

J3u Measurement for CL162

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Introduction

- J3u measurements at TP2 are highly dependent on effects of slew rate and noise and do not reflect actual uncorrelated jitter.
- Current J3u limit is marginal even for test equipment.
- Similar issue was reported in calvin_3ck_adhoc_01_092221 for longer test channels. We observe the J3u marginality for a combination of COM package with recommended TP0-TP2 PCB loss.
- Relates to comments 156 and 171 against D3.0.

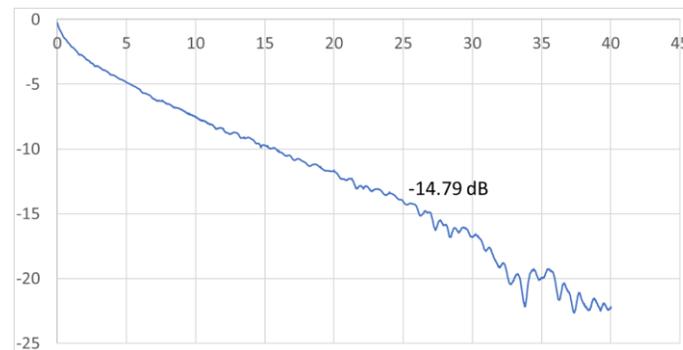
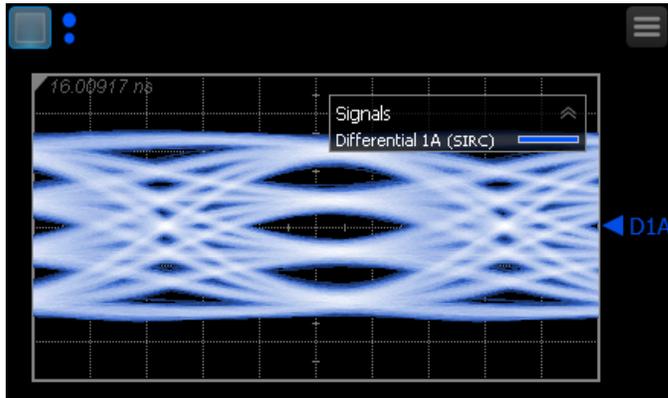
Test setup 1



Signal amplitude: 800 mV
J3u: 71.5 mUI
Jrms: 11.1 mUI

PCB trace + OSFP connector + HCB

Total IL – 14.8dB @26.56 GHz
(3.9 dB for COM package +
10.975 dB for recommended loss
between TP0 and TP2)



Test setup 2



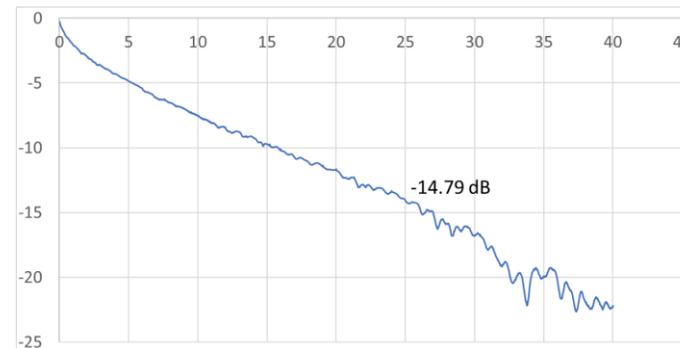
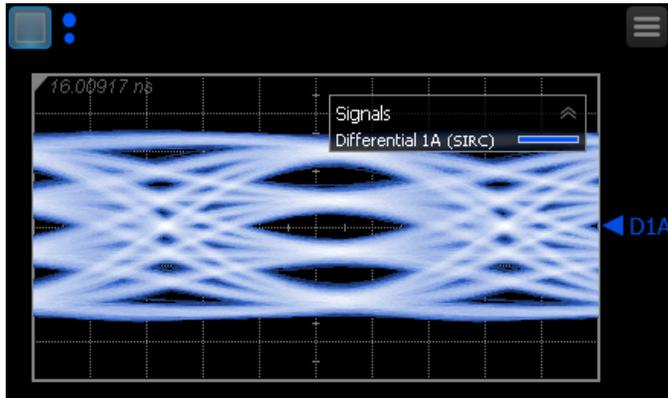
Signal amplitude: 800 mV
J3u: 71.5 mUI
Jrms: 11.1 mUI



J3u: 75 mUI
Jrms: 11.3 mUI

Mathematically embedded channel:
PCB trace + OSFP connector + HCB

Total IL – 14.8dB @26.56 GHz
(3.9 dB for COM package + 10.975 dB for recommended
loss between TP0 and TP2)



Measurement results

Test setup	Measured J3u [mUI]	Measured Jrms [mUI]	A _{DD} [mUI]	σ_{RJ} [mUI]
No channel	71.5	11.1	5	10
Physical channel	105.5*	15.45	0.45**	15**
Embedded channel	75	11.3	3**	10**

*Applying TX FIR to equalize the channel loss worsens measured J3u

** Negative discriminant in A_{DD} calculation. Calculated based on hidaka_3ck_adhoc_01_041421.

Measurement results for Test setup 1 (TP2)

Effect of TX FIR

Launch Amplitude	TX FIR Setting	Measured J3u [mUI]
800 mV	[0,0,0,1,0]	105.5
800 mV	[0,0,0,0.75,-0.25]	138
560 mV	[0,0,0,1,0]	137

Test setup 3

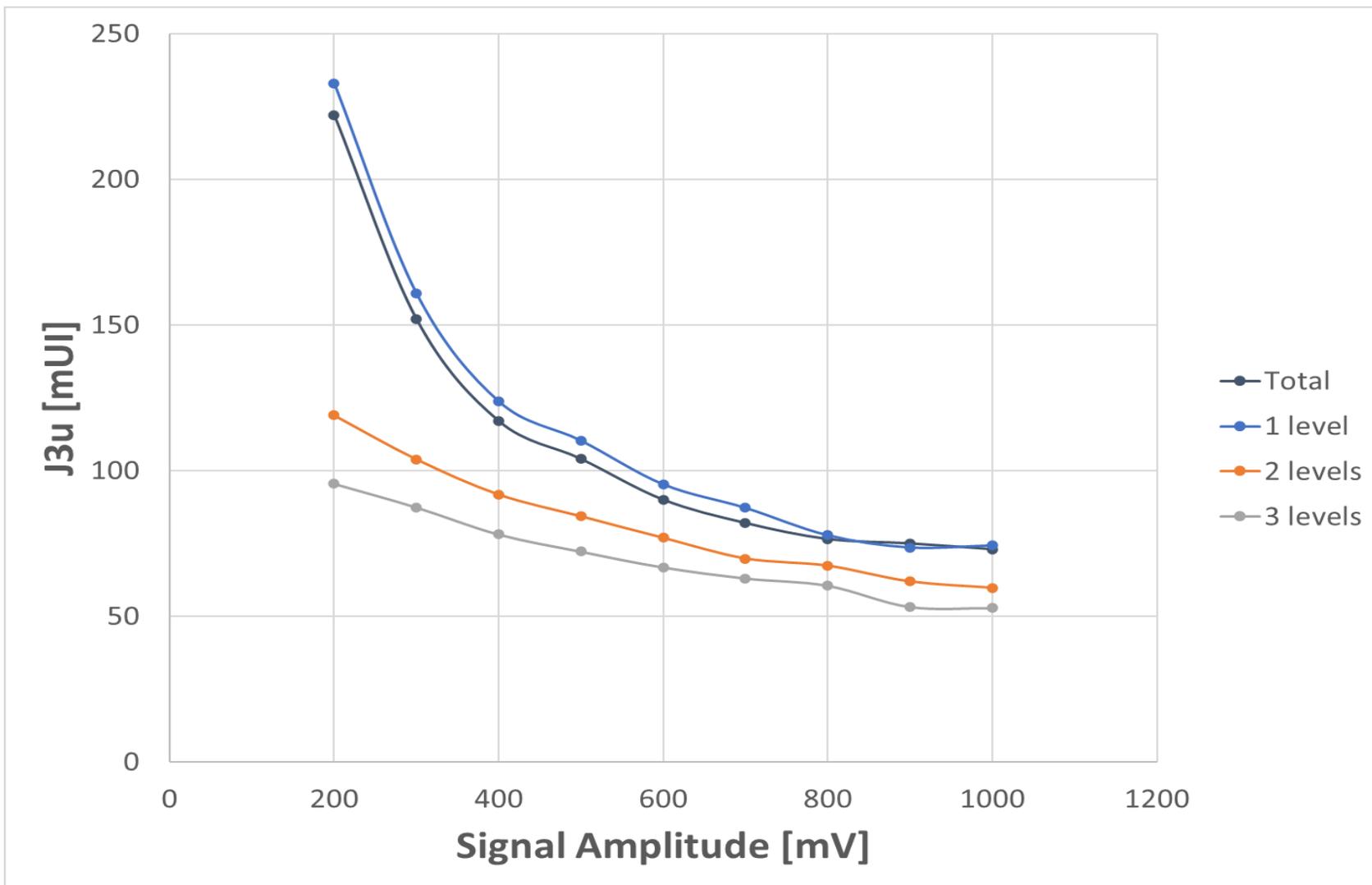


Signal amplitude: 200 - 1000 mV

J3u: 71.5 mUI

Jrms: 11.1 mUI

Measurement Results – Setup 3



Total – J3u calculated based on the combined histogram of 12 edges

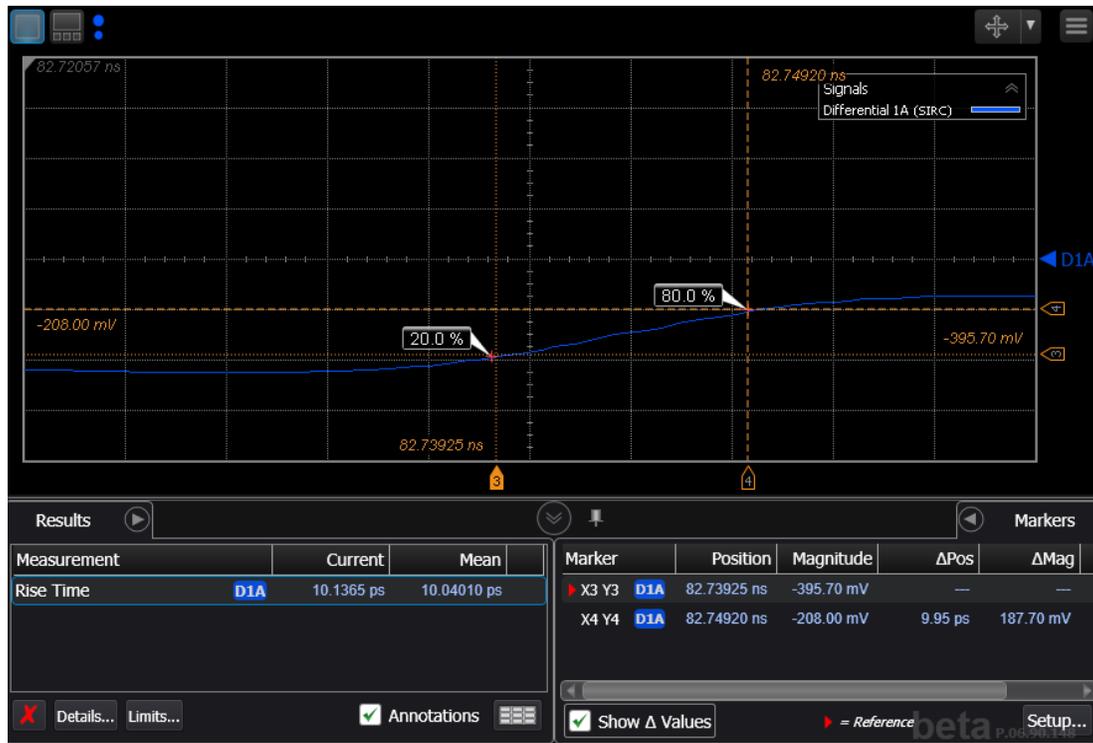
1 level – J3u calculated based on the combined histogram of transitions between adjacent levels (0->1, 3->2, etc.)

2 levels – J3u calculated based on the combined histogram of 0->2, 1->3, 2->0, 3->1 transitions

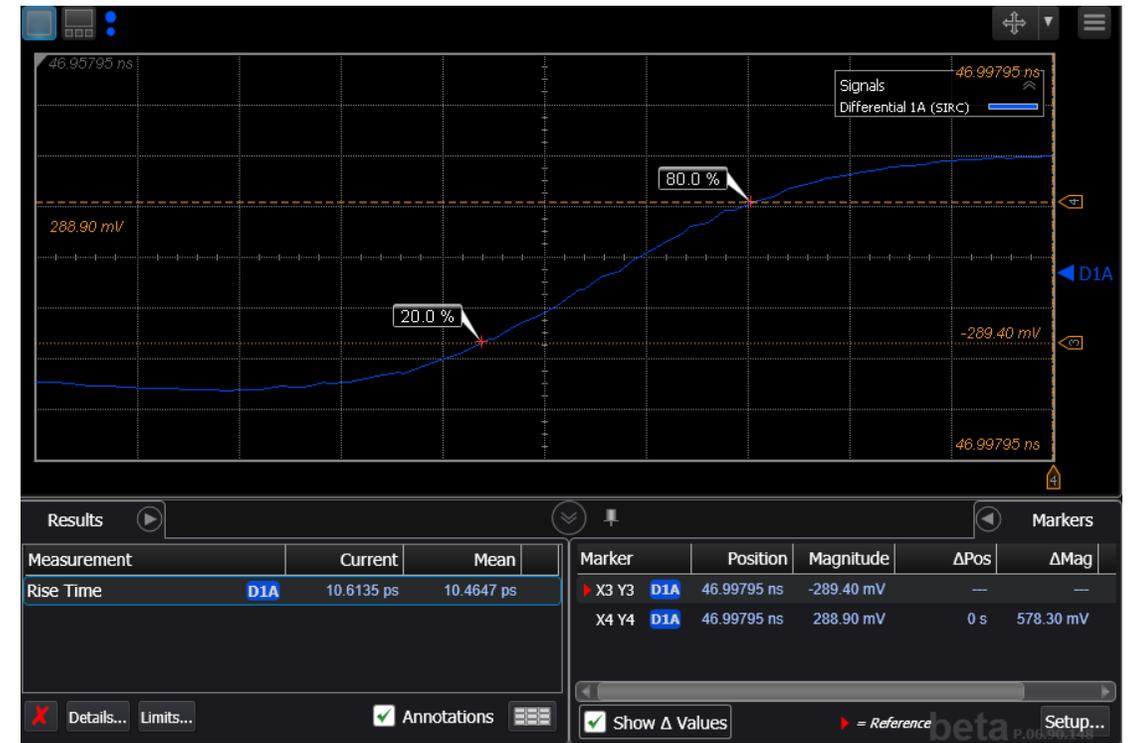
3 levels – J3u calculated based on the combined histogram of 0->3, 3->0 transitions

Edge snapshots – 1000 mV amplitude

0 ->1



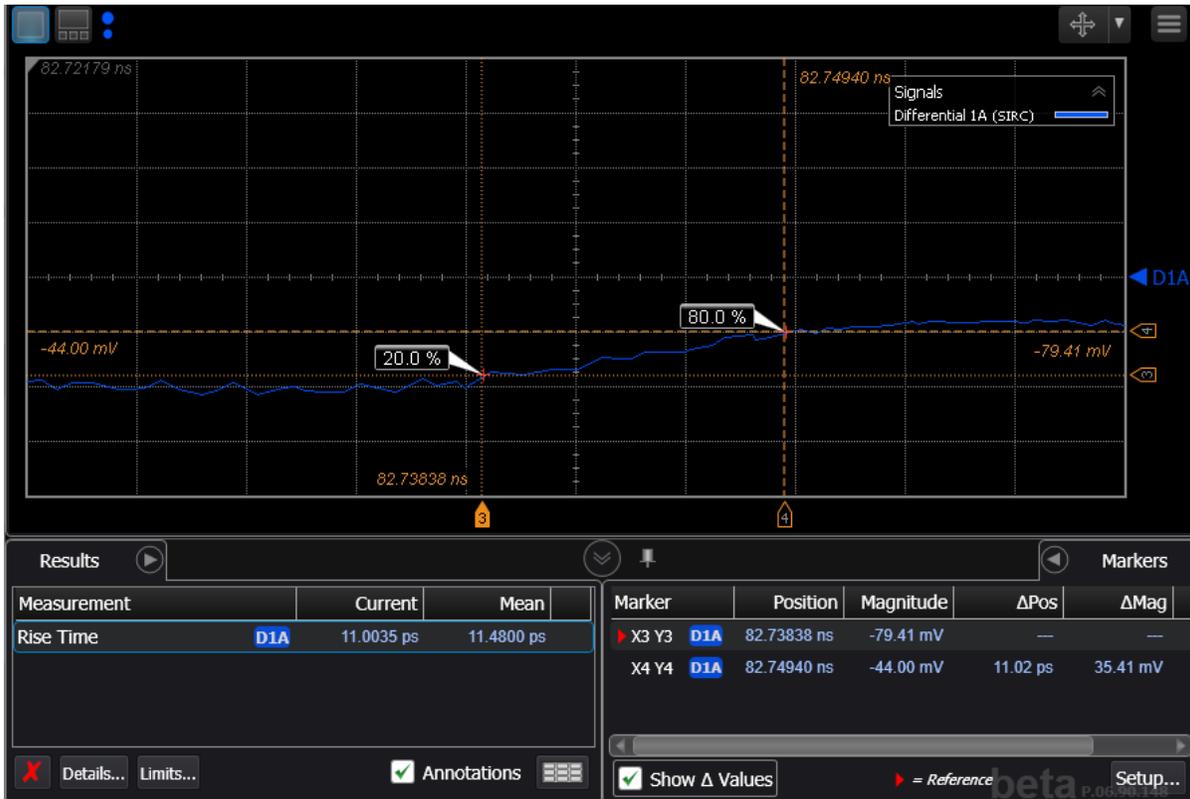
0 ->3



Edge snapshots – 200 mV amplitude

0 ->1

0 ->3

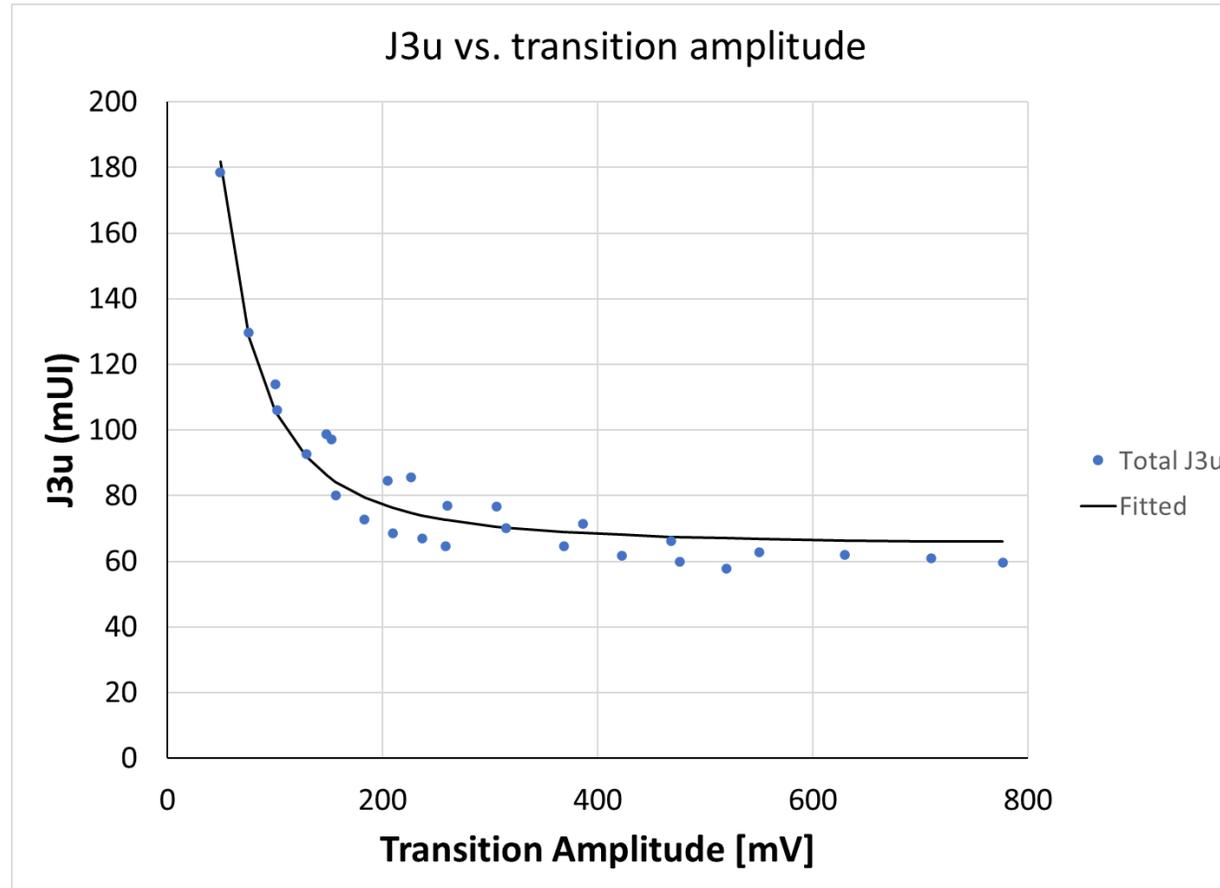


Dependency on the Transition amplitude

Signal amplitude	Transition	Transition amplitude	J3u
200 mV	2 levels	100 mV	110 mUI
400 mV	1 level	102 mV	106 mUI
200 mV	3 levels	148 mV	98 mUI
300 mV	2 levels	152 mV	97 mUI
600 mV	1 level	156 mV	93 mUI
300 mV	3 levels	225 mV	85 mUI
400 mV	2 levels	205 mV	84 mUI
500 mV	2 levels	260 mV	69 mUI
1000 mV	1 level	259 mV	65 mUI

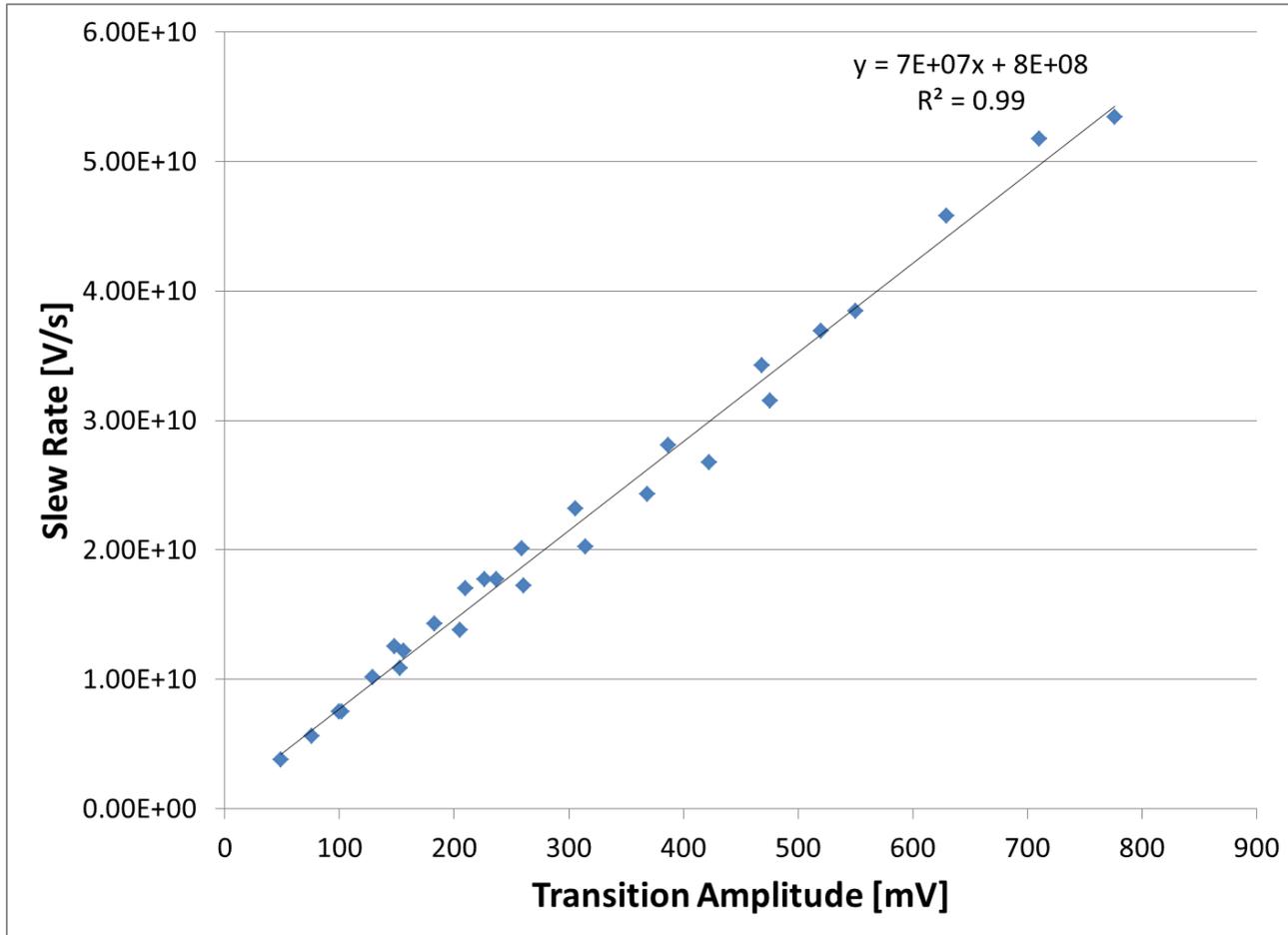
High correlation of J3u with the transition amplitude, regardless of the specific edge

Dependency on the Transition amplitude



$$Fitted J3u[mUI] = \sqrt{65.07^2 + \left(\frac{8366.6}{TA[mV]}\right)^2}$$

Effect of Amplitude Noise through Slew Rate



Effect of amplitude noise and slew rate on J3u - assumptions:

RMS noise = 1mV

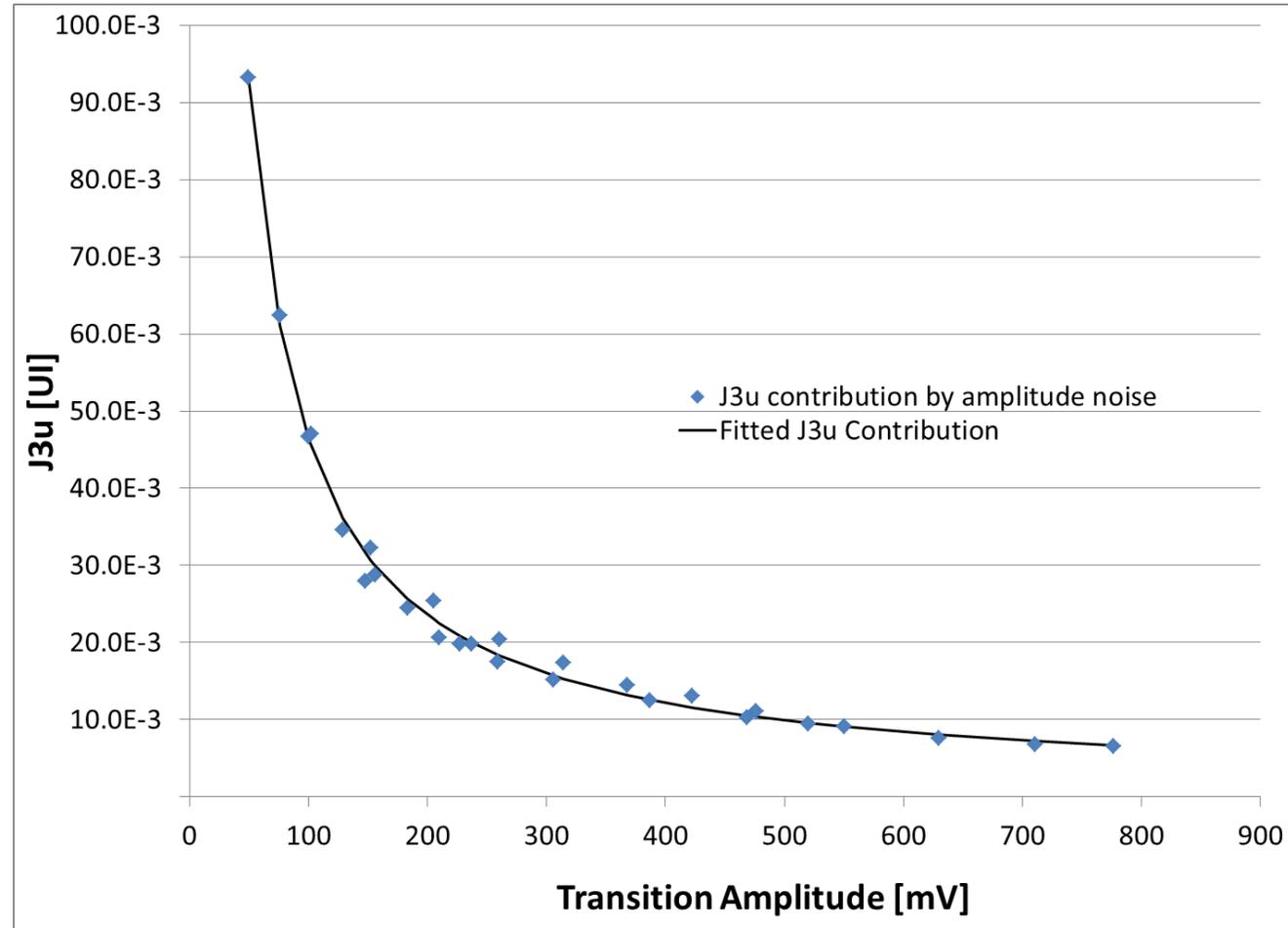
Jrms resulted from noise = RMS Noise [V]/Slew Rate [V/s]

Gaussian distribution of jitter: J3u \approx 6.6×Jrms



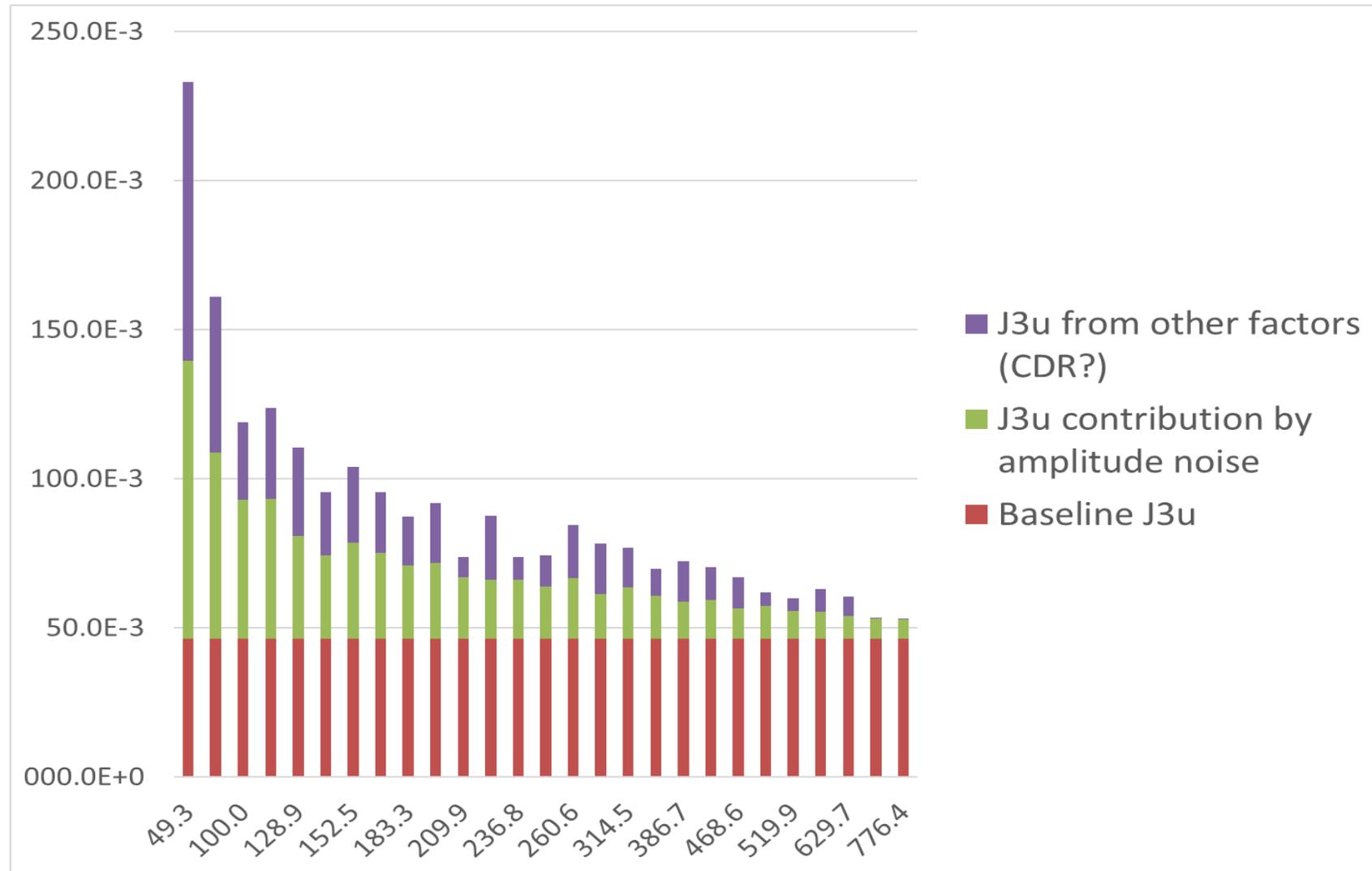
J3u resulted from noise \approx 6.6 × 1mV/Slew Rate [V/s]

Effect of Amplitude Noise through Slew Rate



$$\text{Fitted } J3u[UI] = \frac{4.5563}{TA [mV]} + 0.0008$$

J3u breakdown by factors



Amplitude Noise Effect at TP2

TP	Launch Amplitude	Transition levels	TX FIR Setting	Measured J3u [mUI]	J3u caused by amplitude noise [mUI]	Delta [mUI]
TP2	800 mV	3	[0,0,0,1,0]	82.5	34.5	48
		2		93.9	48.2	45.7
		1		111.3	59	52.3
		3	[0,0,0,0.75,-0.25]	95.8	34.1	61.7
		2		117.5	56.9	60.6
		1		132.7	84	48.7
TPO	800 mV	3	[0,0,0,1,0]	60.5	7.7	52.8
		2		70.3	13.1	57.2
		1		73.8	20.6	53.2

Summary and conclusions of experiments

- J3u measurements at TP2 do not reflect actual uncorrelated jitter, as they are highly dependent on effects of slew rate limits and noise.
- Test equipment are borderline for the current J3u specification.
- TX equalization does not resolve the measurement issue.
- Measurement issue will become worse for 200 GEL.
- Other metric of uncorrelated jitter should be considered.

Proposed changes on next slide

Proposed changes

- Calculate J3u only for the transitions between 0 and 3 levels in pattern. The specific R03 and F30 transitions are defined in Table 120D-4.
- Account for the noise effect to remove the J3u portion induced by amplitude from the measurements.