GN25L98 GPON 2Layer BOB – Board 23

Prepared by : Yiju Cai
09/24/2015

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Revision History

- Revision 1

  Initial revision 09/24/2015

Introduction

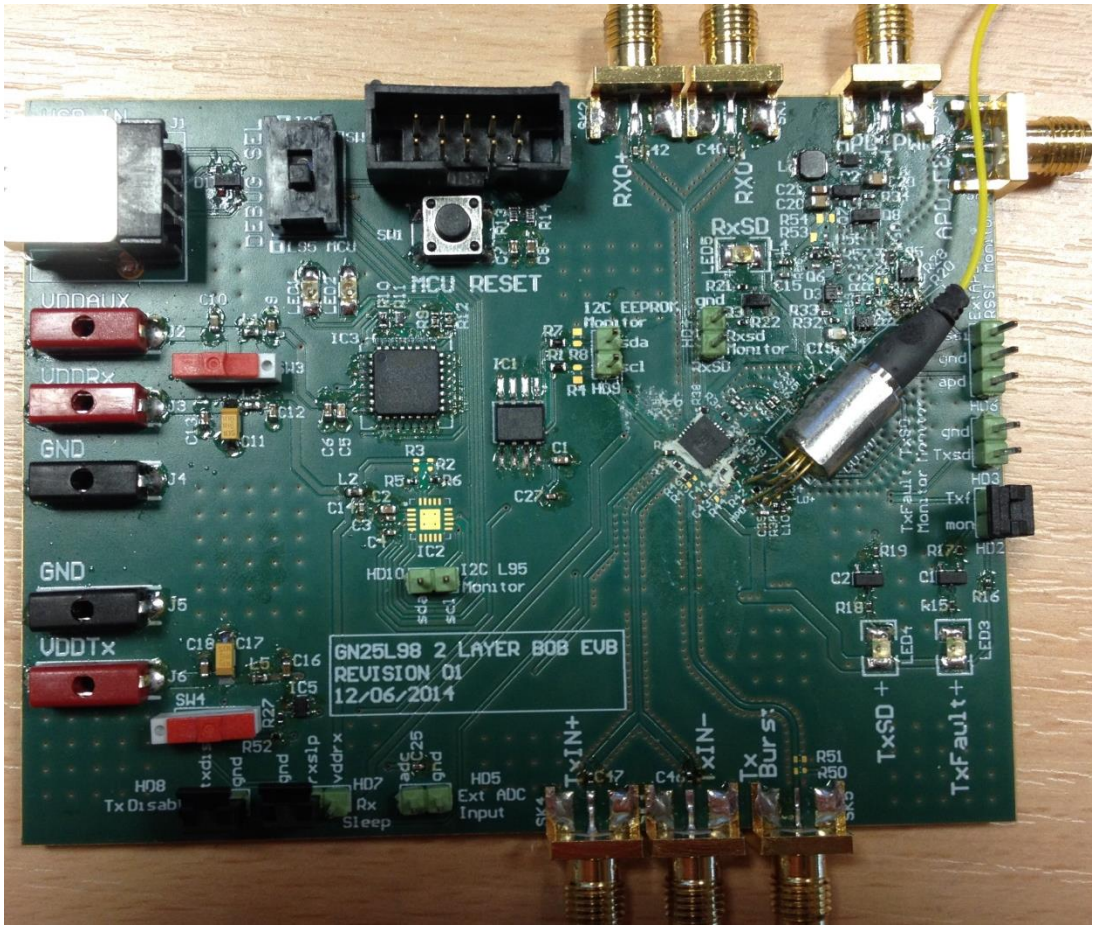
- This report provides test results from measurements conducted on a GN25L98 based GPON DDMI 2 Layer BOSA on Board (BOB) design that will be sampled to customers.
  - Board 23
  - BOSA - EZConn: 1.25G 1310nm DFB/ 2.5G 1490nm APD-TIA(Lab44APD+GN25L53)
  - Part number: EBS63432-B1203
  - BOSA S/N EEU082448
  - Each module is supplied as part of a kit that encompasses the 2 Layer BOB, Graphical User Interface, Test cables, etc.
- This sample utilises GN25L98 B00 silicon.
- The version of Graphical User Interface is GN25L98_GPON_DDMI_GUI_V0_R1_B3.
- Config File:A2_Table_2_Template_rev02_BOB_141216

2 Layer BOB Design

- The 2 Layer BOB design provides demonstration of the Transmitter & Receiver performance with APD based GPON BOSA. The EVB is configured with APC & ERC loops enabled and associated seeding for fast start operation provided by pre-configured Bias and Modulation Look Up Tables.
- Look up table support for both the Transmitter and Receiver parameters are demonstrated.
  - Transmitter – Bias and ERC seeding LUT enabled, TRIM_ER LUT enabled
  - Receiver - APD Bias control LUT enabled

  Note: We determine the bias, ERC,TRIM_ER_LUT seeding value at room temperature and extract slope data from the last few samples to determine other temperature points for loading LUT's.
- APD Circuit Quick Trip is enabled
- Full DDMI reporting is provided.

GN25L98 2 Layer BOB



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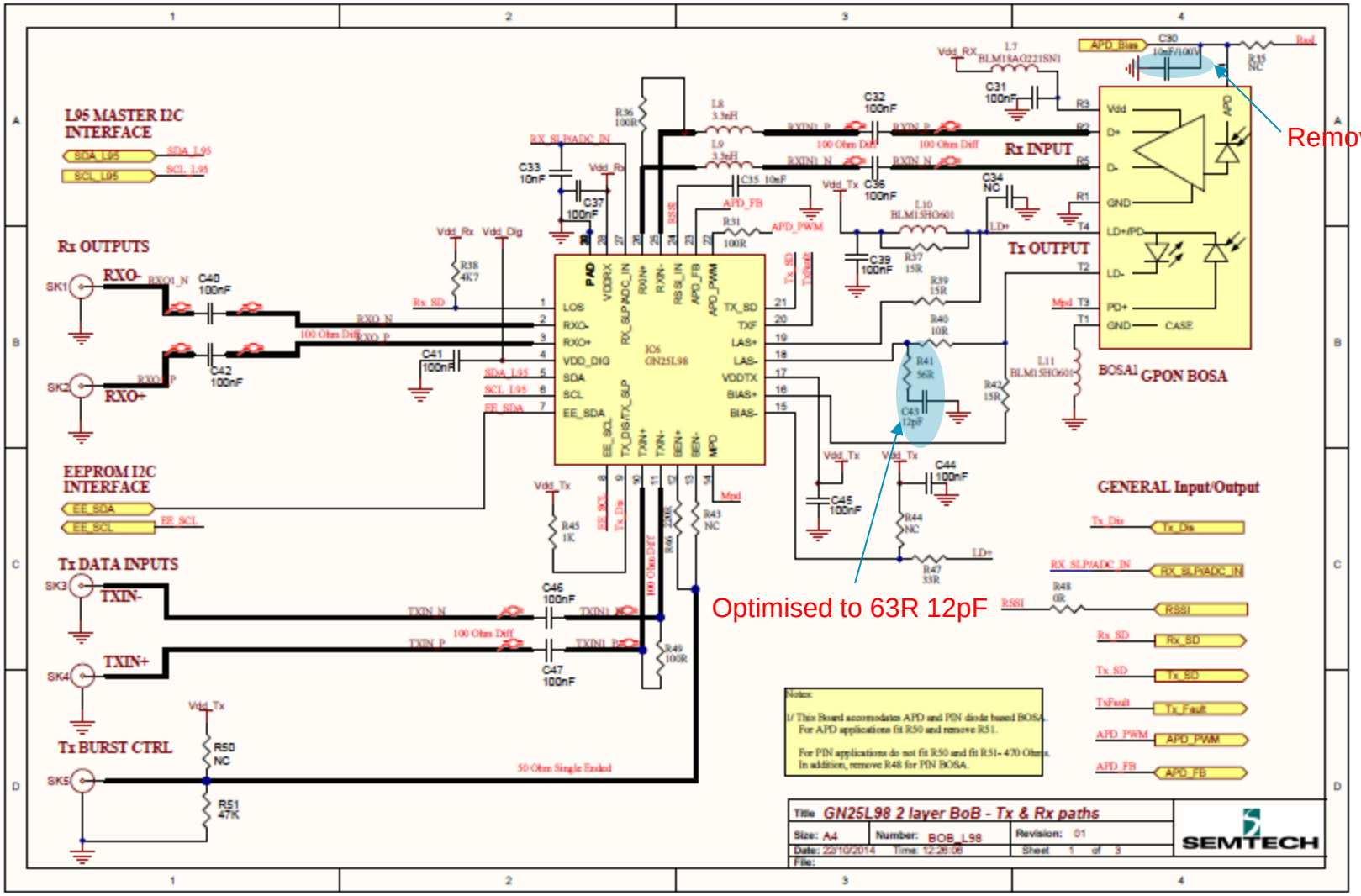
Board Schematic – Tx & Rx signal paths



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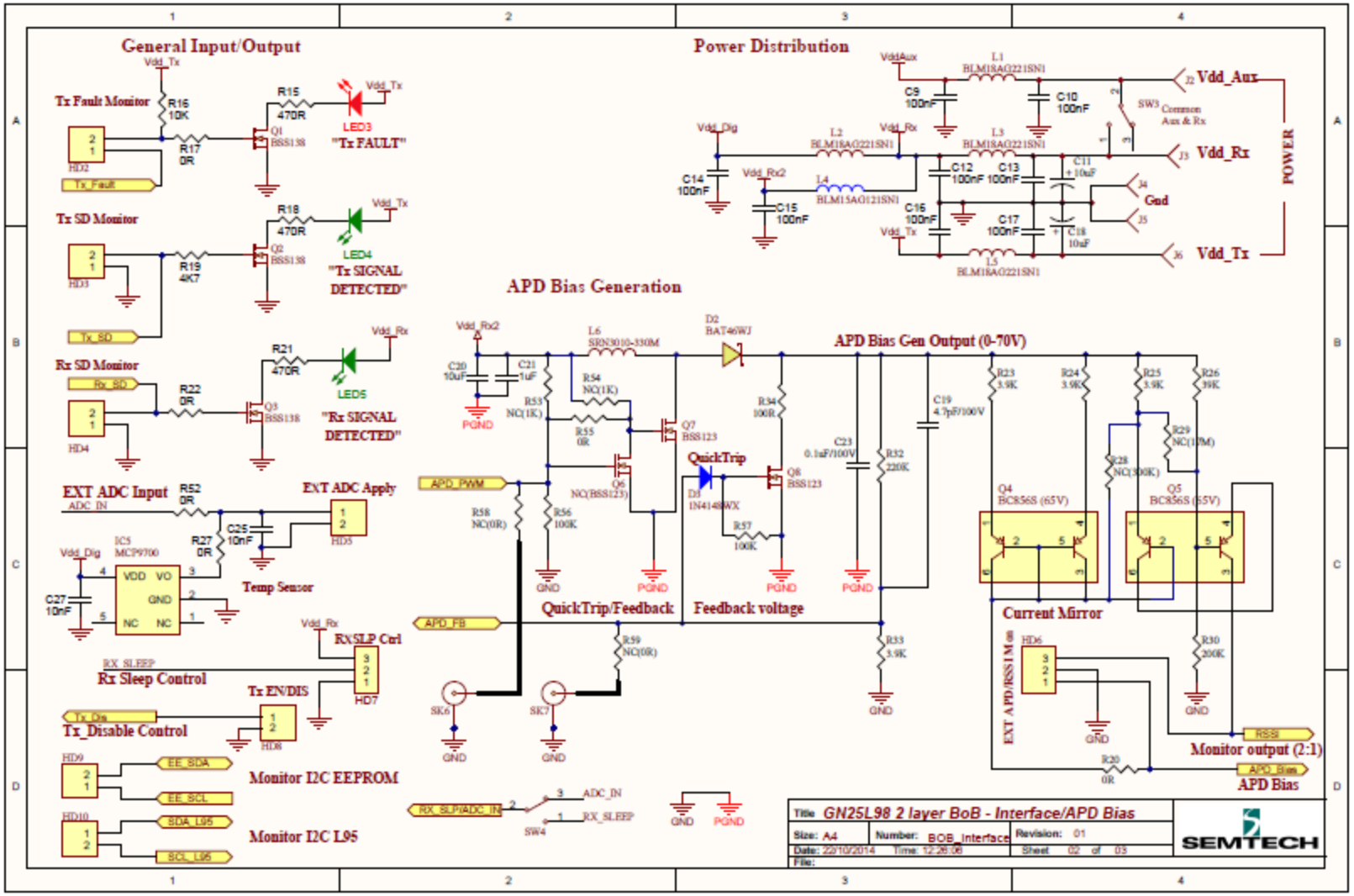
Board Schematic – APD Bias Gen & Interface



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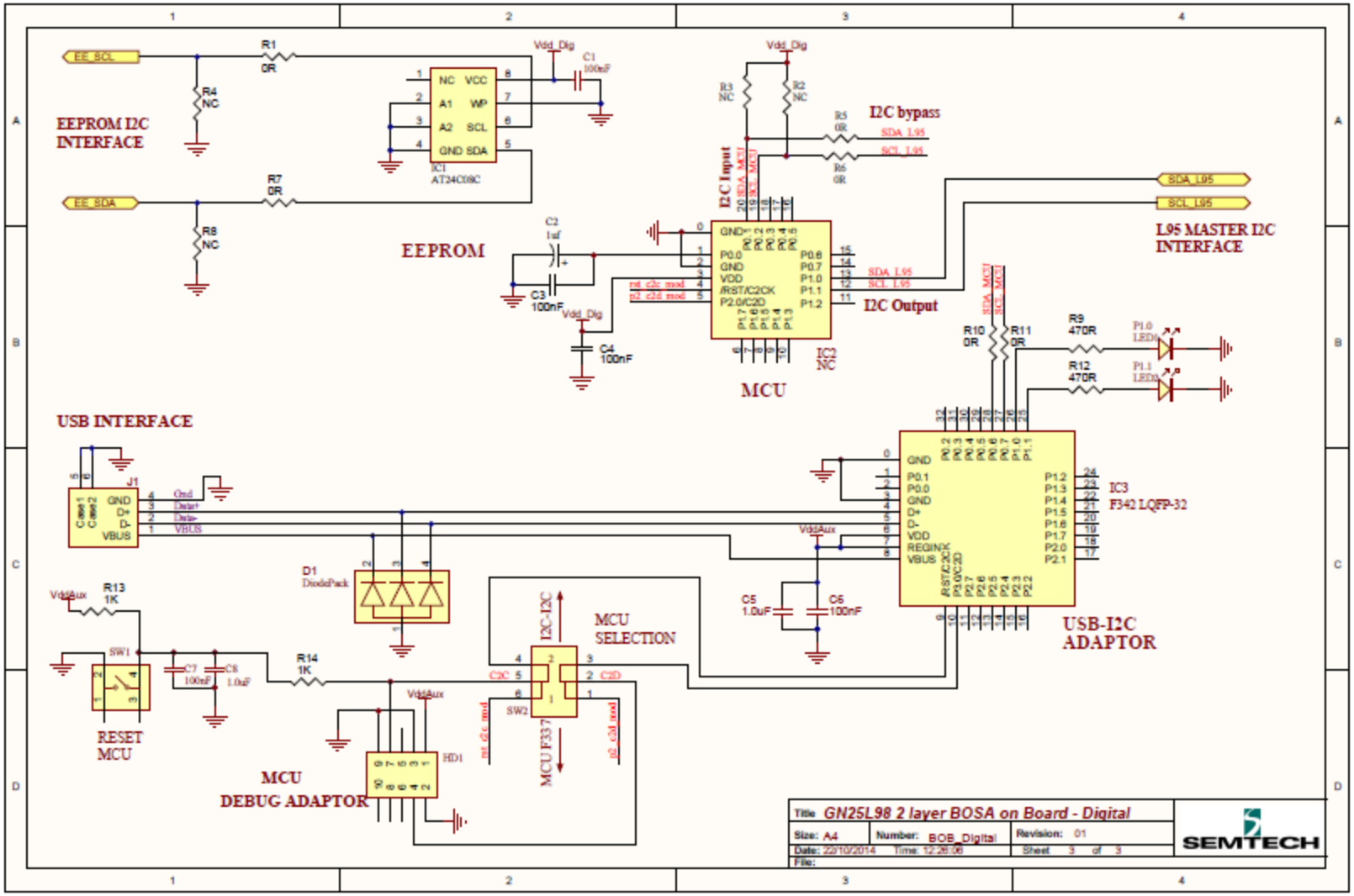
Board Schematic – Digital



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BOM File

Comment	Description	Designator	Footprint	LibRef	Quantity
EZconn GPON BOSA		BOSA1	BOSA_DDMI _ZTE	BOSA_ZTE	1
100nF	Capacitor	C1, C6, C7, C8, C9, C10, C12, C13, C16, C17	0603B	Cap Semi, Cap Semi, Cap Semi, Cap Semi, CAP1, CAP1, CAP1, CAP1, CAP1, CAP1	10
1uf	Polarised Capacitor, Capacitor, Capacitor	C2, C5, C21	0603B	CAPACITOR POL 1206, Cap Semi, CAP1	3
100nF	Capacitor	C3, C4, C14, C15, C31, C32, C36, C37, C39, C40, C41, C42, C44, C45, C46, C47	0402B	CAP1	16
10uF	Polarised Capacitor	C11, C18	1206A	CAPACITOR POL 1206	2
4.7pF/100V	Capacitor	C19	0805A	CAP1	1
10uF	Capacitor	C20	0805a	CAP1	1
0.1uF/100V	Capacitor	C23	0805A	CAP1	1
10nF	Capacitor	C25, C27, C33, C35	0402B	CAP1	4
10nF/100V	Capacitor	C30	0402B	CAP1	1
NC	Capacitor, Resistor, Resistor, Resistor, Resistor, Resistor, Resistor, Resistor	C34, R2, R3, R35, R43, R44, R50, R51	0402B	CAP1, RES1, RES1, RES1, RES1, RES1, RES1, RES1	8
12pF	Capacitor	C43	0402B	CAP1	1
DiodePack	SP0503BAHT	D1	SOT143	DiodePack	1
BAT46WJ		D2	SOD323F	BAT46WJ	1
1N4148WX		D3	SOD-323	1N4148WX	1
HEAD2x5	Header, 5-Pin, Dual row	HD1	HDR2X5	Header 5X2	1
HEADER2	Header, 2-Pin	HD2, HD3, HD4, HD5, HD8, HD9, HD10	HEAD2	HEADER2	7
HEADER 3	[NoValue], Header, 3-Pin	HD6, HD7	HEAD3	HEADER3, HEADER 3	2
AT24C08C		IC1	SO3C8	AT24C08C	1
NC	Silicon Labs	IC2	Quad20	DDMI 330	1
F342 LQFP-32		IC3	LCC32	F340 LQFP-32	1
MCP9700		IC5	SC70-5	MCP9700	1
GN25L98		IC6	QFN28	GN25L98	1
USB Thru TypeB		J1	USB	USB Thru TypeB	1
Socket	Socket	J2, J3, J4, J5, J6	2MMPCB	Socket	5
BLM18AG221SN1	Inductor	L1, L2, L3, L5, L7	0603B	Inductor	5
BLM15AG121SN1	Inductor	L4	0402b	Inductor	1
SRN3010-150M		L6	SRN3010	SRN3010-150M	1
3.3NH	Inductor	L8, L9	0402B	Inductor	2
BLM15HG601	Inductor	L10, L11	0402B	Inductor	2
P1.0	Red LED	LED1	1206A	LED	1
P1.1	Red LED	LED2	1206A	LED	1
LED1	Typical RED GaAs LED	LED3	LEDSM	LED1	1
TBD	Typical RED GaAs LED	LED4, LED5	LEDSM	LED1	2
BSS138	N-Channel MOSFET	Q1, Q2, Q3	SOT23	MOSFET-N	3
BC856S (65V)		Q4, Q5	SOT363	BC856S	2
NC(BSS123)	N-Channel MOSFET	Q6	SOT23	MOSFET-N	1
BSS123	N-Channel MOSFET	Q7, Q8	SOT23	MOSFET-N	2
0R	Resistor	R1, R7, R10, R11	0603B	RES1	4
NC	Resistor	R4, R8	0603B	RES1	2
0R	Resistor	R5, R6, R17, R20, R22, R27, R48, R52, R55, R58, R59	0402B	RES1	11
470R	Resistor	R9, R12	0603B	RES1	2
1K	Resistor	R13, R14	0603B	RES1	2
470R	Resistor	R15, R18, R21	0402B	RES1	3
10K	Resistor	R16	0402B	RES1	1
4K7	Resistor	R19, R38	0402B	RES1	2
3.9K	Resistor	R23, R24, R25, R33	0402B	RES1	4
39K	Resistor	R26	0402B	RES1	1
NC(300K)	Resistor	R28	0402B	RES1	1
NC(17M)	Resistor	R29	0402B	RES1	1
200K	Resistor	R30	0402B	RES1	1
100R	Resistor	R31, R34, R36, R49	0402B	RES1	4
220K	Resistor	R32	0402B	RES1	1
15R	Resistor	R37, R39, R42	0402B	RES1	3
10R	Resistor	R40	0402B	RES1	1
56R	Resistor	R41	0402B	RES1	1
1K	Resistor	R45	0402B	RES1	1
220R	Resistor	R46	0402B	RES1	1
33R	Resistor	R47	0402B	RES1	1
NC(1K)	Resistor	R53, R54	0603B	RES1	2
100K	Resistor	R56, R57	0402B	RES1	2
SMA	SMA connector	SK1, SK2, SK3, SK4, SK5, SK6, SK7	SMAEDGE2	SMA2, SMA2, SMA2, SMA2, SMA2, SMA, SMA	7
PUSH SW	Schurter LPH (1301.9302)	SW1	LPH	Button Switch	1
MMS22		SW2	MMS22	MMS22	1
SW-SPDT	SPDT Subminiature Togg	SW3, SW4	HEAD3	SW-SPDT	2

R41/C43 altered to 63R/12pF

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Transmitter Test Results

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Transmitter Test List & Deliverables

Parameter	Temperature, C					Deliverable
	-10	0	25	70	85	
1/ Average Power	√	√	√	√	√	Plot Pavg Vs Temp
2/ ER Control	√	√	√	√	√	Plot ER Vs Temp
3/ Eye margin	√	√	√	√	√	Eye Diagrams & Mask margin using GbE mask
4/ Burst Timings			√		√	Capture Burst timing shots

Note: This evaluation board can work fine in all temperature ranges from -40C to 85C,to save the test time, just test from -10C to 85C.

1. Transmitter Mean Power Control

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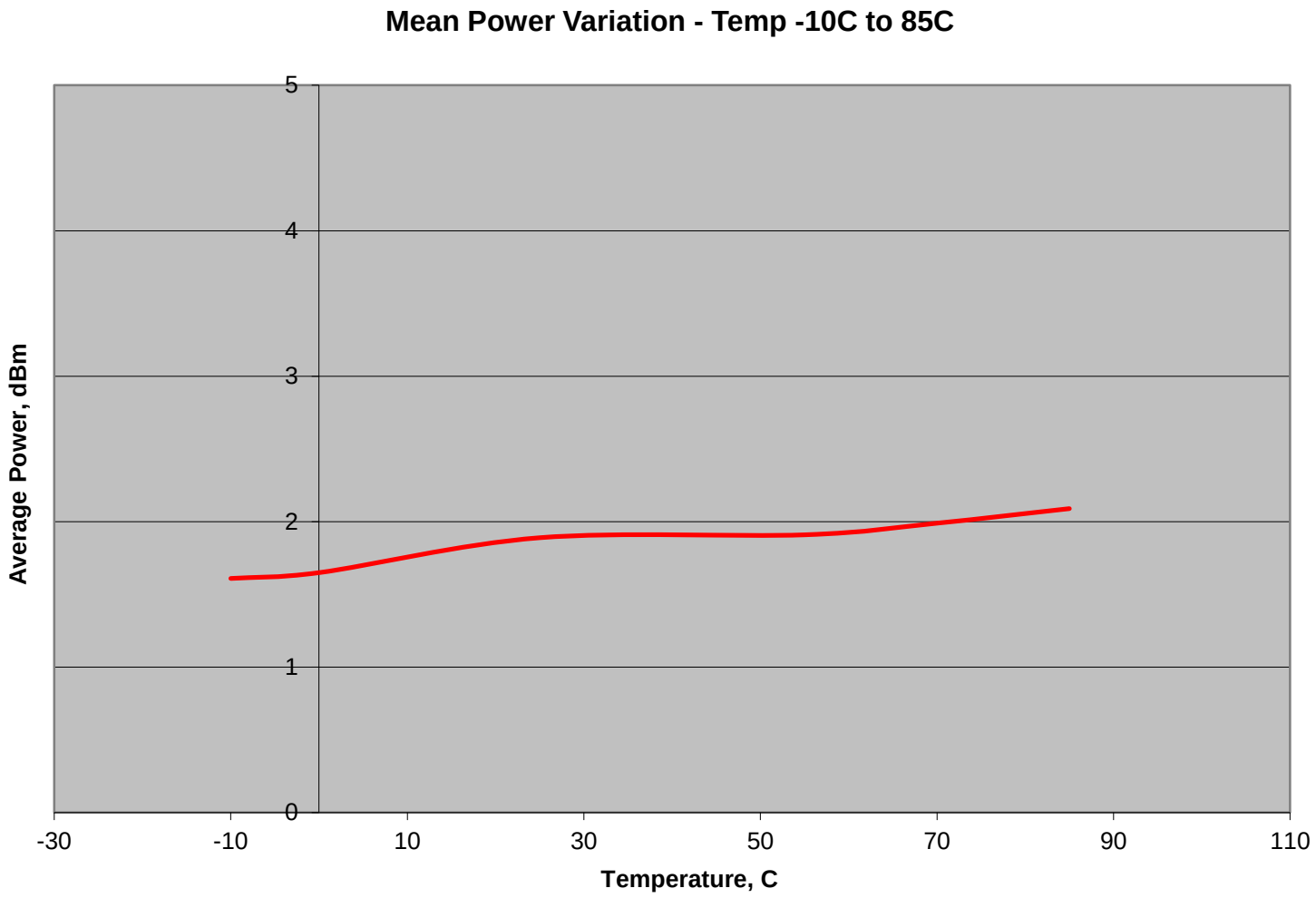
Transmitter Mean Power Control



- 0.48dB variation over -10C to +85C temperature range

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2. Transmitter ER Control

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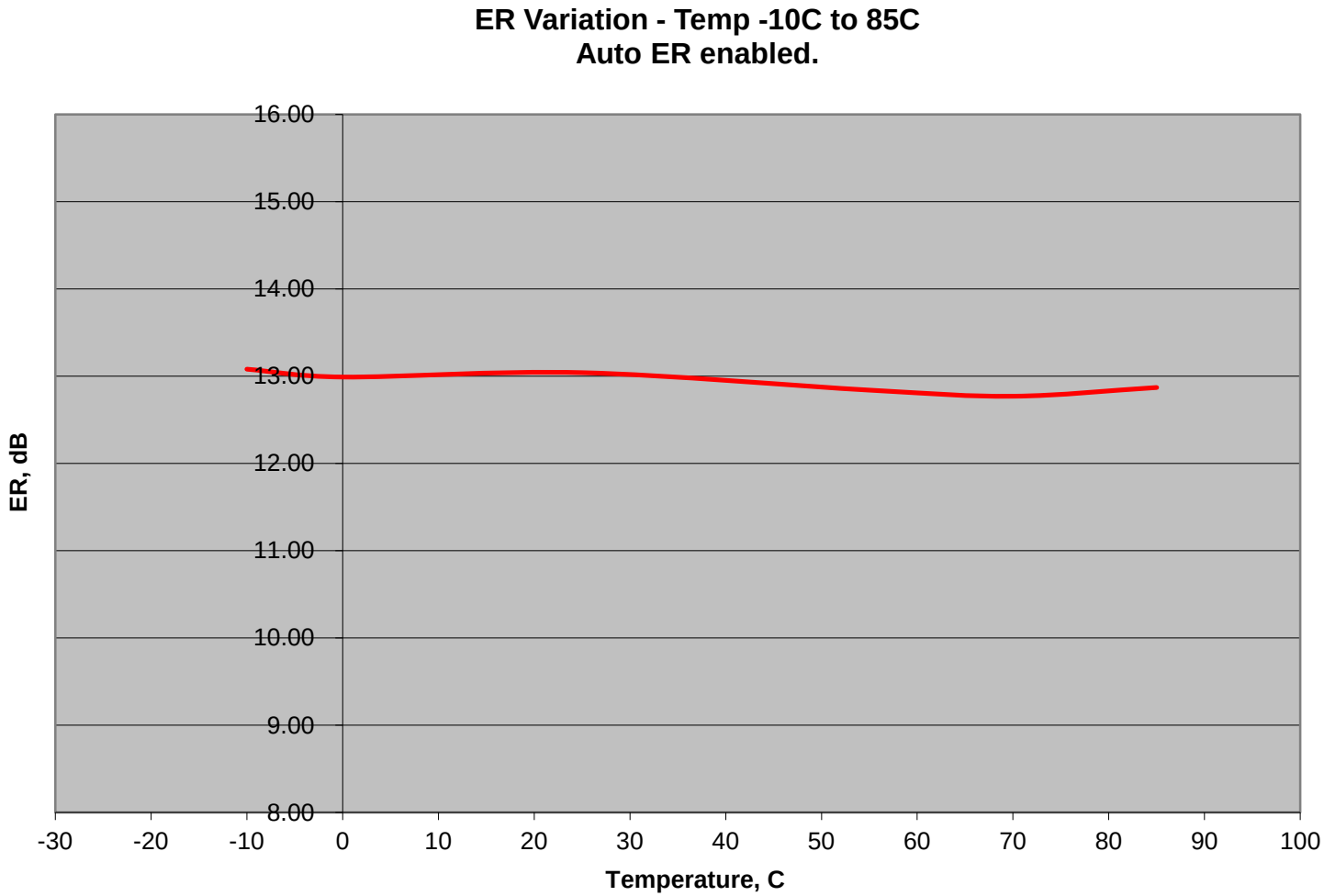
Transmitter Extinction Ratio



- 0.31dB variation over -10C to +85C temperature range
- TRIM_ER LUT enabled! (optional feature)

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3. Transmitter Mask Margin

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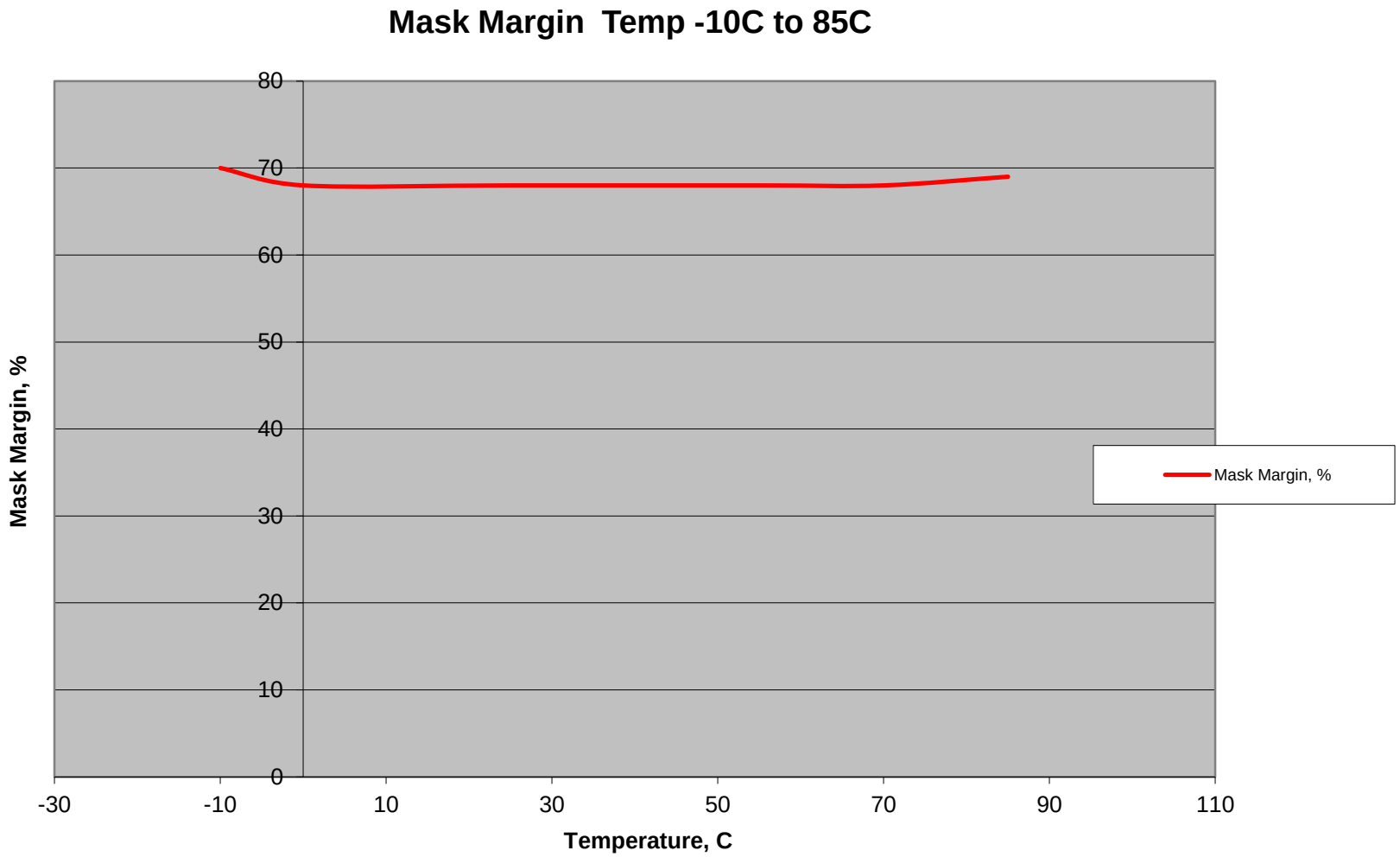
Transmitter Mask Margin -10C to 85C



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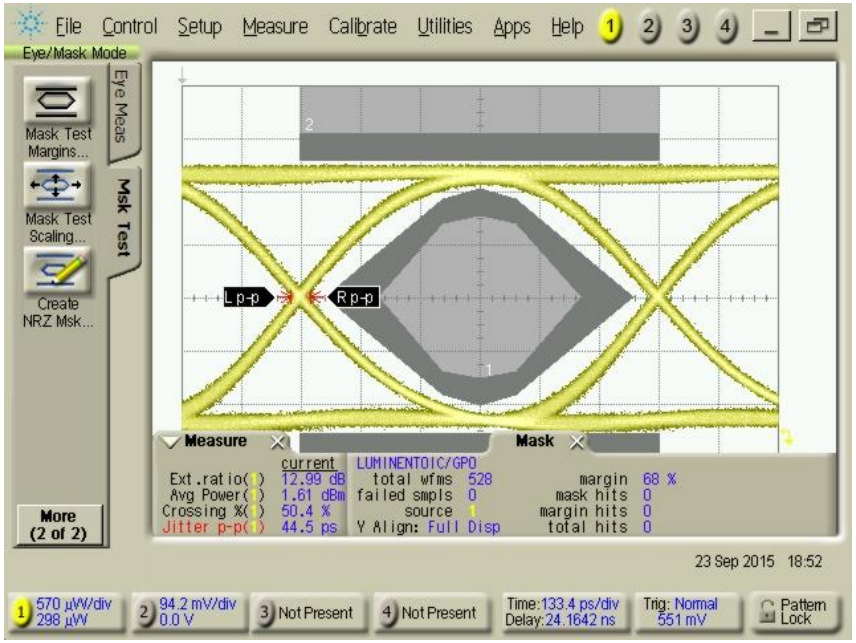
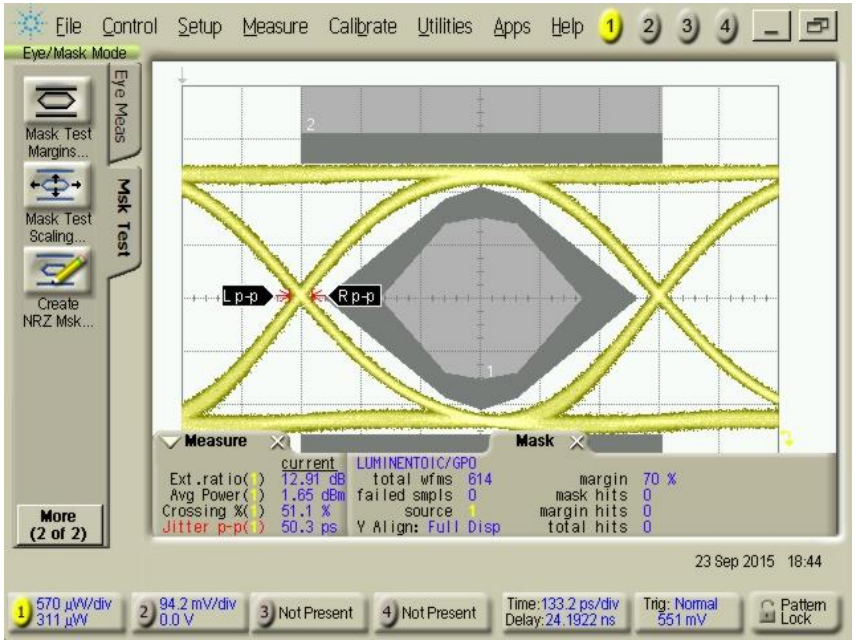
Transmitter Mask Margin



Mask margin -10C 68%



Mask margin 0C 70%

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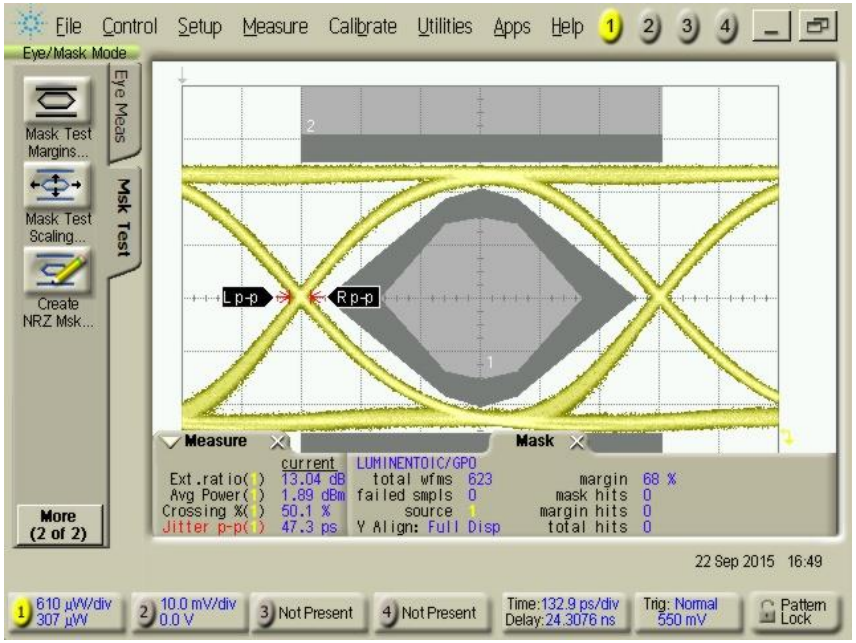
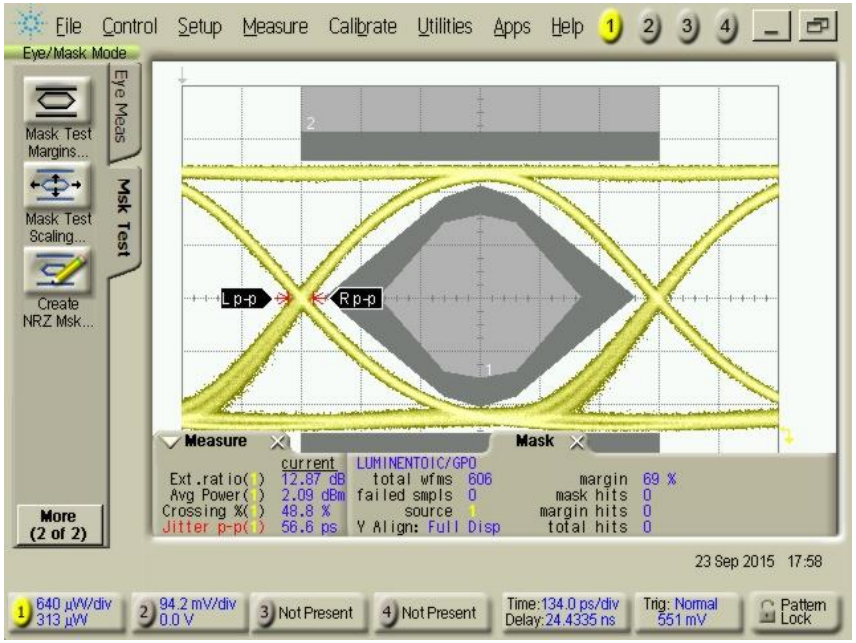
Transmitter Mask Margin



Mask margin 25C 68%



Mask margin 85C 69%

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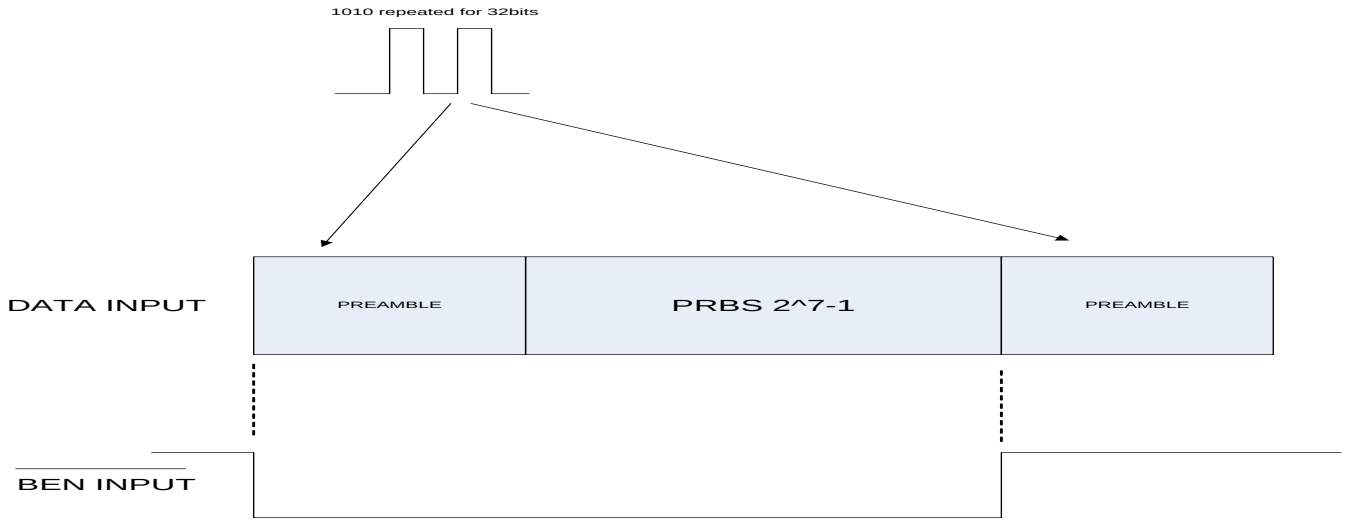
4. Transmitter Burst Timings

Transmitter Burst Timing Requirements

- Tx Burst “ON” time
  - target 12.8ns maximum
- Tx Burst “Off” time
  - Target 12.8ns maximum
- Fast Start up settling time
  - within 3 “on” bursts – total time 1.92us
- Tx SD output delay time
  - Target < 200ns maximum
- Tx SD width variation
  - Target < 100ns width difference wrt BEN input

Transmitter Burst Timing



- Testing of Burst Mode Timing Delays is measured with 32 bit pre-amble pattern (1-0-1-0 repeated) combined with PRBS data. Timings are measured by determining how many bits are missing from pre-amble (Burst ON) or present (Burst OFF) Settling criteria within 10 to 90% of settled power levels.
- Please be noticed that the following timing test data base on the previous EVB.

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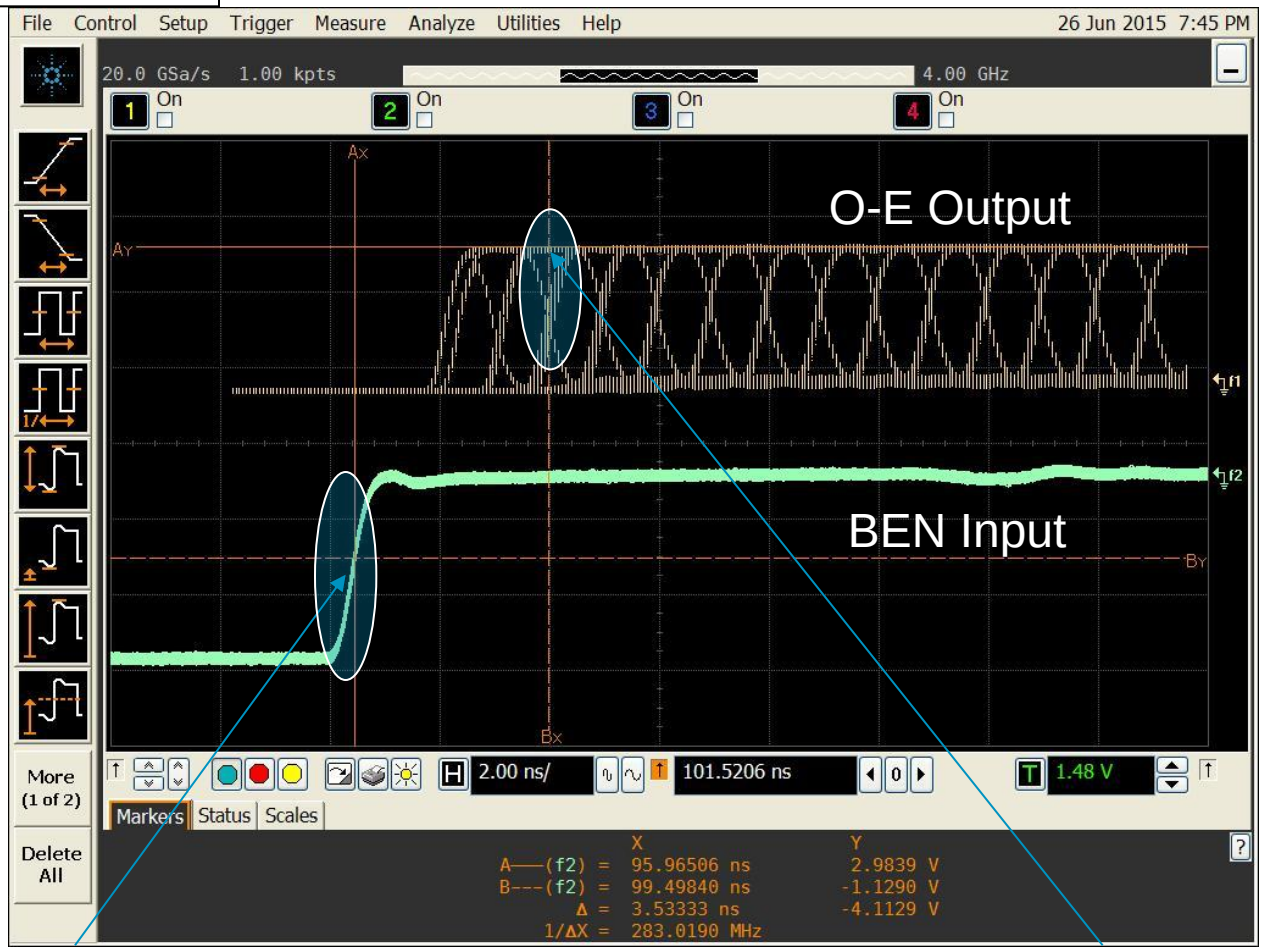
Transmitter - Burst ON performance ,Temp 25C

Spec 12.8ns max



Burst ON delay 3.53ns

Markers indicate relevant timings

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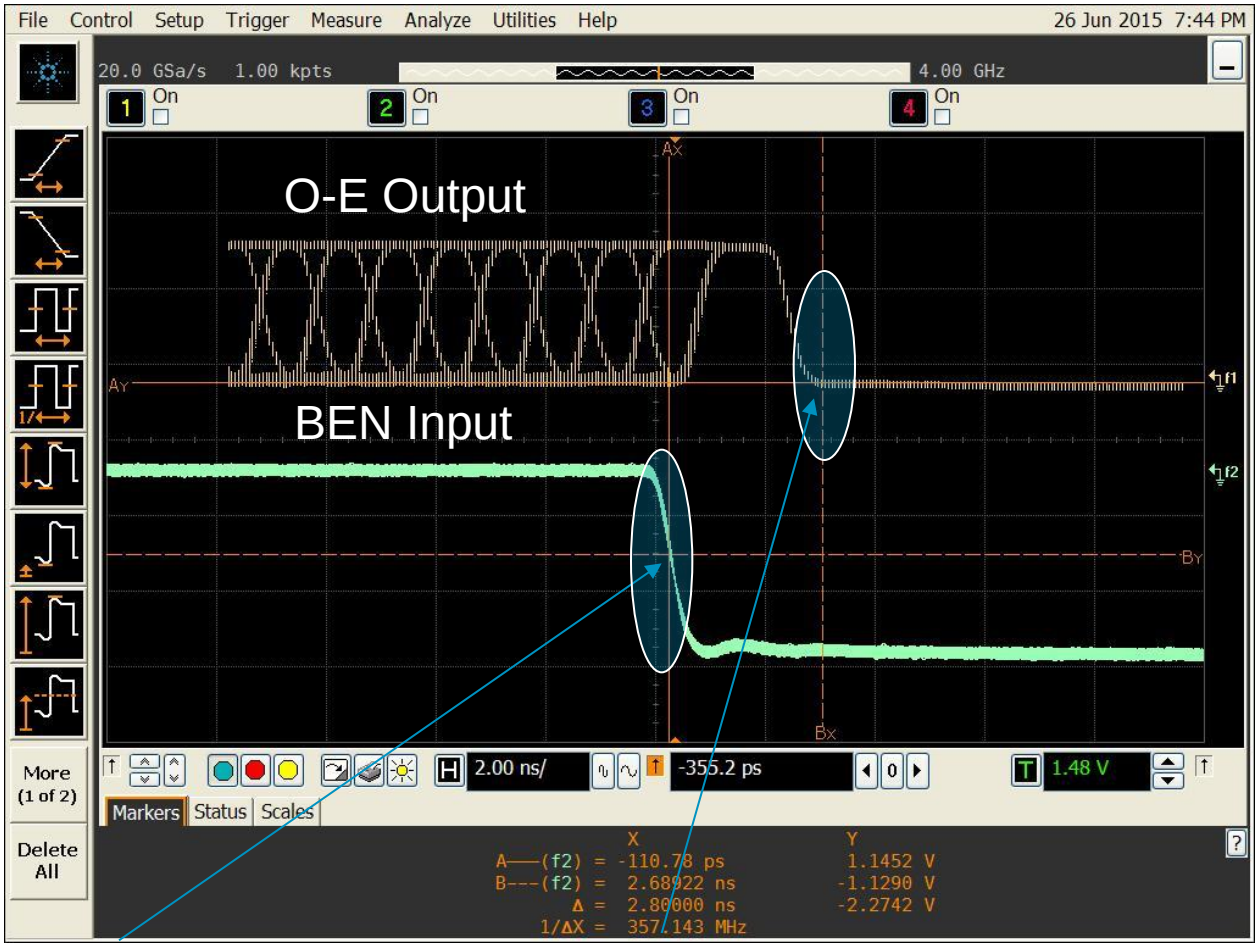
Transmitter - Burst OFF performance ,Temp 25C

Spec 12.8ns max



Burst OFF delay 2.88ns

Markers indicate relevant timings

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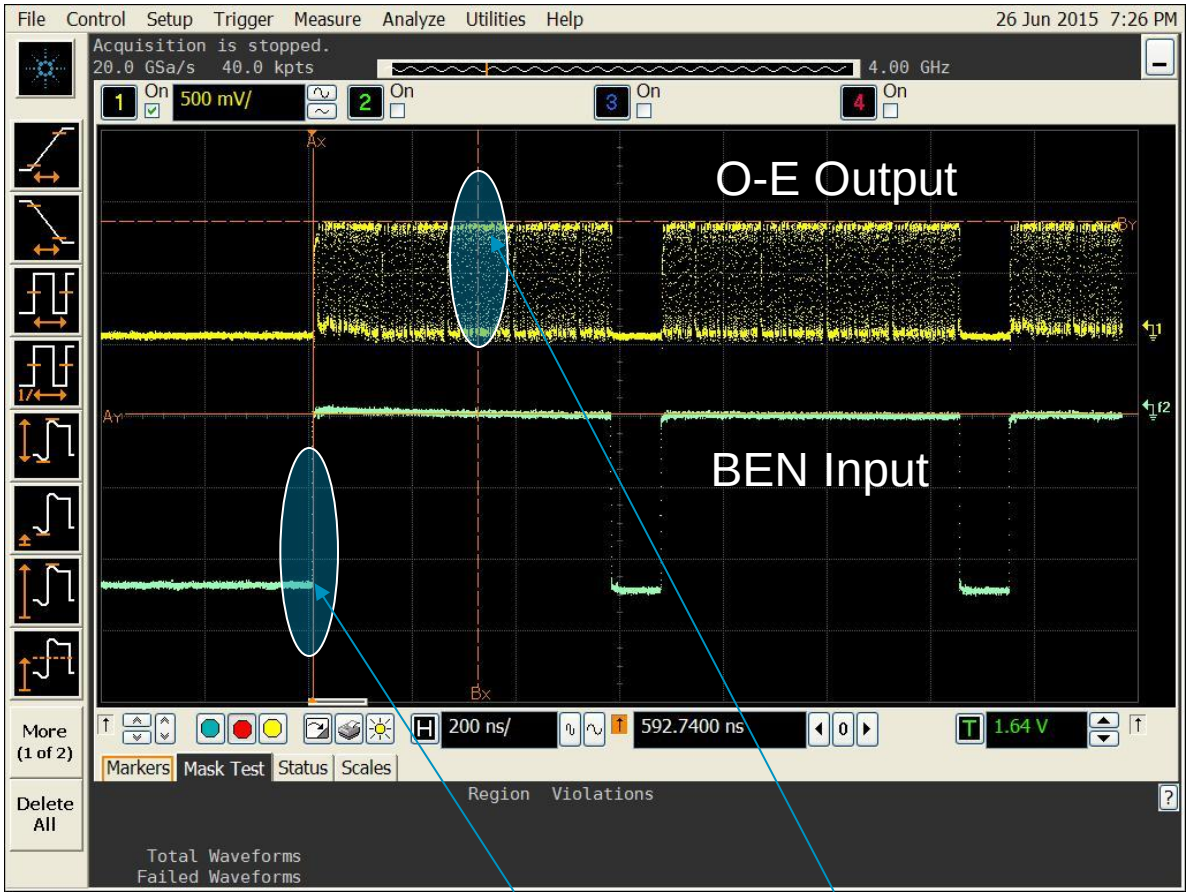
Transmitter - Fast Start Initialization, Temp 25C

Measured 0.337us

Spec 1.92us max



Measure Fast Start Initialization – time from start of 3 bursts to time when Optical output has settled within 10% of steady state power level. Fast start using MOD LUT for seeding.

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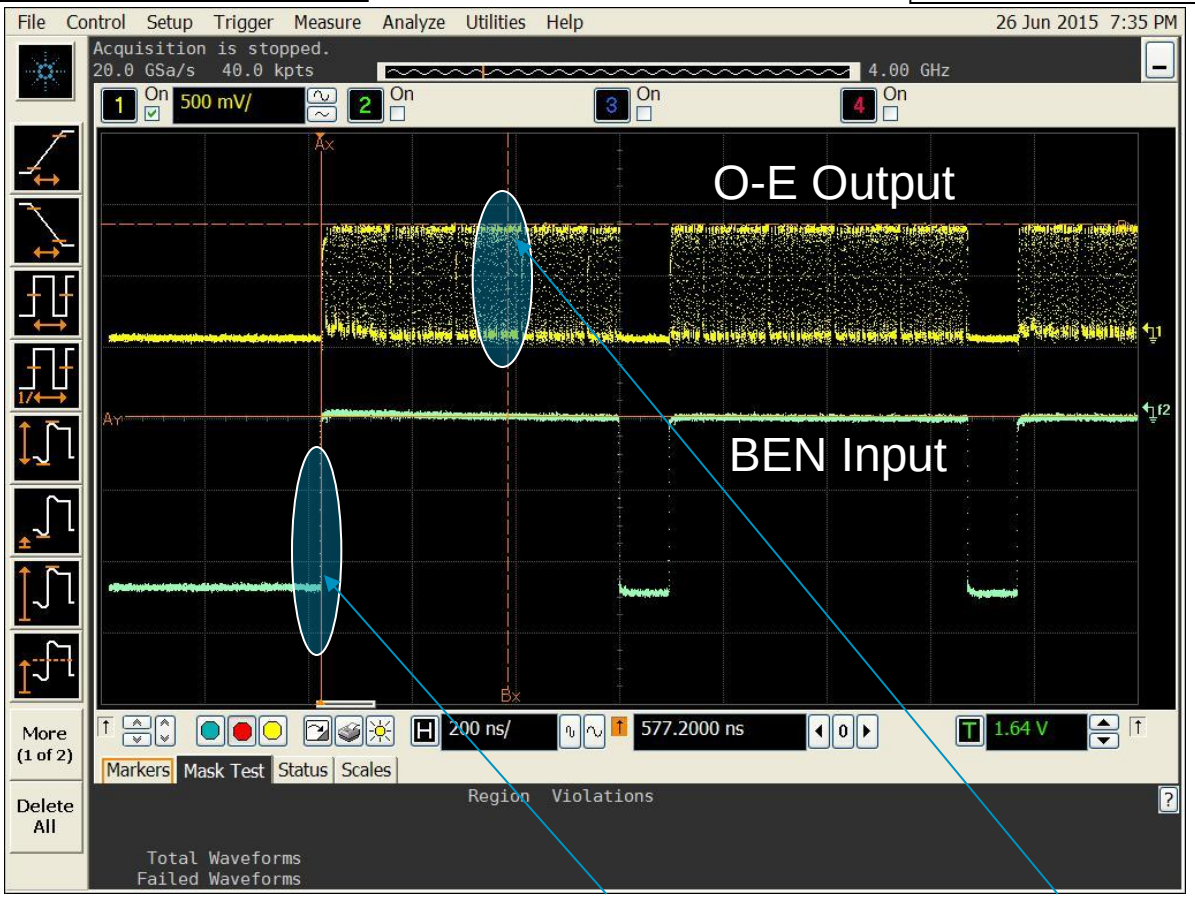
Transmitter - Fast Start Initialization, Temp 85C

Measured 0.391us

Spec 1.92us max



Measure Fast Start Initialization – time from start of 3 bursts to time when Optical output has settled within 10% of steady state power level. Fast start using MOD LUT for seeding.

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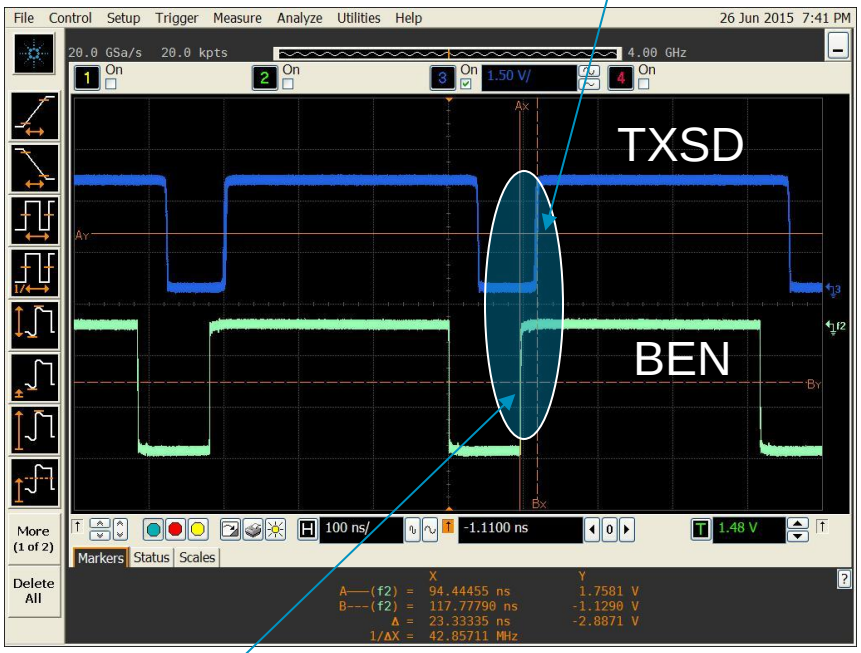
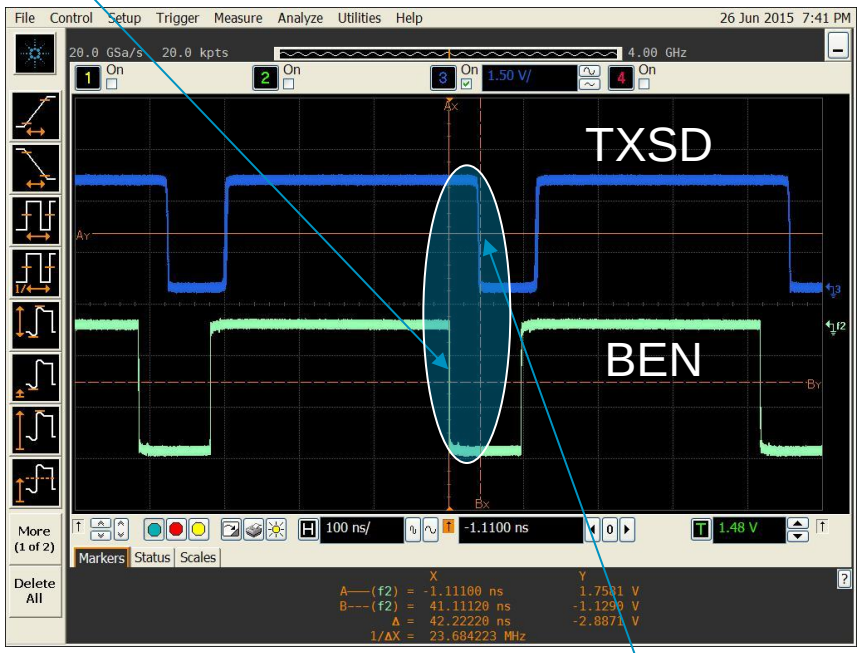
Transmitter - TXSD delay, Temp 25C

TXSD delay spec < 200ns

Measure to TXSD threshold levels





TXSD ON delay 23.33 ns

TX SD OFF delay 42.22ns

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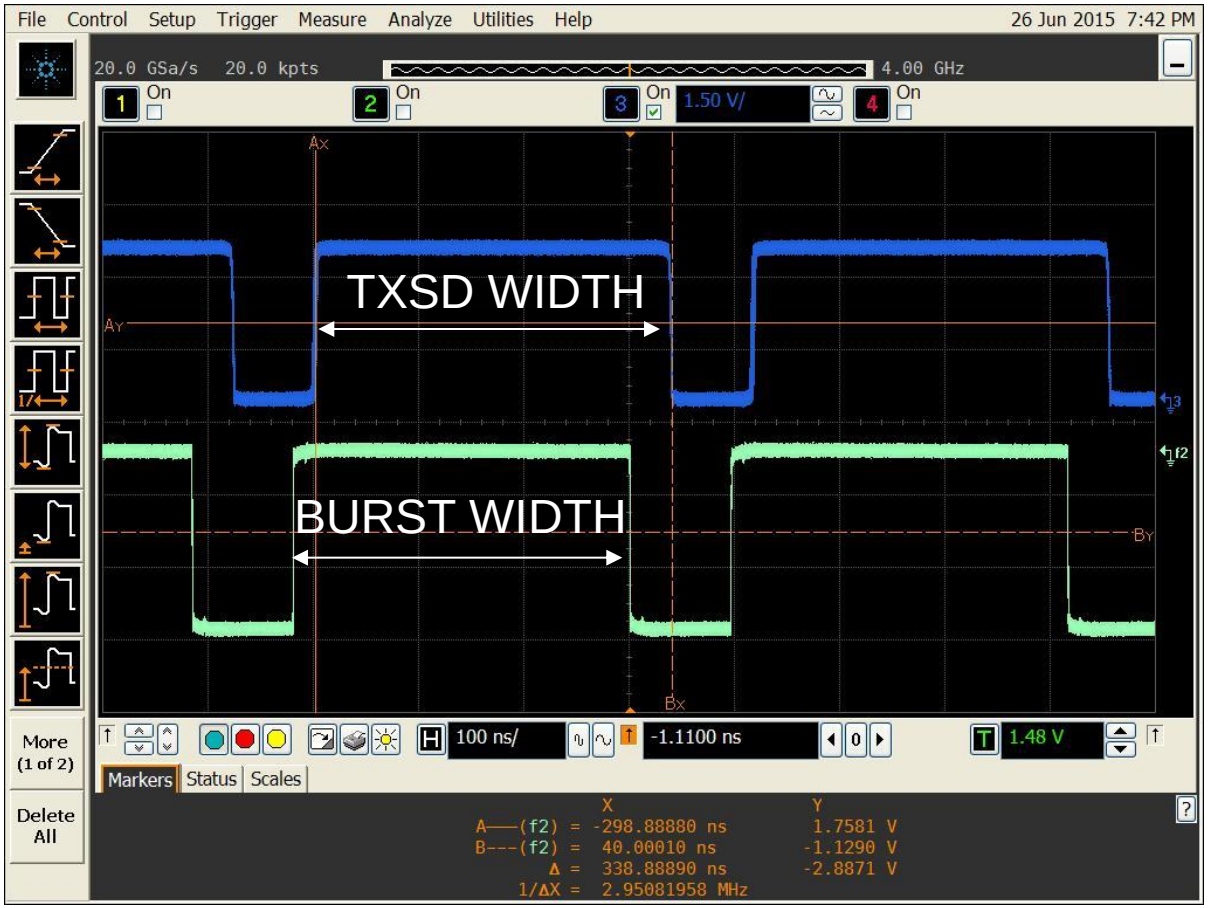
Transmitter – TXSD width variation, Temp 25C

Measure TXSD Width variation

Width variation spec < 100ns



TXSD width 338.88ns , BEN input width 320ns, 18.88ns variation.

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Receiver Test Results

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Receiver Test List & Deliverables

Parameter	Temperature, C				Deliverable
	-10	25	70	85	
5/ APD Control		√			Plot APD Bias & EZConn BOSA requirement
6/ Receiver Sensitivity	√	√		√	BER curve. Determine Sensitivity for BER 1e-10.
7/ Crosstalk Penalty	√	√		√	BER Curve with Burst Tx data present. Determine Crosstalk penalty.
8/ LOS Characteristics	√	√		√	Measure Assert/De-Assert & determine Hysteresis
9/ Rx Eye Quality	√	√		√	Capture Eyes at -30dBm, -20dBm & -10dBm

5. APD Bias Control

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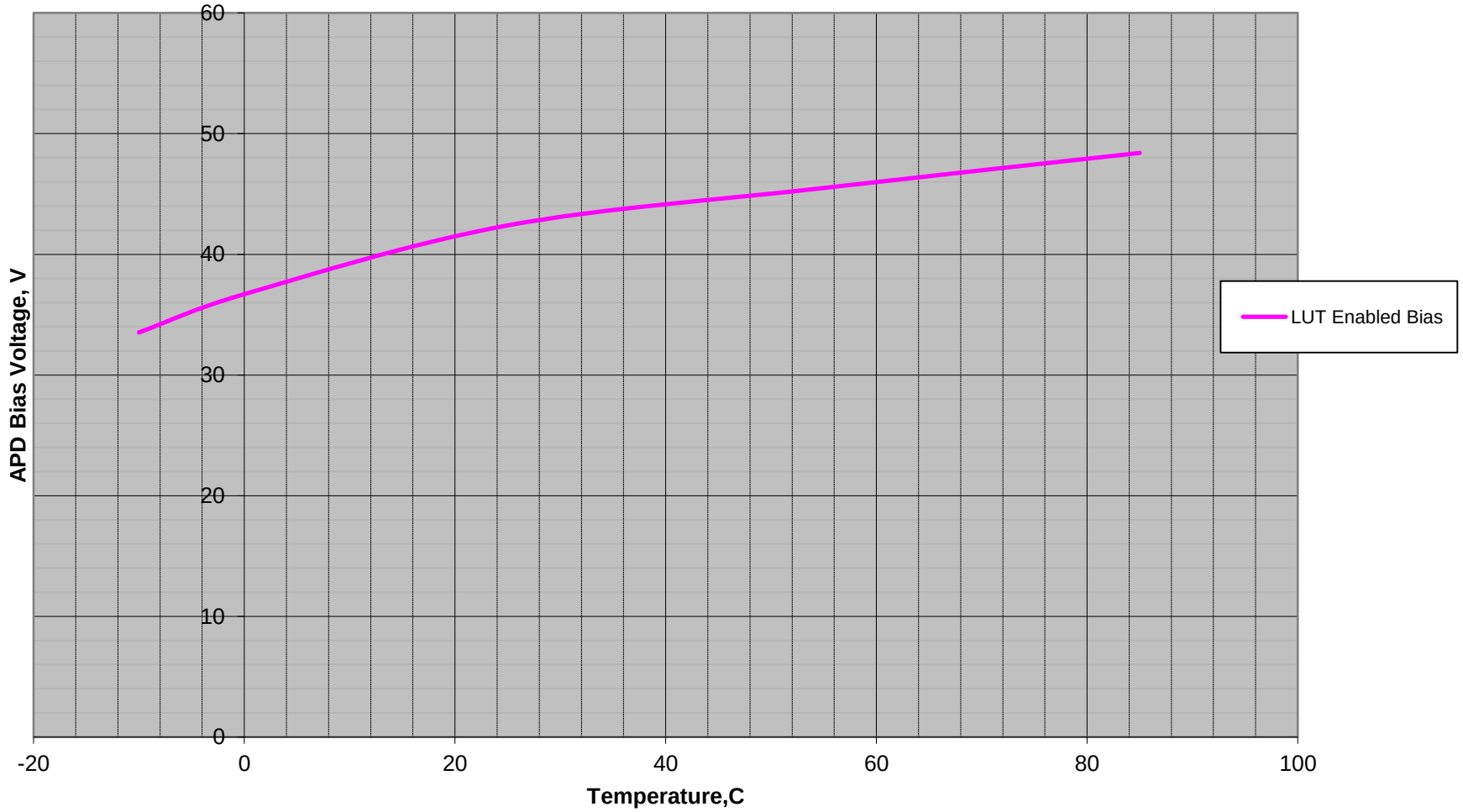
APD Bias Control – LUT



- Determine the bias seeding value at room temperature and extract slope data from the last few samples to determine other temperature points for loading LUT's.

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6. & 7. Receiver Sensitivity & Crosstalk Penalty

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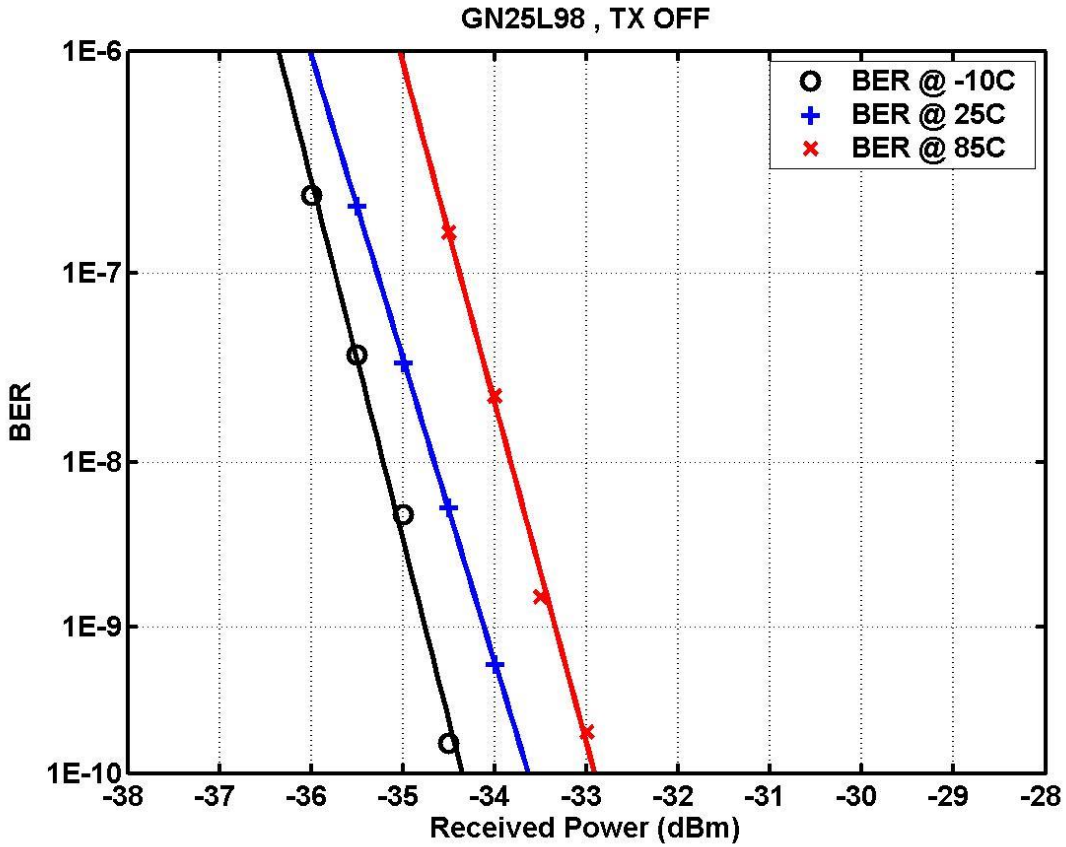
Sensitivity – Tx Disabled

- Responsivity=0.903A/W



Temperature, C	Sensitivity, 1E-10
-10	-34.37
25	-33.64
85	-32.92

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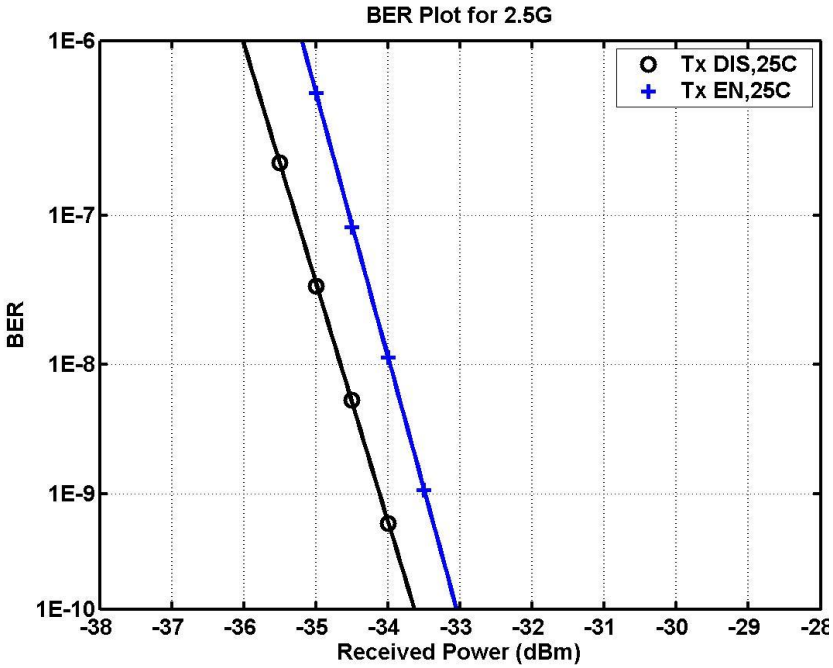
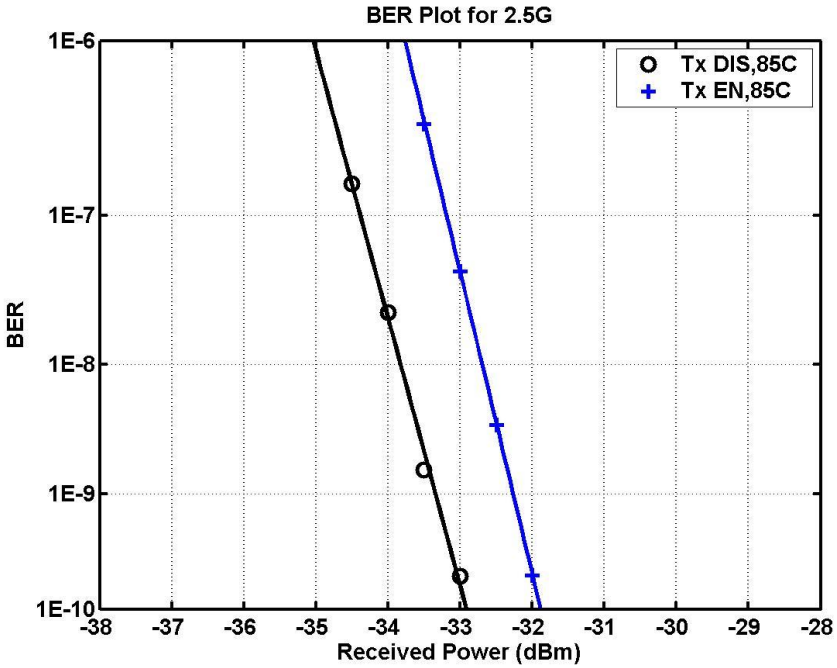
Sensitivity – Crosstalk Penalty, Temp 25C & 85C

Temp 25C



Temp 85C



Temperature, C	Tx DIS Sensitivity, 1E-10 (dBm)	Tx EN Sensitivity, 1E-10 (dBm)	Crosstalk Penalty (dB)
25	-33.64	-33.02	0.59
85	-32.92	-31.89	1.03

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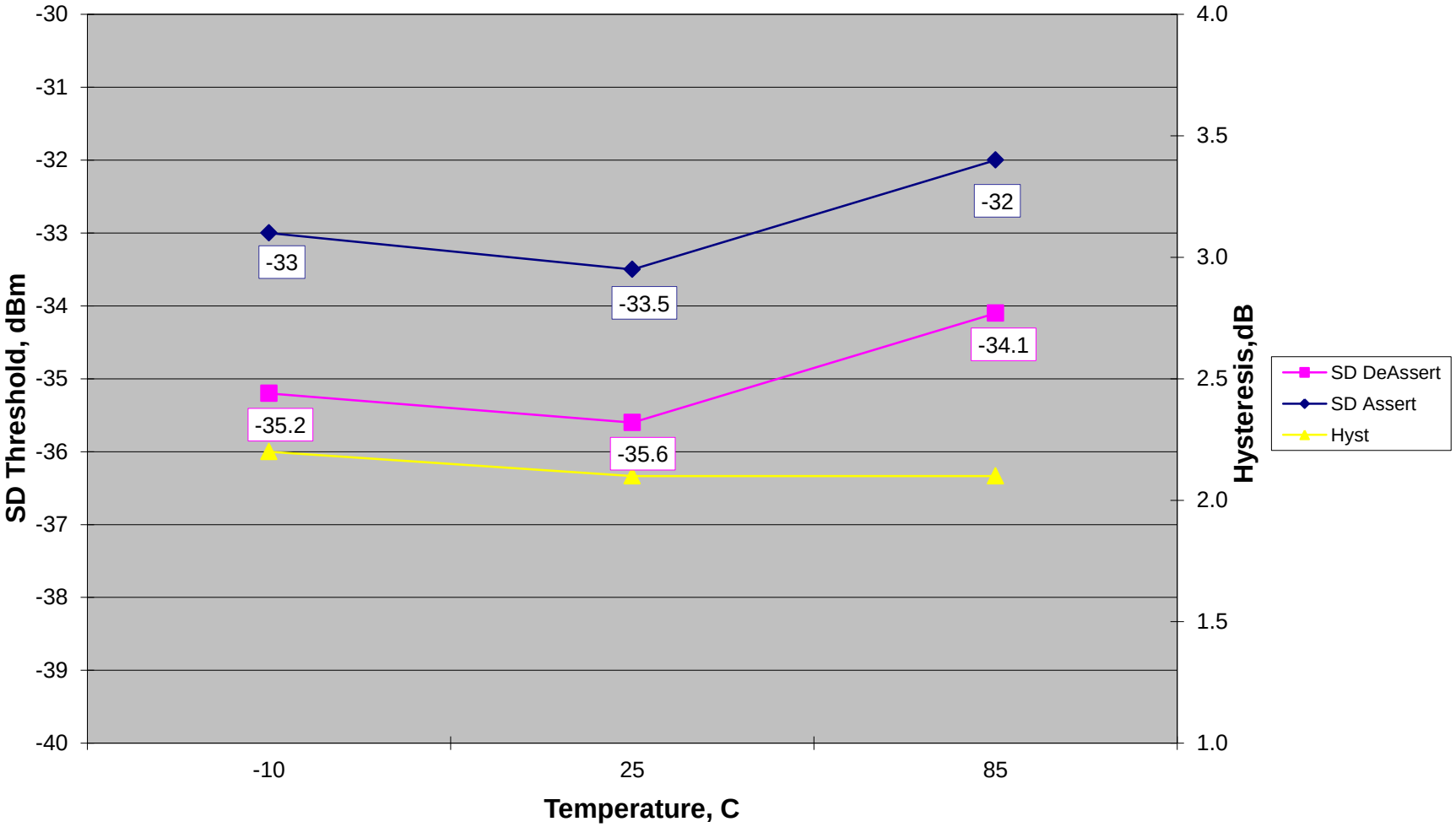
8. Signal Detect Characteristics

Signal Detect thresholds – 2dB hysteresis setting



Note: 1.5dB variation in SD Assert Threshold across -10C to +85C.

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9. Rx Eye Quality

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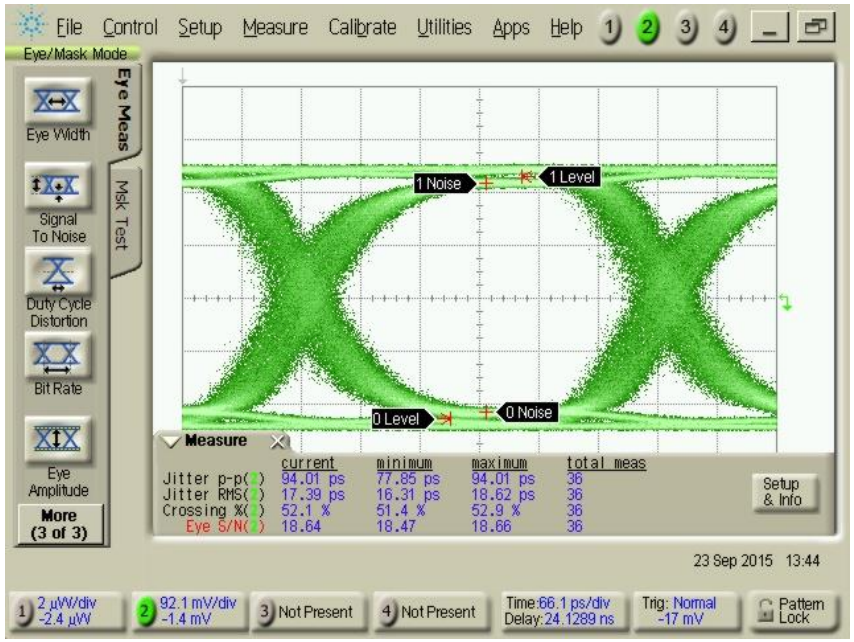
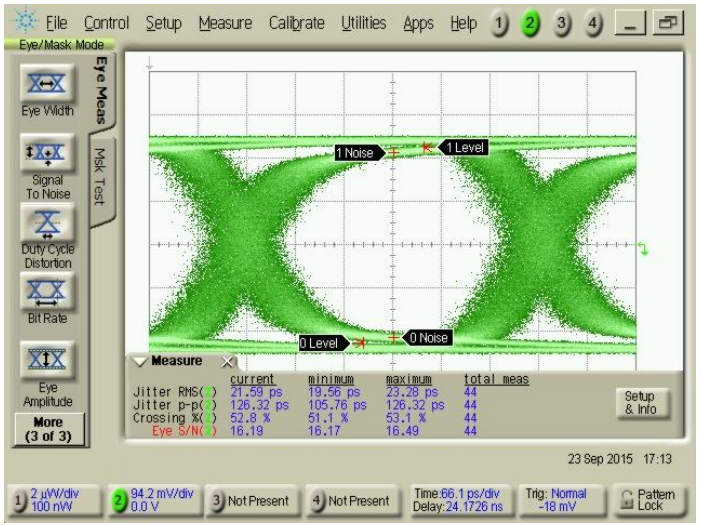
Rx Eye – Single Ended @-30dBm

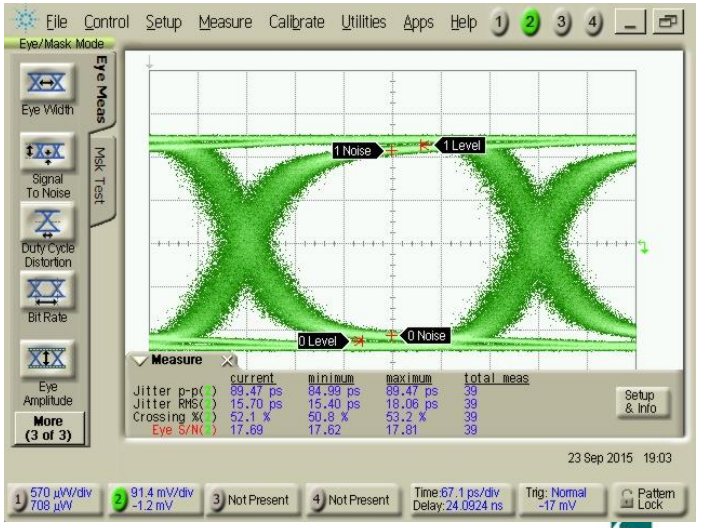
25C



85C



-10C



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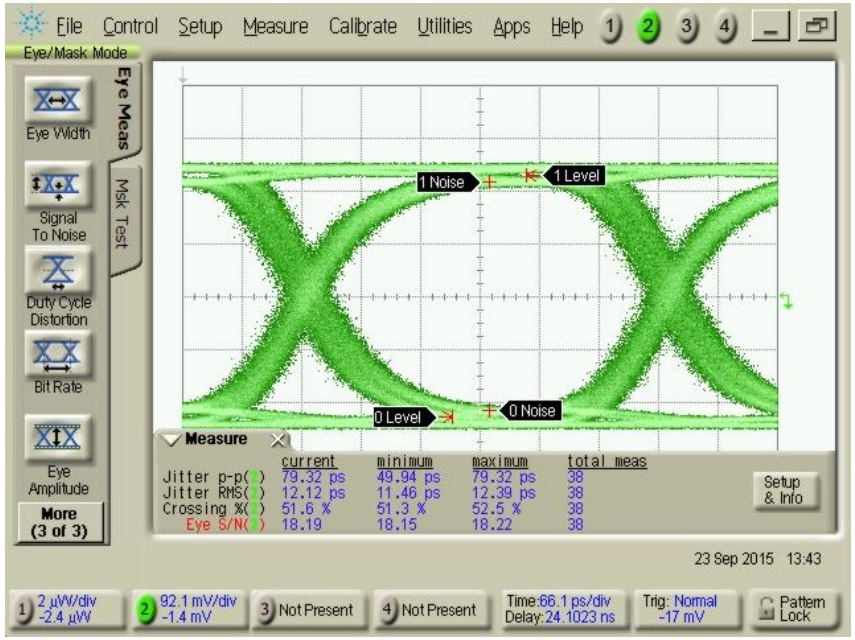
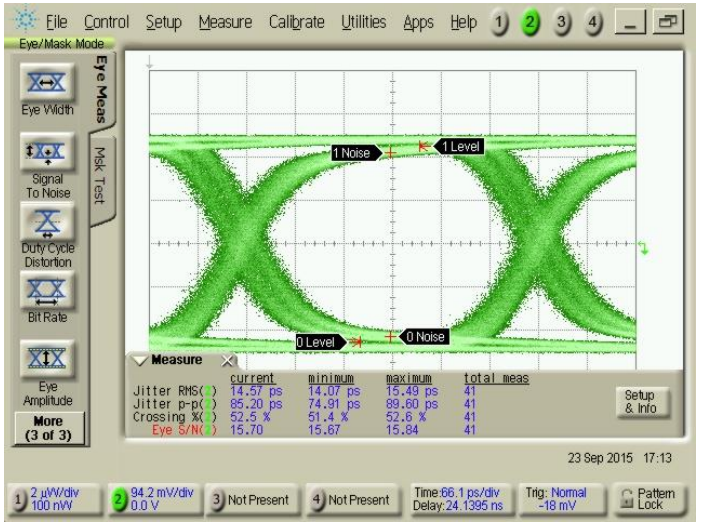
Rx Eye – Single Ended @-20dBm

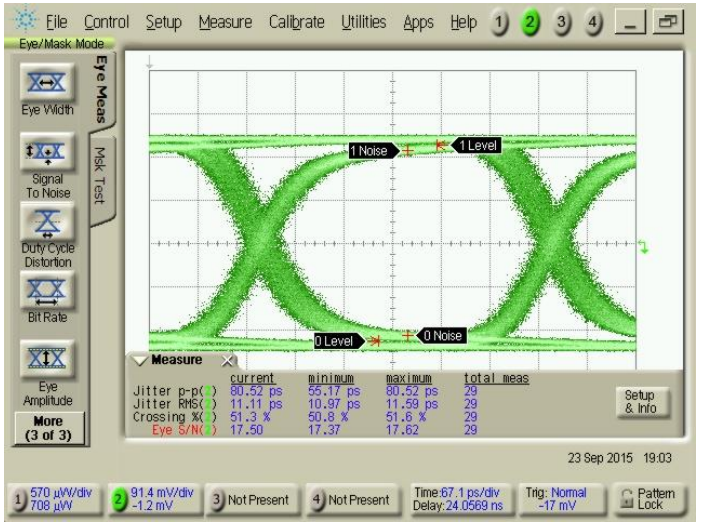
25C



85C



-10C



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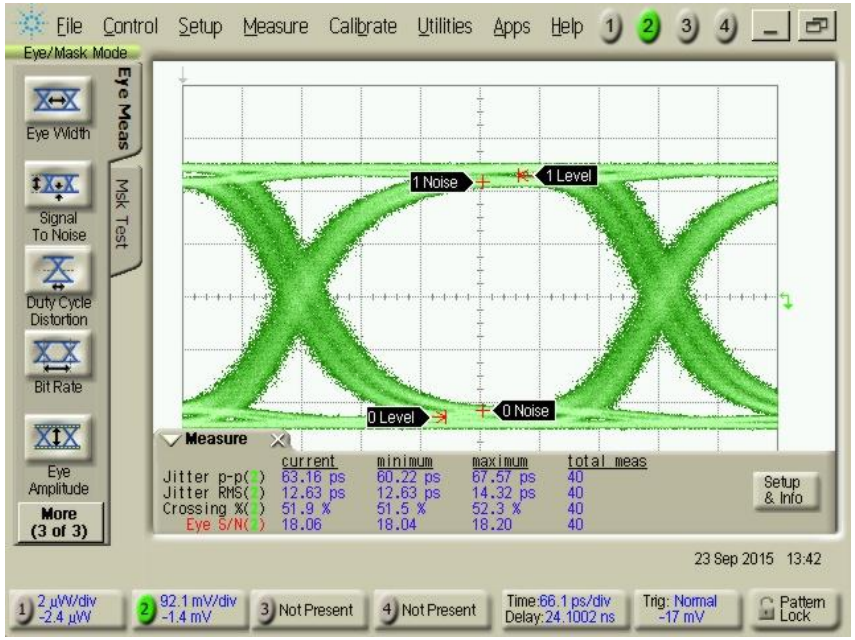
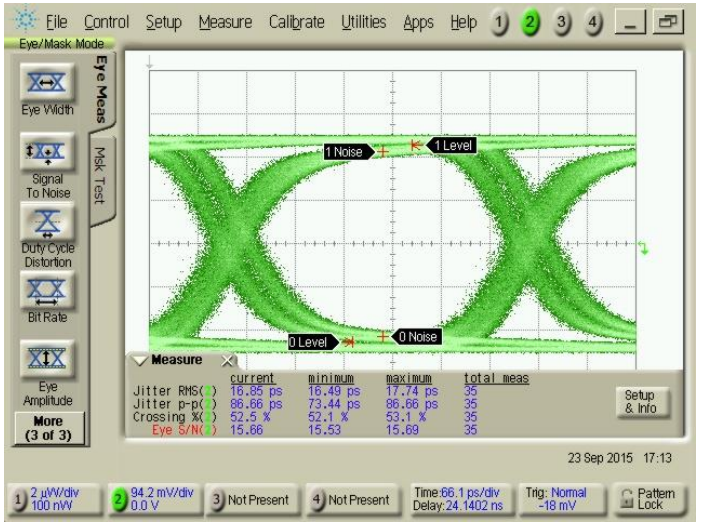
Rx Eye – Single Ended @-10dBm

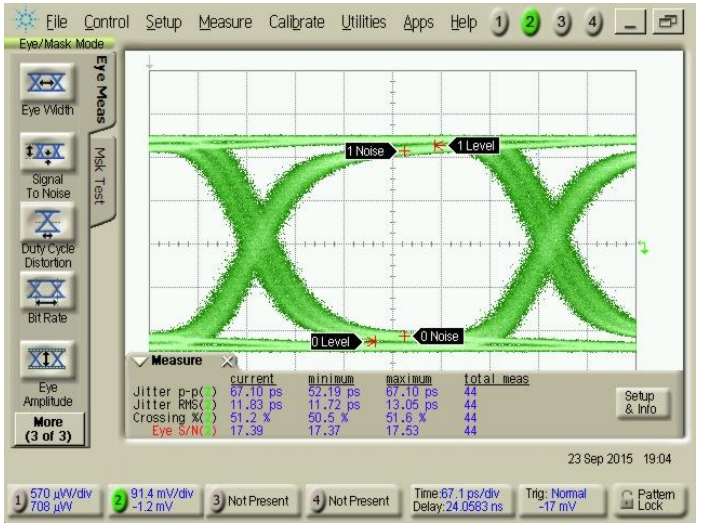
25C



85C



-10C



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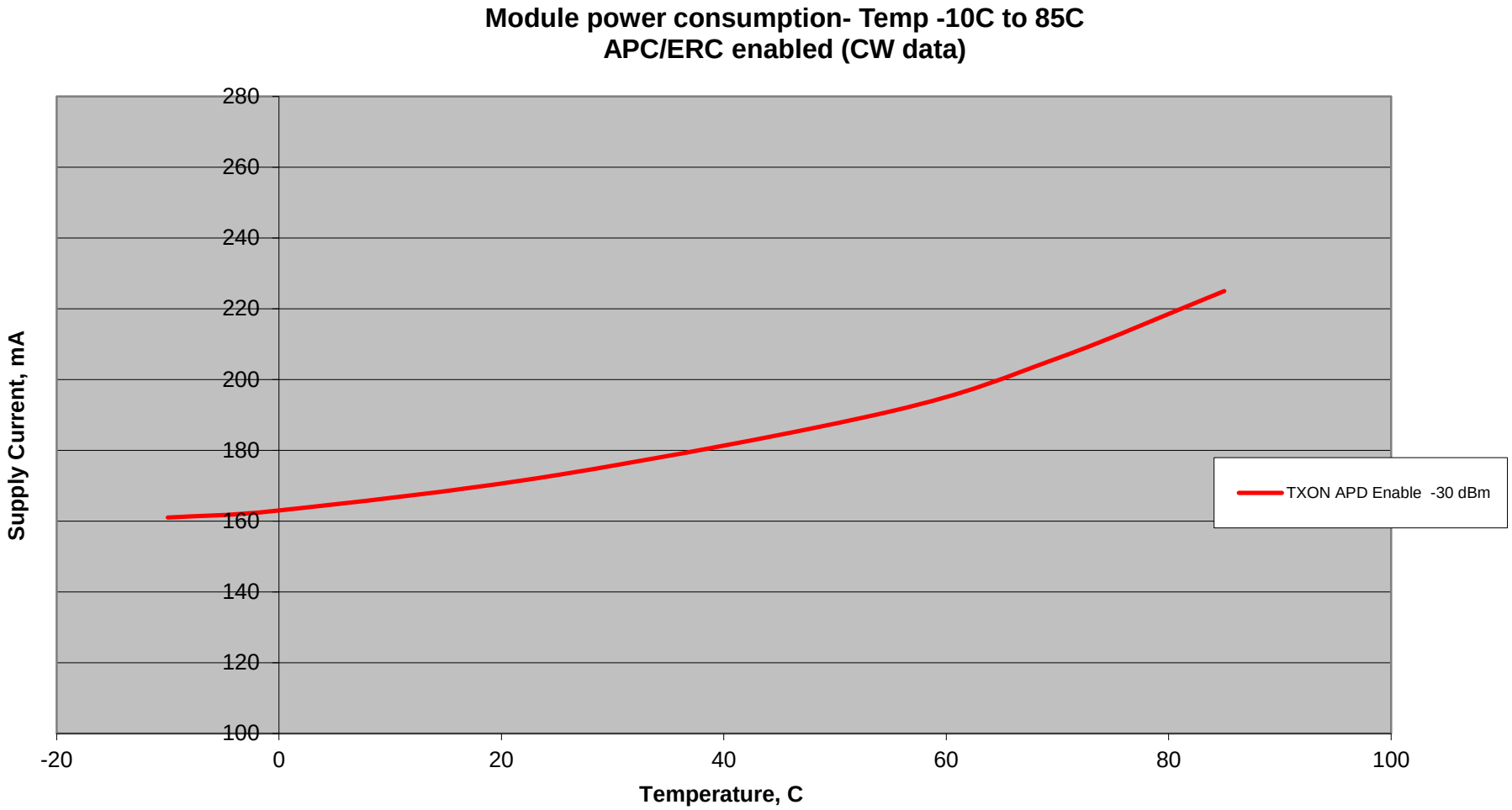
10. Power Consumption

Module Power Consumption, APD controller enabled



- Tx enabled CW data, APD Controller enabled (Popt -30dBm).

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11. DDMI Reporting Internal Calibration

DDMI Monitor Accuracy – Internal Cal

Temperature

Temp	Readback TEMP,C	Error,C
-40	-40.86	-0.86
-10	-10.73	-0.73
0	0.91	0.91
25	24.12	-0.88
70	69.03	-0.97
85	83.98	-1.02

Tx Power

TX PowerMeasured,dBm	Readback TX Power dBm	Error,dBm
3.67	3.58	-0.09
2.03	1.99	-0.04
0.03	0.12	0.09
-2.06	-1.85	0.21
-2.99	-2.69	0.3

Vdd

Vdd	Readback Vdd	Error, %
3	2.96	1.3
3.3	3.28	0.6
3.6	3.53	1.9

- Temperature calibration has to be performed with Tx and Rx powered up in normal operation mode.
  - Tx ON with Burst data
  - Rx APD controller enabled with Popt -30dBm

Bias Current accuracy difficult to define at module level, but accuracy guaranteed by product characterisation!

DDMI Monitor Accuracy – Internal Cal

Rx power

GN25L98

Rx Power Force ,dBm	Readback Rx power, dBm	Error dBm
-35	-35.23	-0.23
-33	-33.01	-0.01
-30	-30	0
-20	-20.04	-0.04
-15	-15.06	-0.06
-12	-12.1	-0.1
-8	-8.05	-0.05

GN25L95

Rx Power Force ,dBm	Readback Rx power, dBm	Error dBm
-35	-36.99	-1.99
-33	-33.98	-0.98
-30	-30.97	-0.97
-27	-27.7	-0.7
-24	-24.32	-0.32
-20	-20.22	-0.22
-15	-14.91	0.09
-12	-11.61	0.39
-9	-8.44	0.56
-7	-6.24	0.76

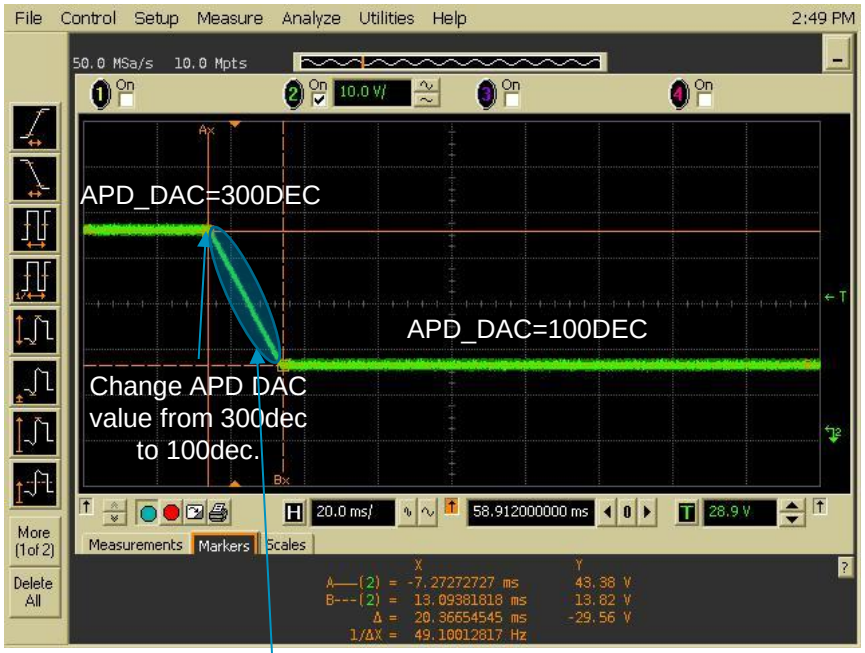
- Enhanced DDMI reporting capability provides higher margin to the specification for Rx Power reporting.

12. APD Controller OC/OV Fault

Over Voltage Fault and Auto Restart

The capture shows the restart activity in the presence of a “over voltage” event.

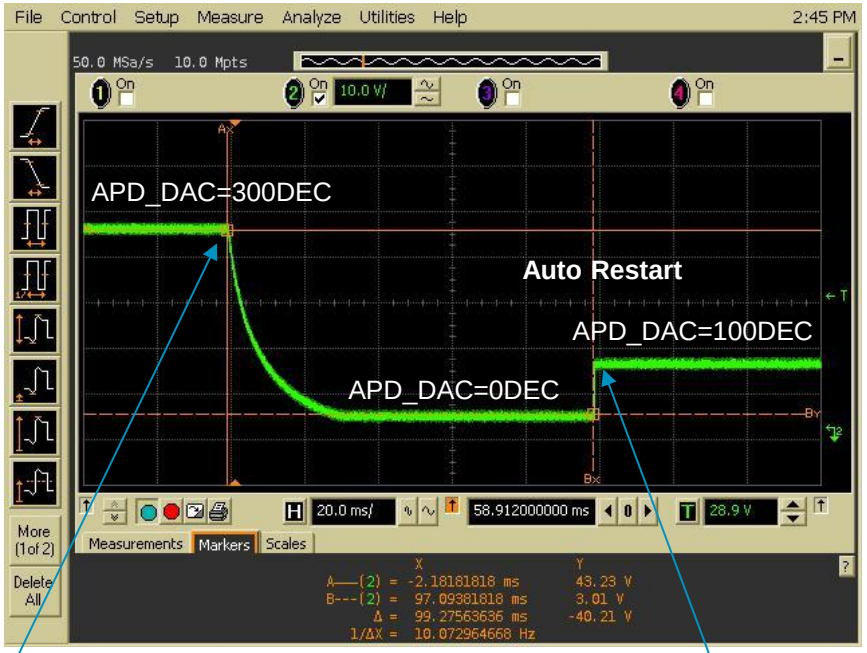
Ramp Target Enabled
Ramp Target Rate = 102us



No OV Fault

APD Bias ramp to the target value set by APD_DAC at 102us/step

Ramp Target Enabled
Ramp Target Rate = 1.6us



APD Controller shut down due to OV Fault triggered (Quick Trip NOT enabled)

OV Fault Triggered, attempts 1 restart and recovers the APD Controller

APD Controller restarted

- **The OV Threshold is defined in the equation below (refer to slide 9 for R32 and R33):**

$$\left(9.87mV + \left(1.261 * \left(\frac{APD\_THRESHOLD[7:4]}{255}\right)\right)\right) * \left(\frac{R32 + R33}{R33}\right)$$

- The OV Fault is triggered by deliberately changing the APD_DAC value from 300dec to 100dec with Ramp Target Rate set to 1.6us and APD_OV_RAMP_DIS=‘0’.
- Restart Timer is set to 105ms.

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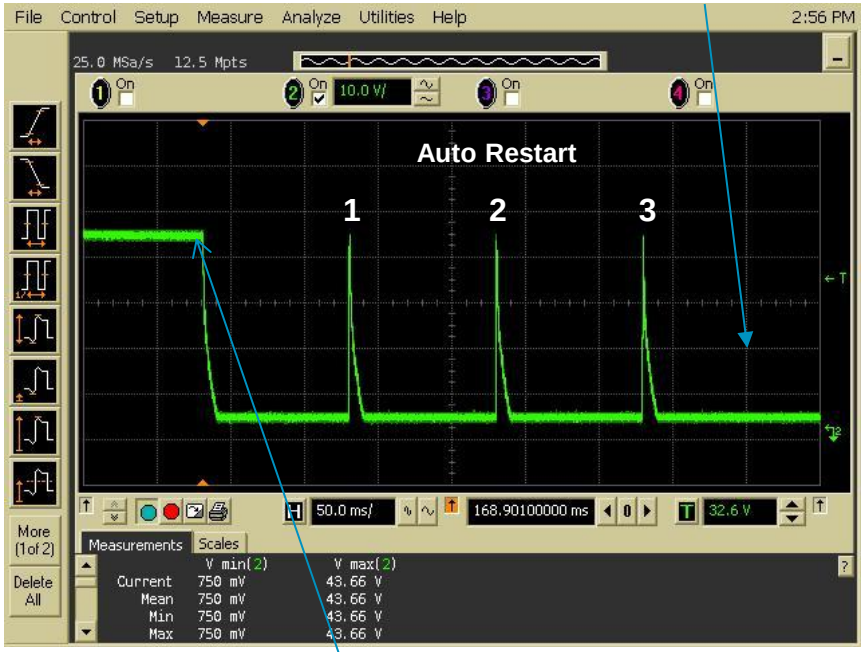
Over Current Fault and Auto Restart

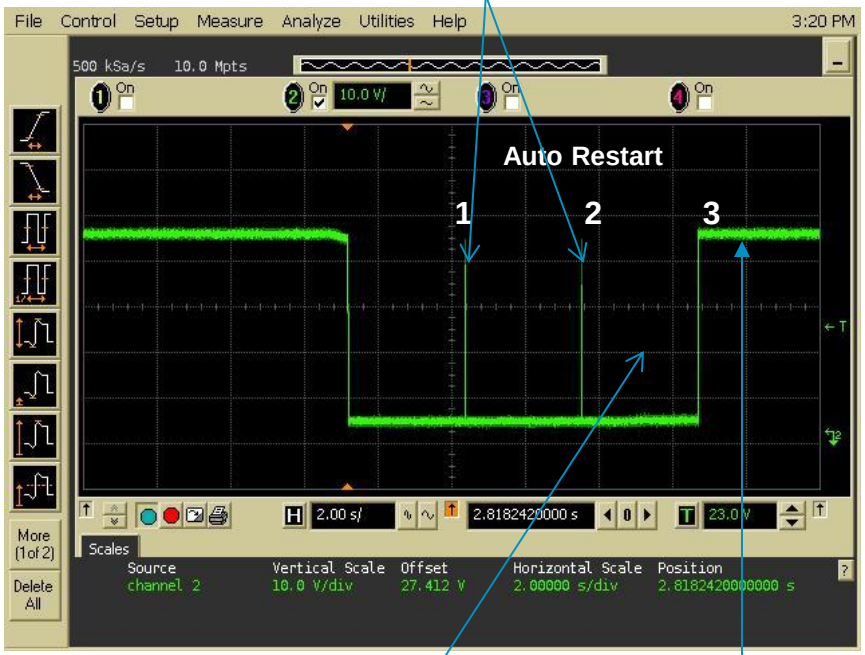
The capture shows the restart activity in the presence of a “over voltage” event.

APD Controller permanently disabled



Attempts 3 restarts and then permanently disable the APD Controller

Period between restarts is programmable, 3.36s in this case.



Attempts 3 restarts and then restart the APD Controller

APD Controller restarted

The OC Fault is triggered by increasing the input optical power above the OC Threshold.

The input optical power is changed below the OC Threshold to recover the APD controller from fault.

- **The OC Threshold is defined in the equation below:**

$$RSSI > \frac{3mA * APD\_THRESHOLD[3:0]}{15}$$

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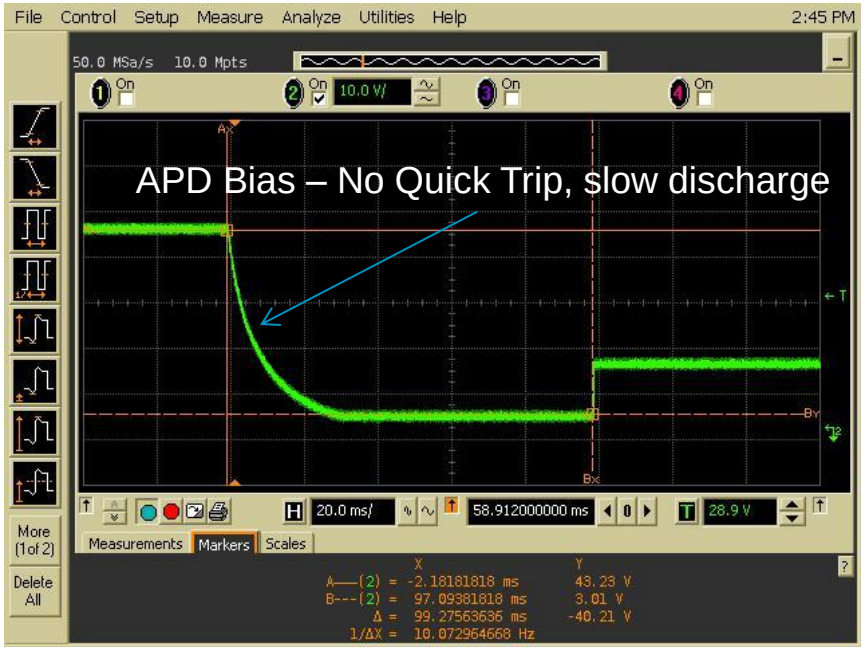
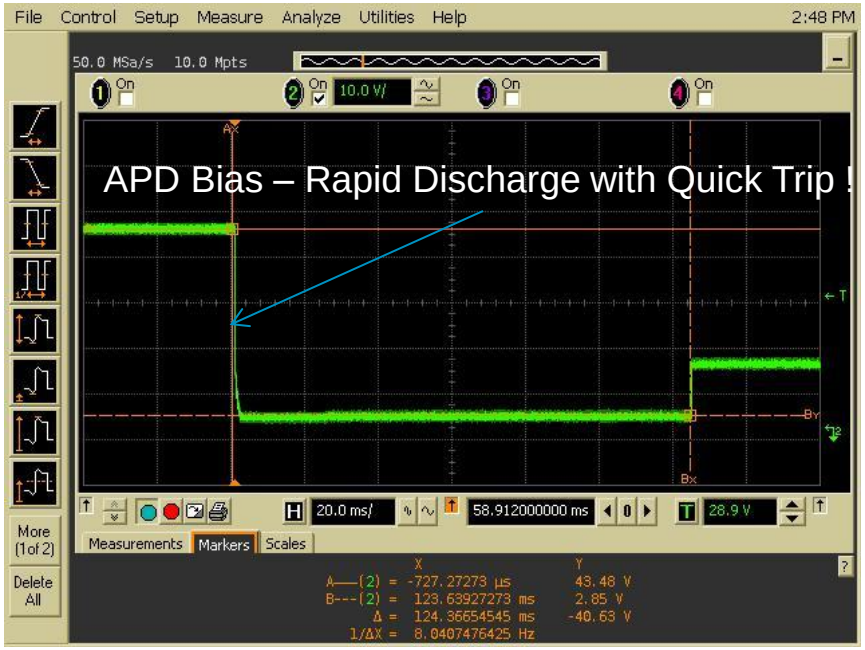
Quick Trip

The capture shows the APD output quick discharge capability of the Quick Trip functionality.



OV Fault Triggered, Quick Trip Disabled



OV Fault Triggered, Quick Trip Enabled

The quick trip signal is maintained for 20ms and is then removed

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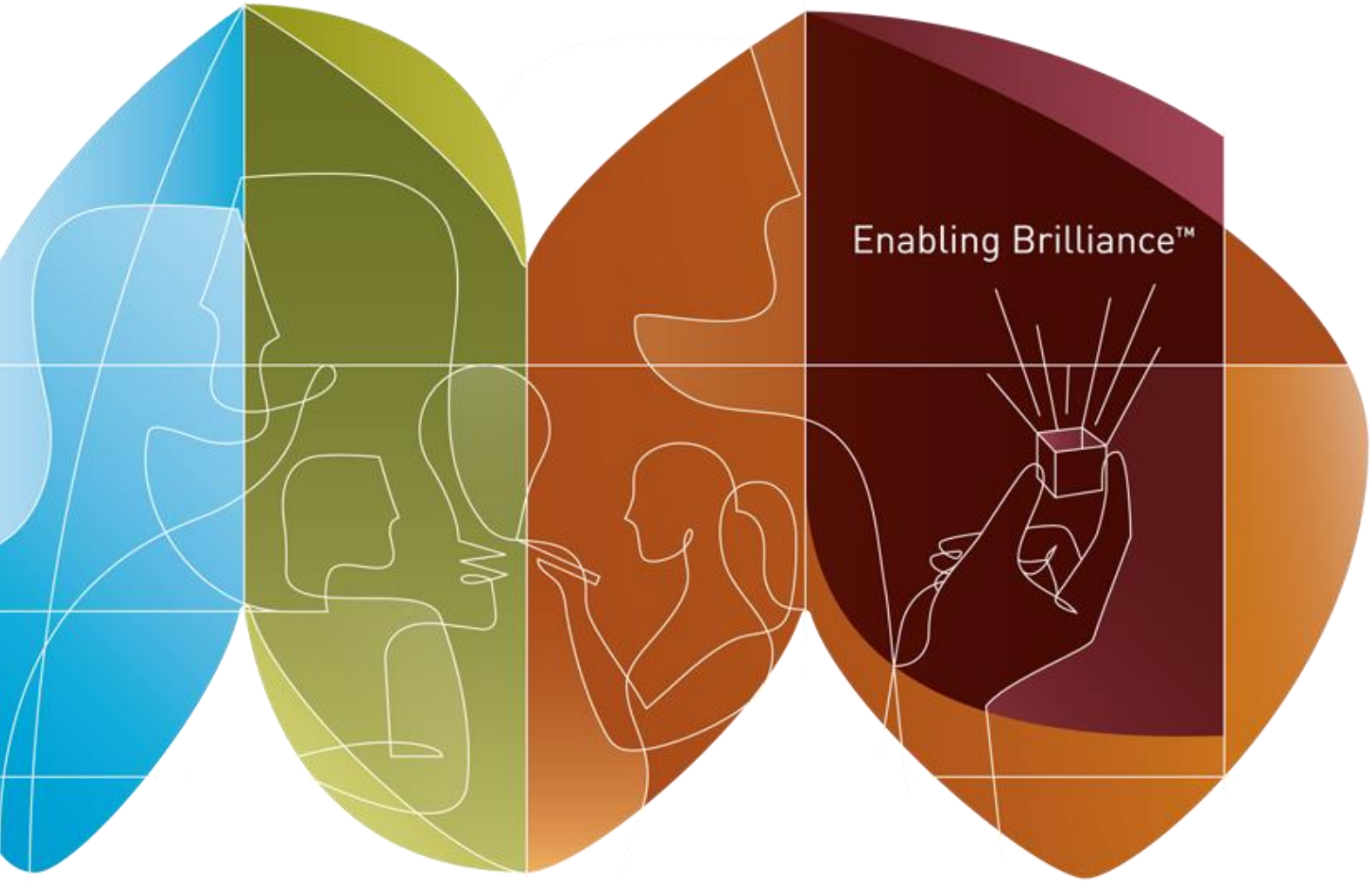
Summary

- The performance of a GN25L98 based GPON 2 Layer BOB design has been presented.
- Automatic Extinction Ratio Control has been demonstrated and will meet the requirement for BOB on applications.
  - Common requirement is ER=13dB over temperature range -40C to 85C.
  - ER variation is typical 0.31dB with TRIM_ER LUT enabled to compensate for ER variation over temperature.
- Transmitter meets Burst Settling time and Fast Start requirements with margin, utilising Bias and Mod LUT's for Fast Start seeding.
- Demonstrated the capability of the lower cost integrated APD controller and associated LUT.
- Receiver Sensitivity and crosstalk performance is competitive.
- Enhanced DDMI reporting capability provides higher margin to the specification for the parameters available, especially for Rx Power.
- GUI is available for download from Semtech FTP site. Contact Semtech Sales for details.



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