp = 0.440 UI

RJpp = 0.20 UI

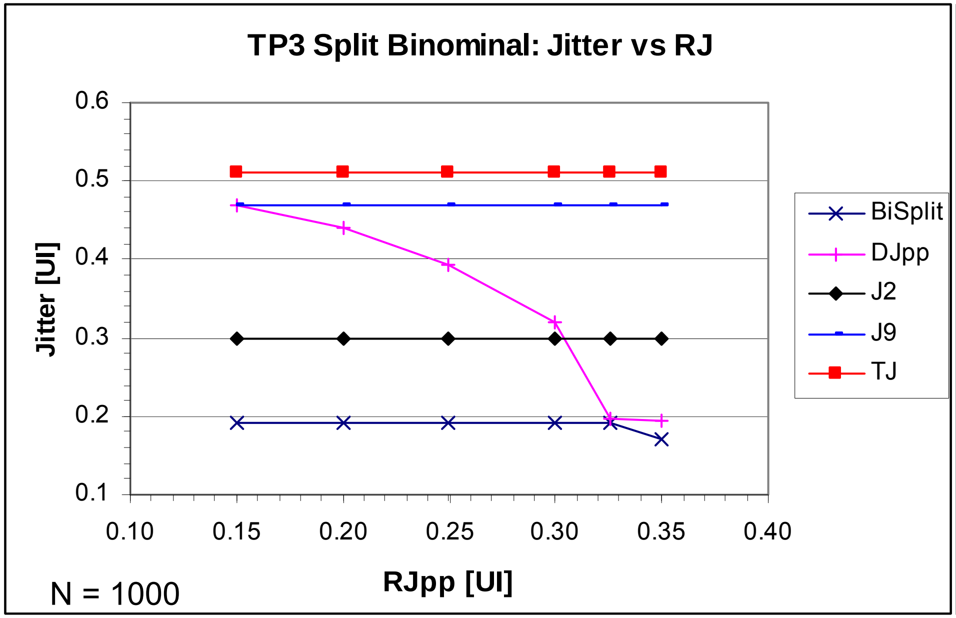
J2 = 0.30 UI

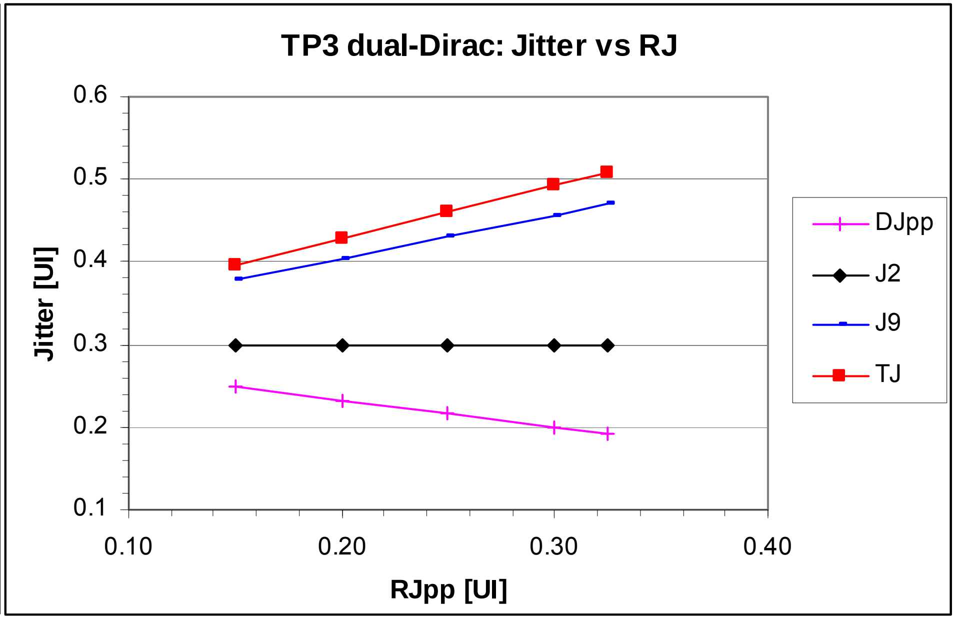
J9 = 0.47 UI

TJ = 0.51 UI

In the above charts, J2 was reduced to 0.30 UI from 0.35 UI. The resulting distribution appears less extreme and more likely to occur in practice.

TP3 Jitter Distributions: Split Binominal & dual-Dirac





J2 ≤ 0.30 UI

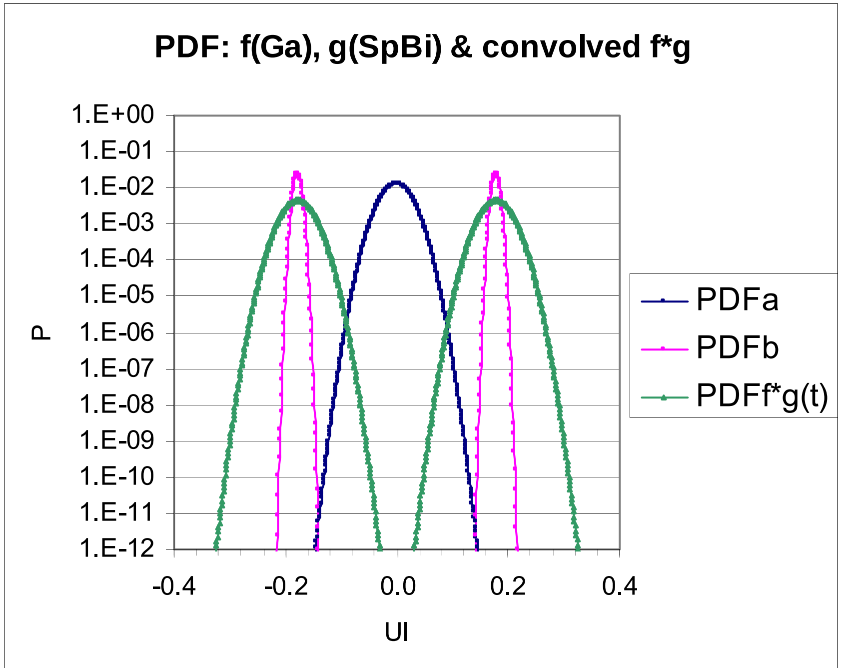
J9 ≤ 0.47 UI

J2 ≤ 0.30 UI

J9 ≤ 0.47 UI

- The above charts show tradeoffs at TP3 between RJ and the other jitter metrics for a split binominal and dual-Dirac probability distribution functions. While a dual-Dirac, Gaussian combination can only satisfy a particular J2, J9 combination, e.g. J2 = 0.30 UI and J9 = 0.47 UI, for a single RJ, dDJ combination, a split binominal, Gaussian combination can do so over a range of RJ and DDJ.
- It should be noted that these are only two idealized distributions of a great many possible distributions. It seems reasonable to expect that the dual-Dirac distribution represents one extreme. A split binominal distribution may be useful where DDJ distributions are bimodal.
- The proposed split between J2 and J9 appears reasonable in that it can be described by two relatively different jitter distributions and the split binominal distribution used to describe DDJ does not appear extreme.

TP4 Jitter Distribution Analysis



N = 1000

BiSplit = 0.356 UI

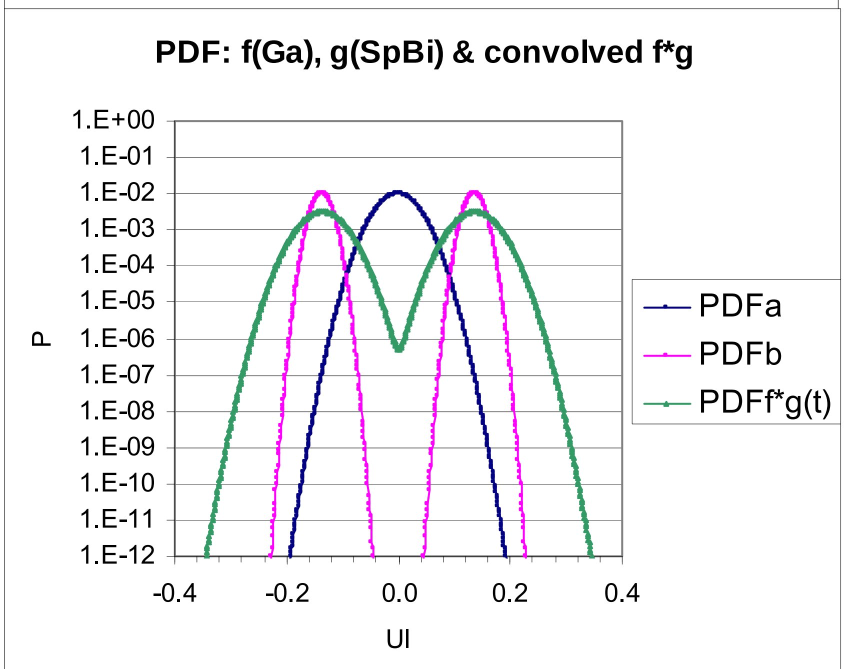
DDJpp = 0.432 UI

RJpp = 0.30 UI

J2 = 0.46 UI

J9 = 0.62 UI

TJ = 0.658 UI



N = 1000

BiSplit = 0.273 UI

DDJpp = 0.456 UI

RJpp = 0.40 UI

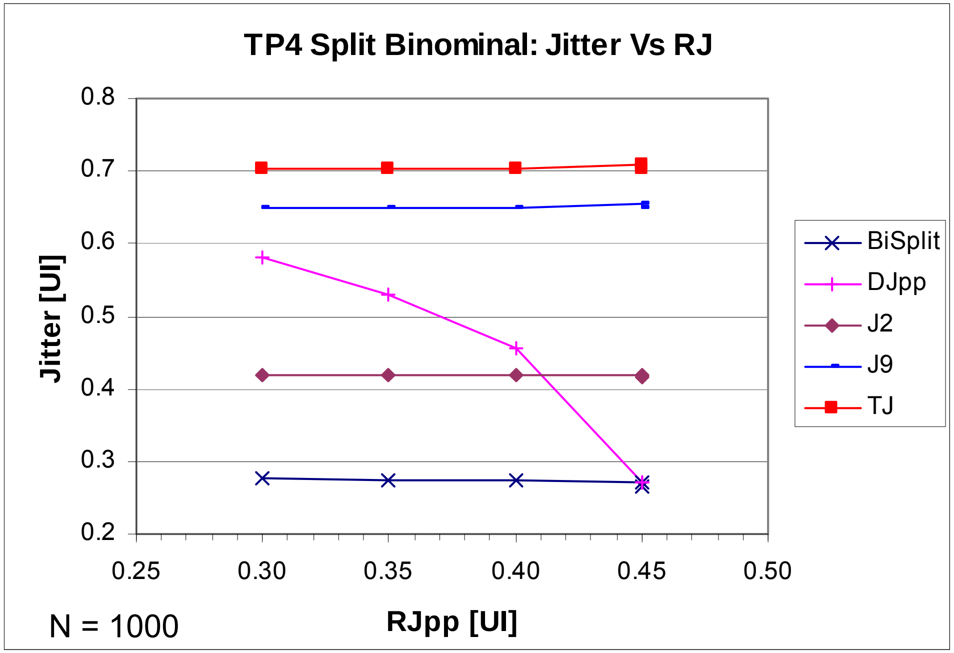
J2 = 0.42 UI

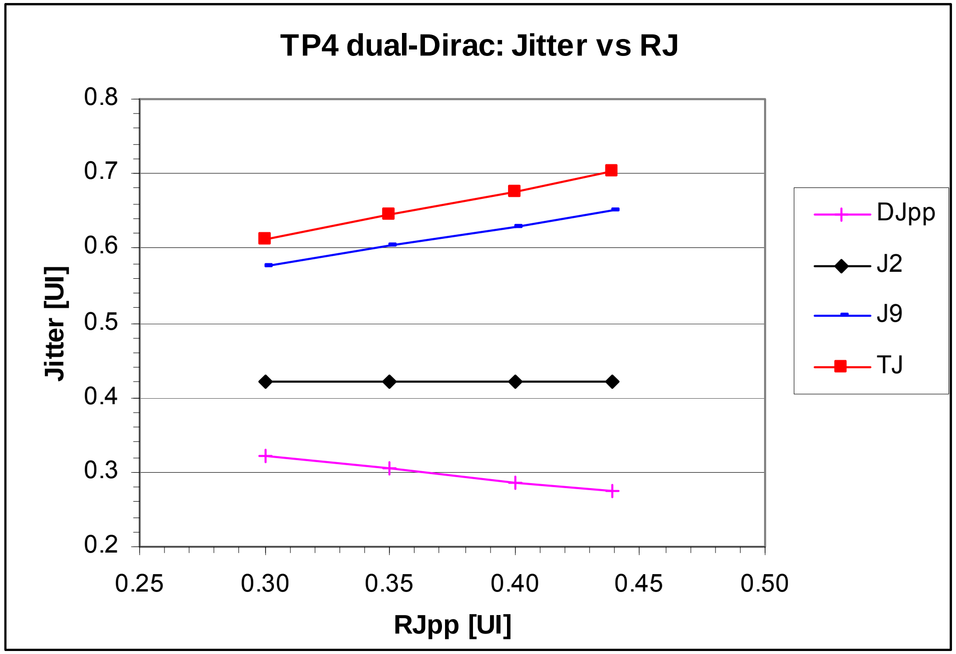
J9 = 0.65 UI

TJ = 0.704 UI

- For SR4 and SR10 receivers at TP4 the existing values for J2 (0.46 UI) and J9 (0.62 UI) are aligned with a TJ of 0.66 UI instead of the current 0.7 UI target.
- As can be seen in the upper chart, a distribution yielding J2 = 0.46 UI and J9 = 0.62 UI when modeled using split binominal DDJ and Gaussian RJ appears extreme and unlikely to occur in practice.
- The lower chart using the proposed values for J2 and J9 from comment 886 is less extreme and should more closely represent worst case distributions found in practice.

TP4 Jitter Distribution Analysis





J2 ≤ 0.42 UI

J9 ≤ 0.65 UI

J2 ≤ 0.42 UI

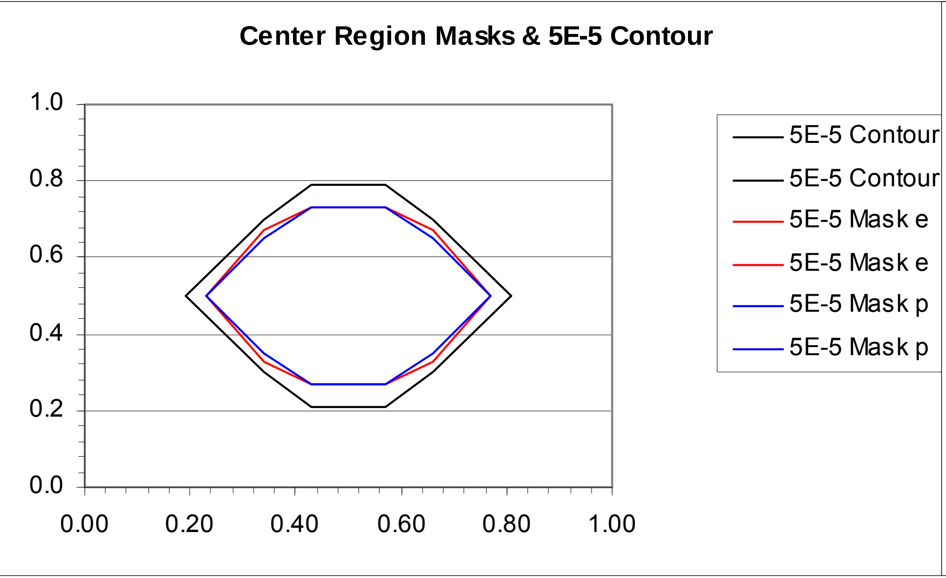
J9 ≤ 0.65 UI

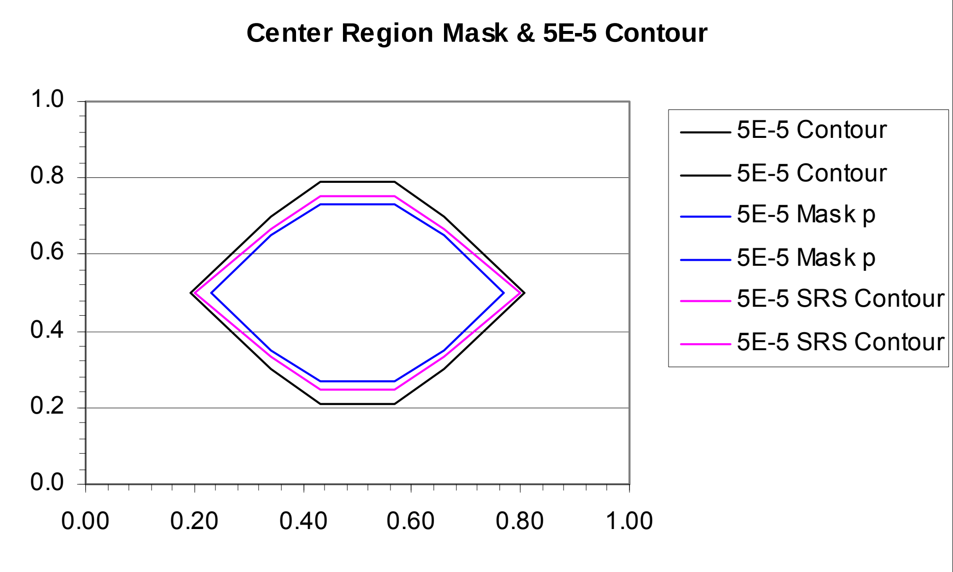
- The above charts show tradeoffs at TP4 between RJ and the other jitter metrics for a split binominal and dual-Dirac probability distribution functions.
- The proposed split between J2 and J9 appears reasonable in that it can be described by two relatively different jitter distributions and the split binominal distribution used to describe DDJ does not appear too extreme.

Comment 872

Comment 872: In Table 86-6, the existing Y2 coordinate yields a mask that is not well matched with currently expected worst case Tx output contours.

Proposal: In Table 86-6 change the Y2 coordinate from 0.33 to 0.35 (0.36 would be a better choice by further reducing the shoulder at X2, Y2).





All of the contours (5E-5 BER) and masks (5E-5 Hit Ratio) in the above charts are shown as observed with the Ref Rx defined in Clause 86.

The chart on the left shows the proposed (p) Tx Mask compared with the existing (e) mask and expected 5E-5 BER contour for the baseline worst case Tx. It may be apparent that the shoulder at the X2, Y2 coordinate presents a point more stressful than the rest of the mask. Since the TDP spec is defined to limit jitter at TP2, it is appropriate for the Tx eye mask to be inside the expected worst case 5E-5 BER contour; the eye mask is to control aberrant signal characteristics such as overshoot and ringing and not add additional burden.

The chart on the right compares the proposed (p) Tx Mask with the same 5E-5 BER contour and with the expected 5E-5 contour from the stressed eye. Here the alignment, while not perfect, appears reasonable.

Comment 793

Comment 793: To make a future 40GBASE-LR4 module with an unretimed interface feasible, the J2 and J9 limits of the XLPPI interface are proposed to be slightly changed.
A related comment proposes to modify the optical power levels of 40GBASE-LR4.

See king_01_0110.pdf

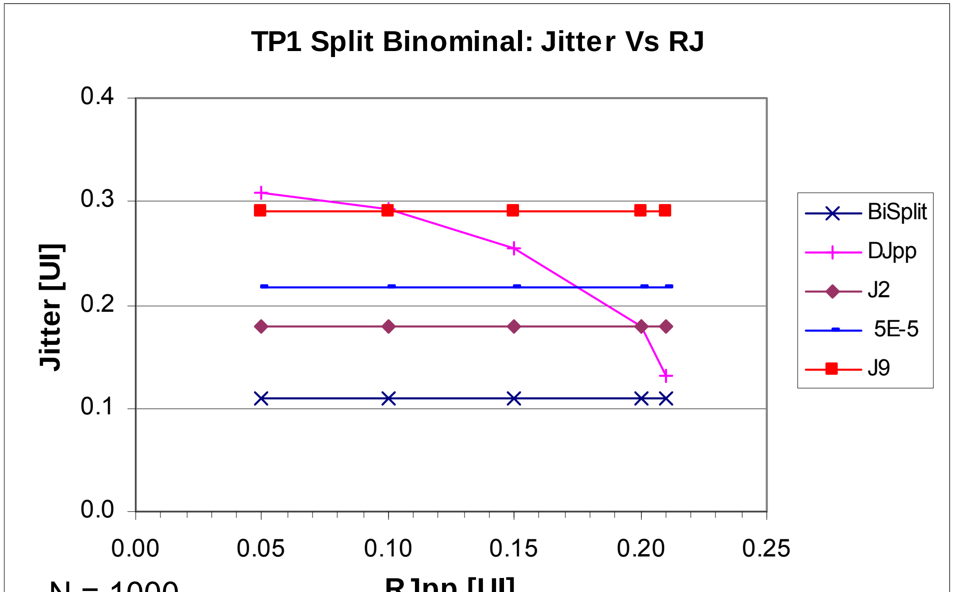
Proposal: In Table 86A-1 change "J2 Jitter output" to "J2 Jitter output for 100GBASE-R" and add a new row above for "J2 Jitter output for 40GBASE-R" with a value of 0.17 UI Max. In Table 86A-2 change "J2 Jitter tolerance" to "J2 Jitter tolerance for 100GBASE-R" and add a new row for "J2 Jitter tolerance for 40GBASE-R" at "TP1a" with a value of 0.17 UI Max.

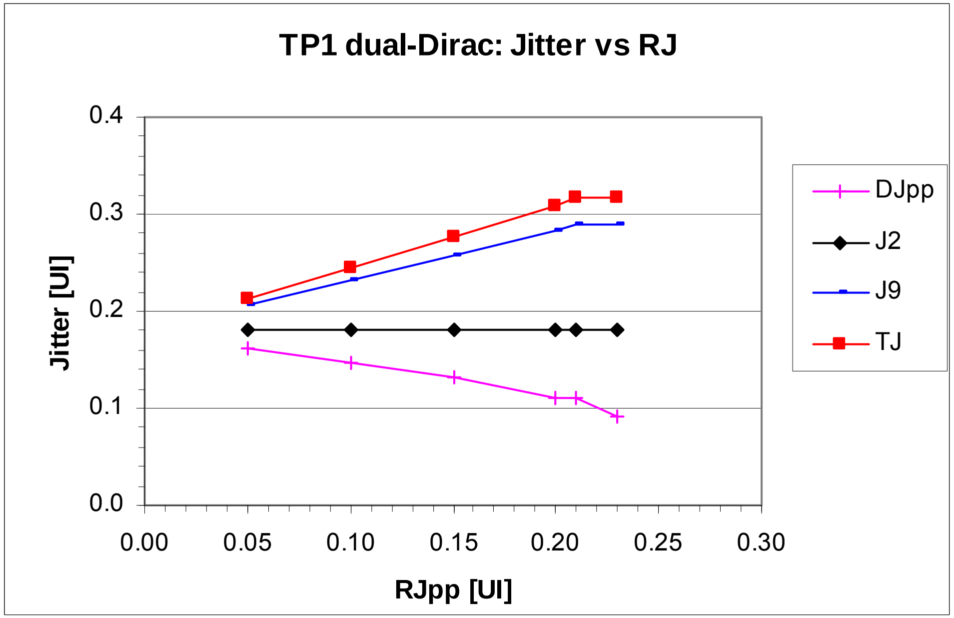
In Table 86A-3 change "J9 Jitter output" to "J9 Jitter output for 100GBASE-R" and add a new row above for "J9 Jitter output for 40GBASE-R" with a value of 0.64 UI Max. In Table 86A-4 change "J9 Jitter tolerance" to "J9 Jitter tolerance for 100GBASE-R" and add a new row above for "J9 Jitter tolerance for 40GBASE-R" at "TP4" with a value of 0.64 UI Max.

See king_01_0110 for further details.

Note, there is a related comment to increase the optical power levels of 40GBASE-LR4

TP1 Jitter Distribution Analysis





J2 ≤ 0.18 UI

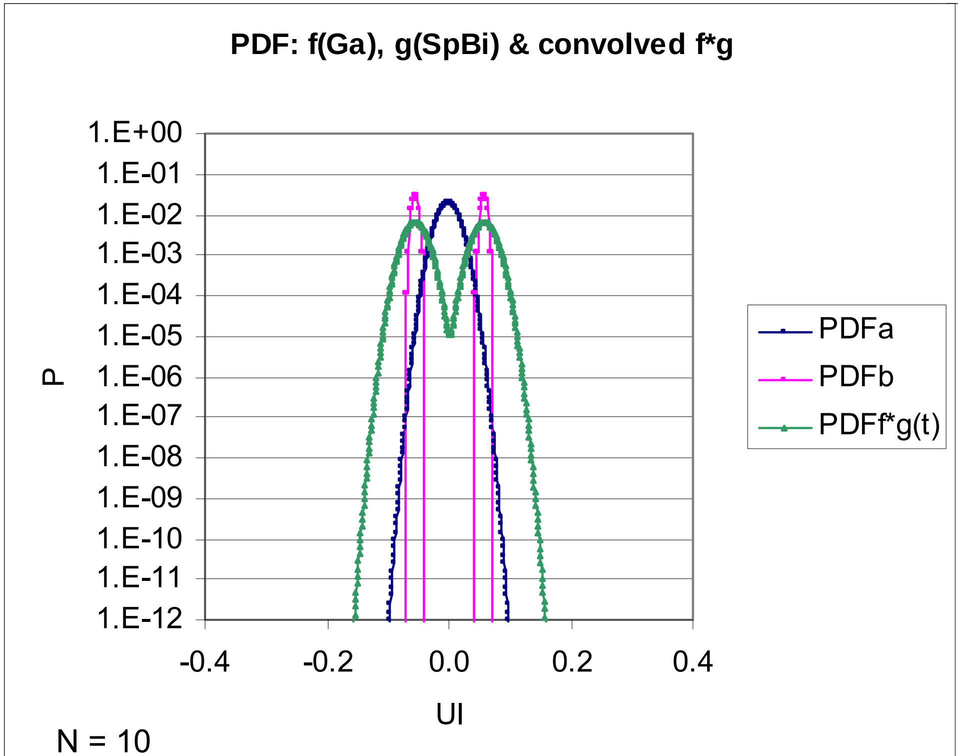
J9 ≤ 0.29 UI

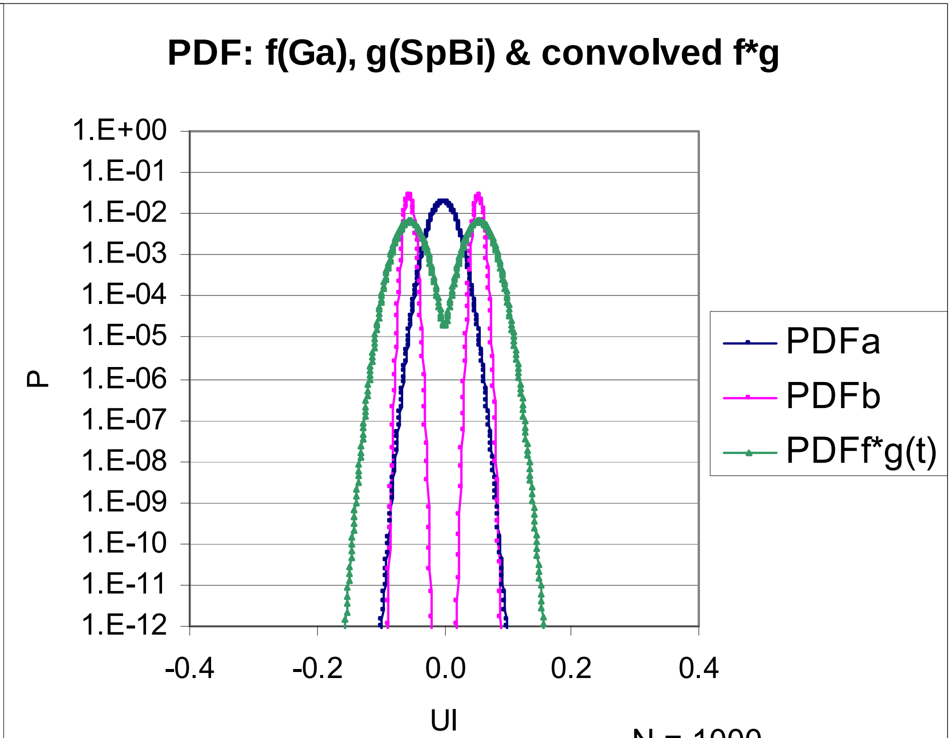
J2 ≤ 0.18 UI

J9 ≤ 0.29 UI

- The above charts show tradeoffs at TP1 between RJ and the other jitter metrics for a split binominal and dual-Dirac probability distribution functions.
- The proposed split between J2 and J9 appears reasonable in that it can be described by two relatively different jitter distributions and the split binominal distribution used to describe DDJ does not appear too extreme.

TP1 Jitter Distribution Analysis





N = 10

BiSplit = 0.112 UI

DDJpp = 0.144 UI

RJpp = 0.20 UI

J2 = 0.18 UI

J9 = 0.29 UI

TJ = 0.316 UI

The above charts represent an increase in TP1 J9 from 0.26 UI to 0.29 UI. The bimodal distribution may be associated with either significant under-emphasis or significant over-emphasis.

N = 1000

BiSplit = 0.109 UI

DDJpp = 0.180 UI

RJpp = 0.20 UI

J2 = 0.18 UI

J9 = 0.29 UI

TJ = 0.316 UI

nPPI Proposals to accommodate LR4 & host relief

	D3.0	793	886	C	886a
Table 86A-1					
TP1a J2 host jitter output for XLPPI, Max, UI	0.18	0.17	0.18	0.17	0.18
TP1a J2 host jitter output for CPPI, Max, UI	0.18	0.18	0.18	0.17	0.18
TP1a J9 host jitter output for nLPPI, Max, UI	0.26	0.26	0.26	0.29	0.29
Table 86A-2					
TP1 J2 module jitter input for XLPPI, Min, UI	0.18	0.17	0.18	0.17	0.18
TP1 J2 module jitter input for CPPI, Min, UI	0.18	0.18	0.18	0.17	0.18
TP1 J9 module jitter for input nLPPI, Min, UI	0.26	0.26	0.26	0.29	0.29
Table 86A-3					
TP4 J2 module jitter output for nLPPI, Max, UI	0.46	0.46	0.42	0.42	0.42
TP4 J9 module jitter output for XLPPI, Max, UI	0.62	0.64	0.65	0.65	0.65
TP4 J9 module jitter output for CPPI, Max, UI	0.62	0.62	0.65	0.65	0.65
Table 86A-4					
TP4a J2 host jitter input for nLPPI, Min, UI	0.46	0.46	0.42	0.42	0.42
TP4a J9 host jitter input for XLPPI, Min, UI	0.62	0.64	0.65	0.65	0.65
TP4a J9 host jitter for input CPPI, Min, UI	0.62	0.62	0.65	0.65	0.65

•A change in TP1 J9 from 0.26 UI to 0.29 UI can be supported without a change in clause 86 optical requirements. The change in TP1 J2 is not required for SR devices and presents an unneeded burden on the host at TP1. Since LR4 only request 0.03UI relief from XLPPI which is provided by the proposed change in TP4 J9, keeping TP1 J2 at 0.18 UI is recommended.