



Laboratory Verification of the SLR 2000 Quadrant Microchannel Plate Photomultiplier Tube

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12th International Workshop on Laser Ranging
Matera, Italy
November 13-17, 2000



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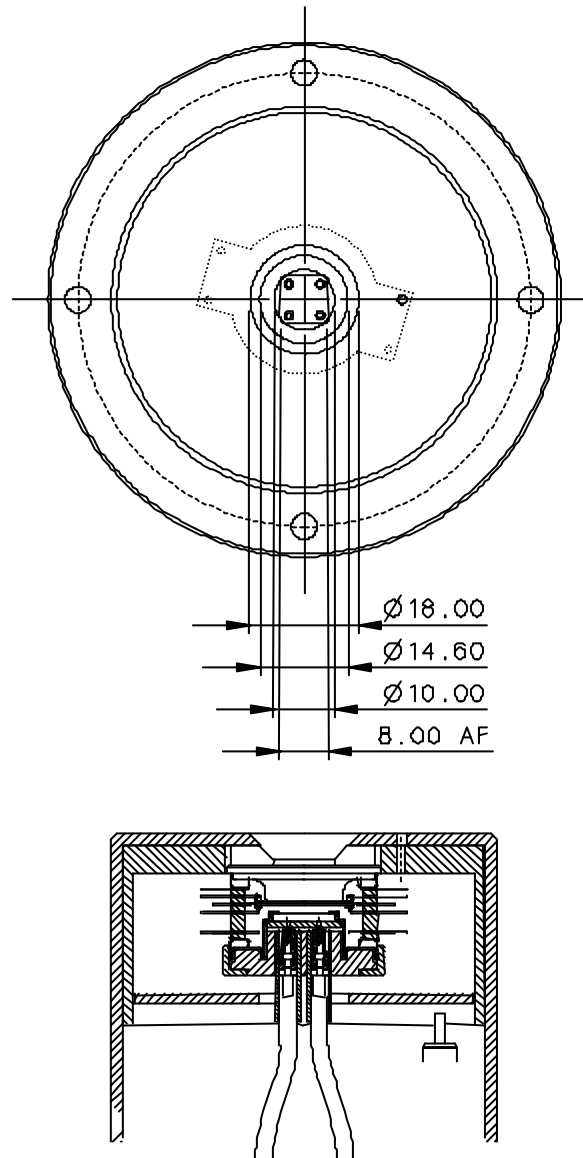
SLR 2000 Quadrant MCP



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QMCP Mechanical Design



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Quadrant Microchannel Plate (QMCP)

Features:

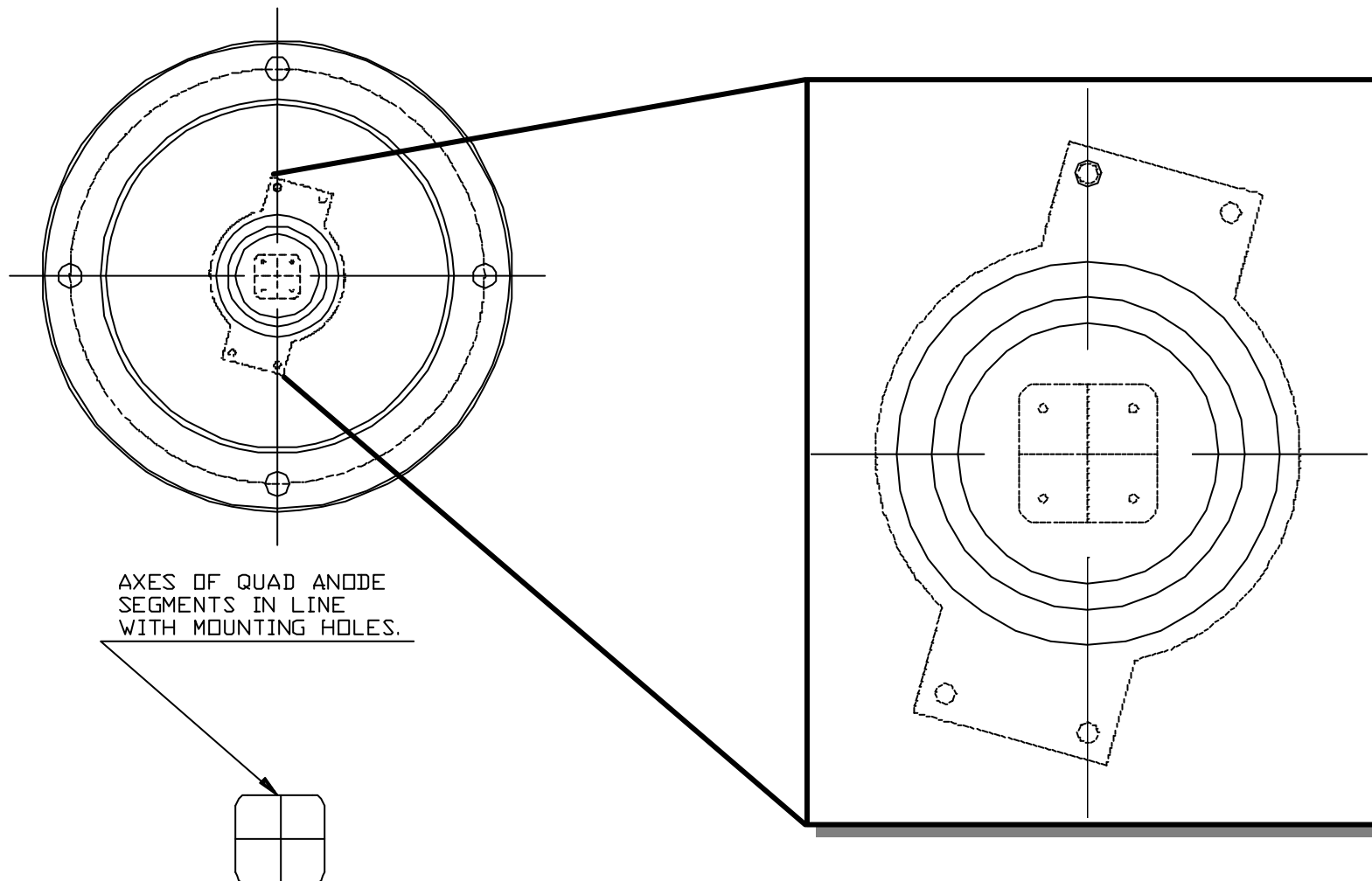
- **Quadrant anode to facilitate pointing corrections**
- **Fast Rise Time ~ 180 ps**
- **Low Timing Jitter ~ 40 ps**
- **Low Timing Offset between quadrants ~8 ps**
- **12% - 14% Quantum Efficiency @ 532nm**
- **3×10^6 Gain**
- **5 Vdc TTL Trigger Input**
- **Four Outputs**



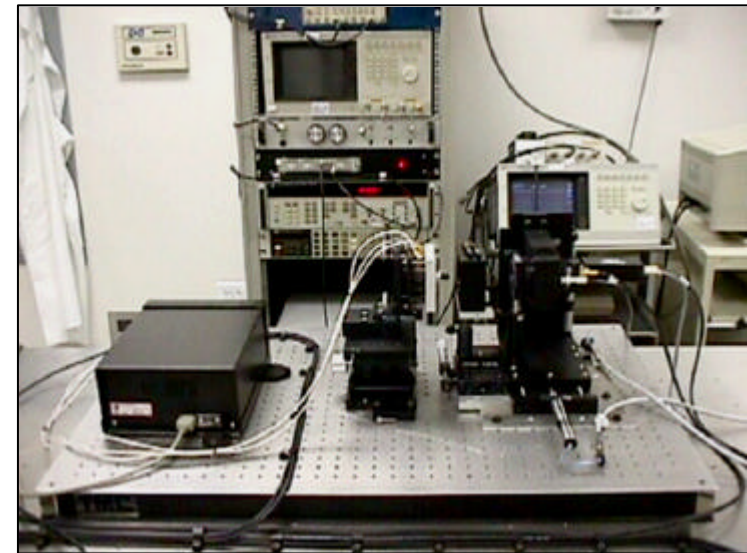
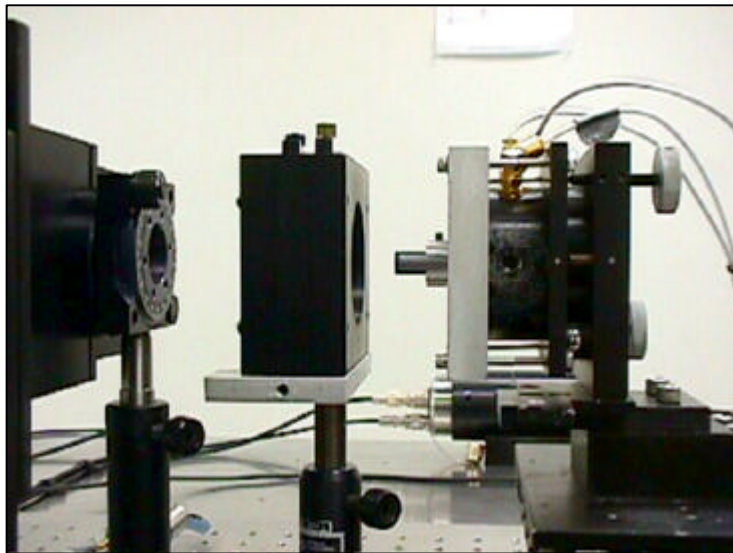
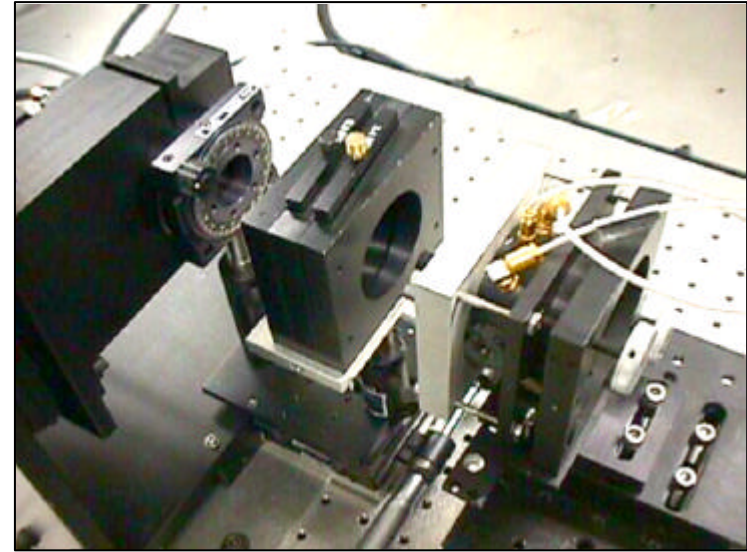
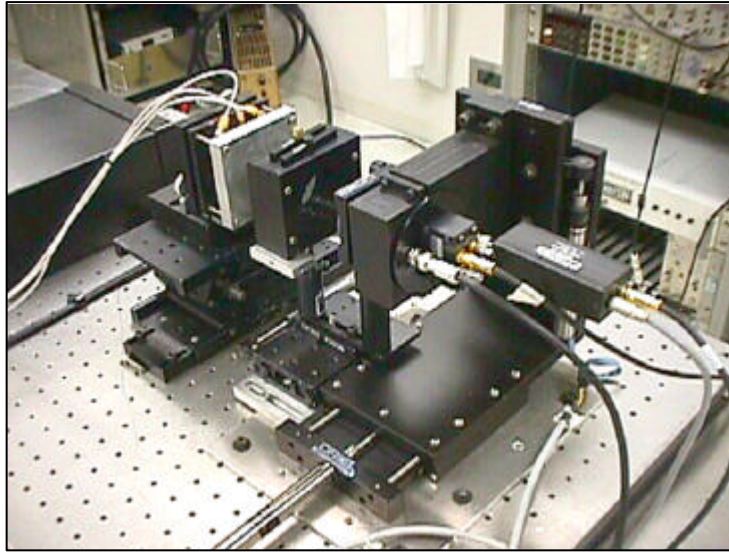
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Quadrant Anode



QMCP Laboratory Test Set Up



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Laboratory Equipment

- **Photek** **GM 150-20 Gating Unit**
- **Opto Electronics** **PLS20 Pulsed Diode Laser**
- **Opto Electronics** **PD10 Picosecond Photodetector**
- **Avtech** **AVRH-1-PS Pulse Generator**
- **Hewlett Packard** **54120 Digital Sampling Oscilloscope**

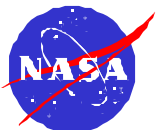


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Laboratory Equipment Equipment and Parameter Measurement Values

- All equipment was within manufactures calibration specifications and within manufacturers calibration period
- QMCP Rise Time and Timing Jitter values were decoupled from individual rise time and timing jitter values of the pertinent laboratory equipment

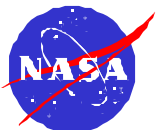
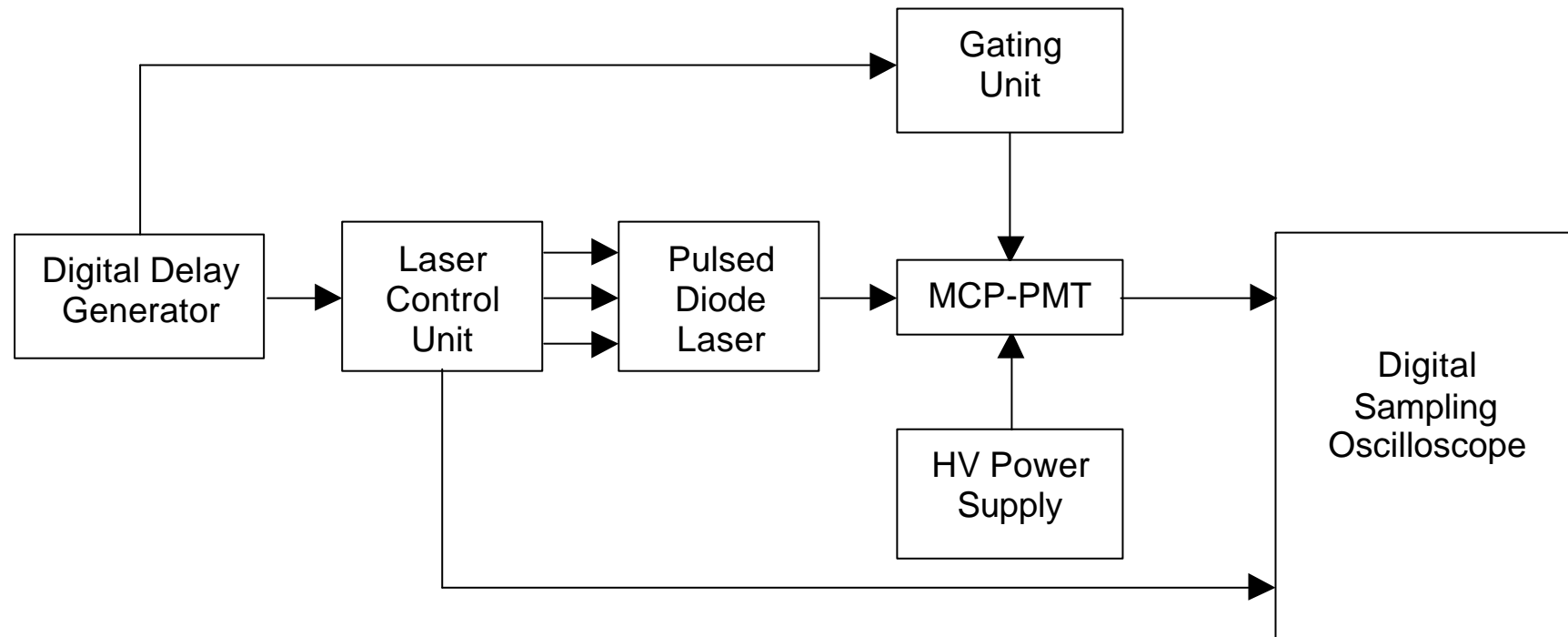


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QMCP Laboratory Test Set Up

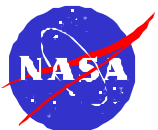
Rise Time and Timing Jitter



Rise Time Measurement

Purpose:

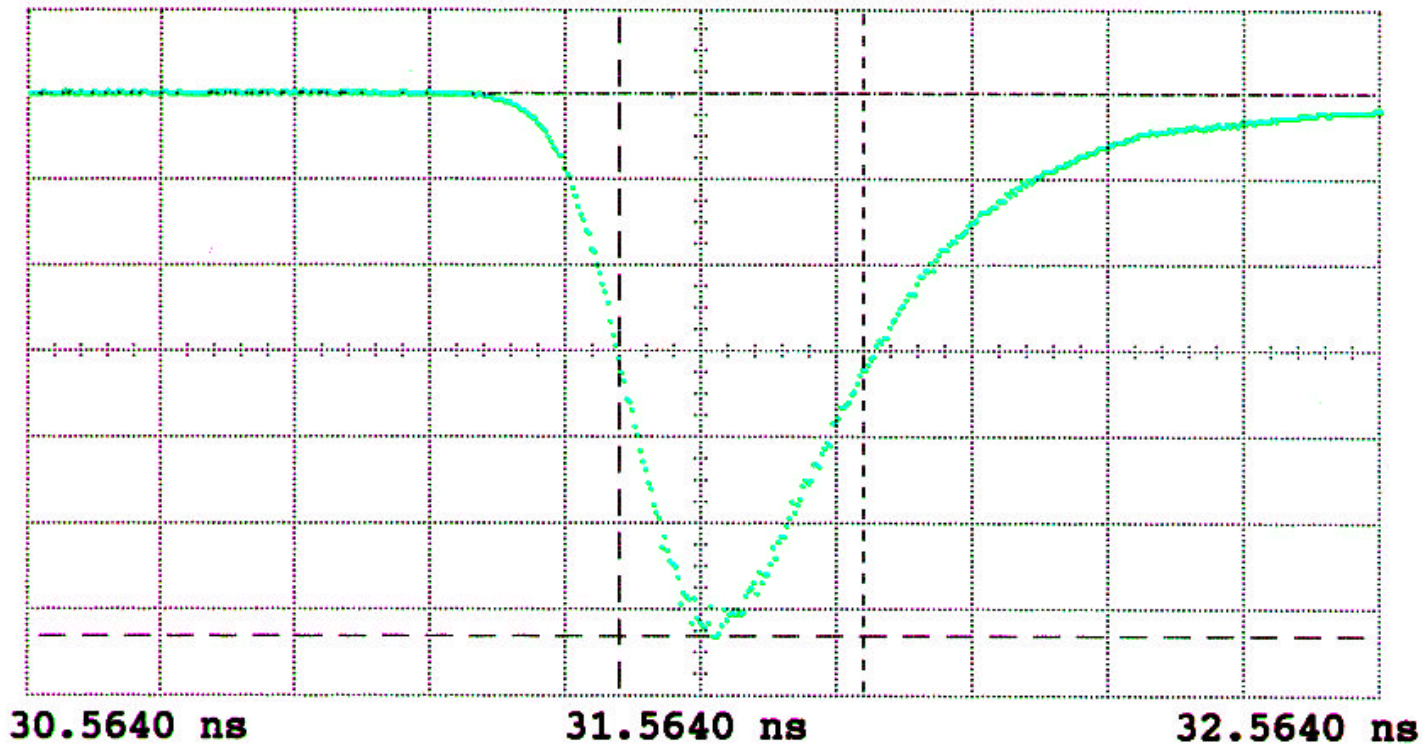
- Quantify the time of transition between the 10 percent and the 90 percent points on the leading edge of the QMCP output pulse



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QMCP Rise Time



■ Ch. 2 = 400.0 mVolts/div
■ Timebase = 200 ps/div
■ Ch. 2 Parameters
■ Rise Time = 507.4 ps
■ - Width = 360.8 ps
■ Preshoot = 495.0 m%

Offset = -1.207 Volts
Delay = 31.5640 ns
P-P Volts = 2.5375 Volts
Fall Time = 185.2 ps
Overshoot = 0.000 %

Range: 179 ps to 181 ps across 4 quadrants



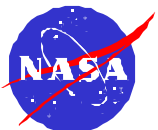
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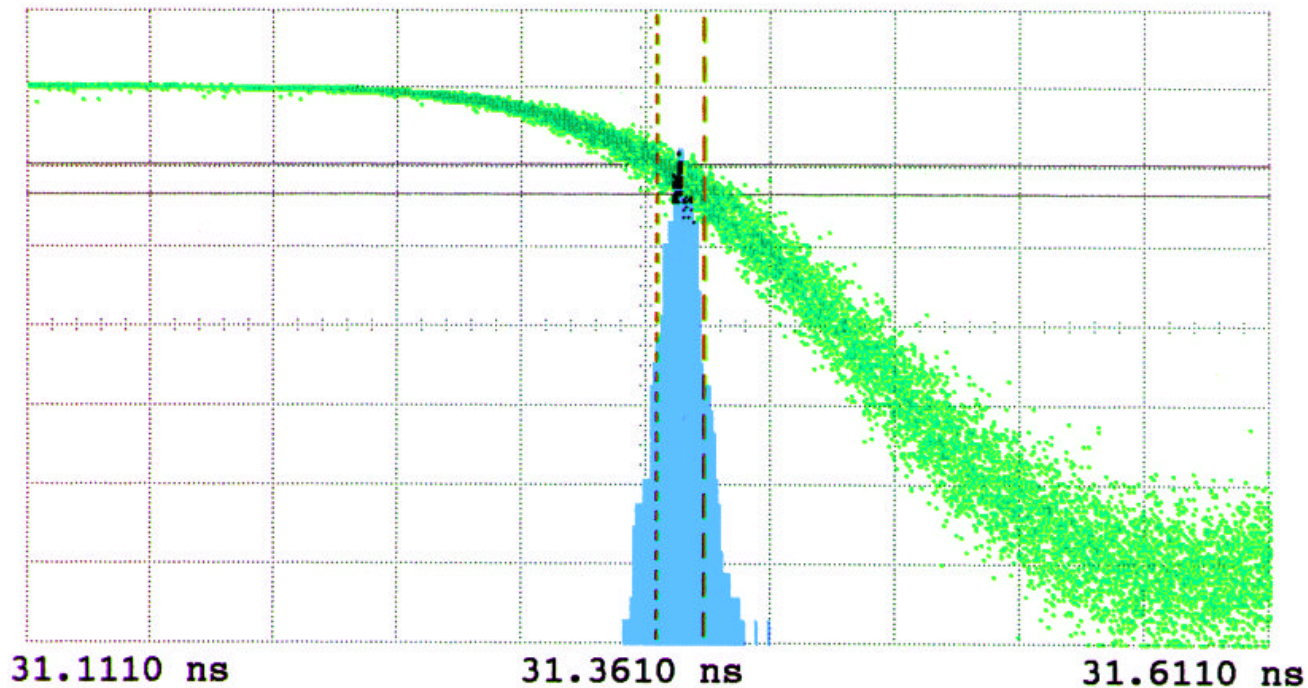
Timing Jitter Measurement

Purpose:

- Quantify the variation in the transit time of a receive signal through the QMCP as measured at the 50% point of the rising edge of the receive signal



QMCP Jitter



■ Ch. 2 = 400.0 mVolts/div
■ Timebase = 50.0 ps/div
■ Delta Window = 150.00 mVolts
■ Window 1 = -400.00 mVolts
■ Delta % = 66.73 %
■ Upper = 83.97 %
■ Delta T = 19.2 ps
■ Start = 31.3845 ns
■ # Samples = 500
■ Mean = 31.3749 ns

Offset = -1.207 Volts
Delay = 31.3610 ns
Window 2 = -550.00 mVolts
Lower = 17.24 %
Stop = 31.3653 ns
Sigma = 9.6 ps

Range: 39 ps to 47 ps across 4 quadrants

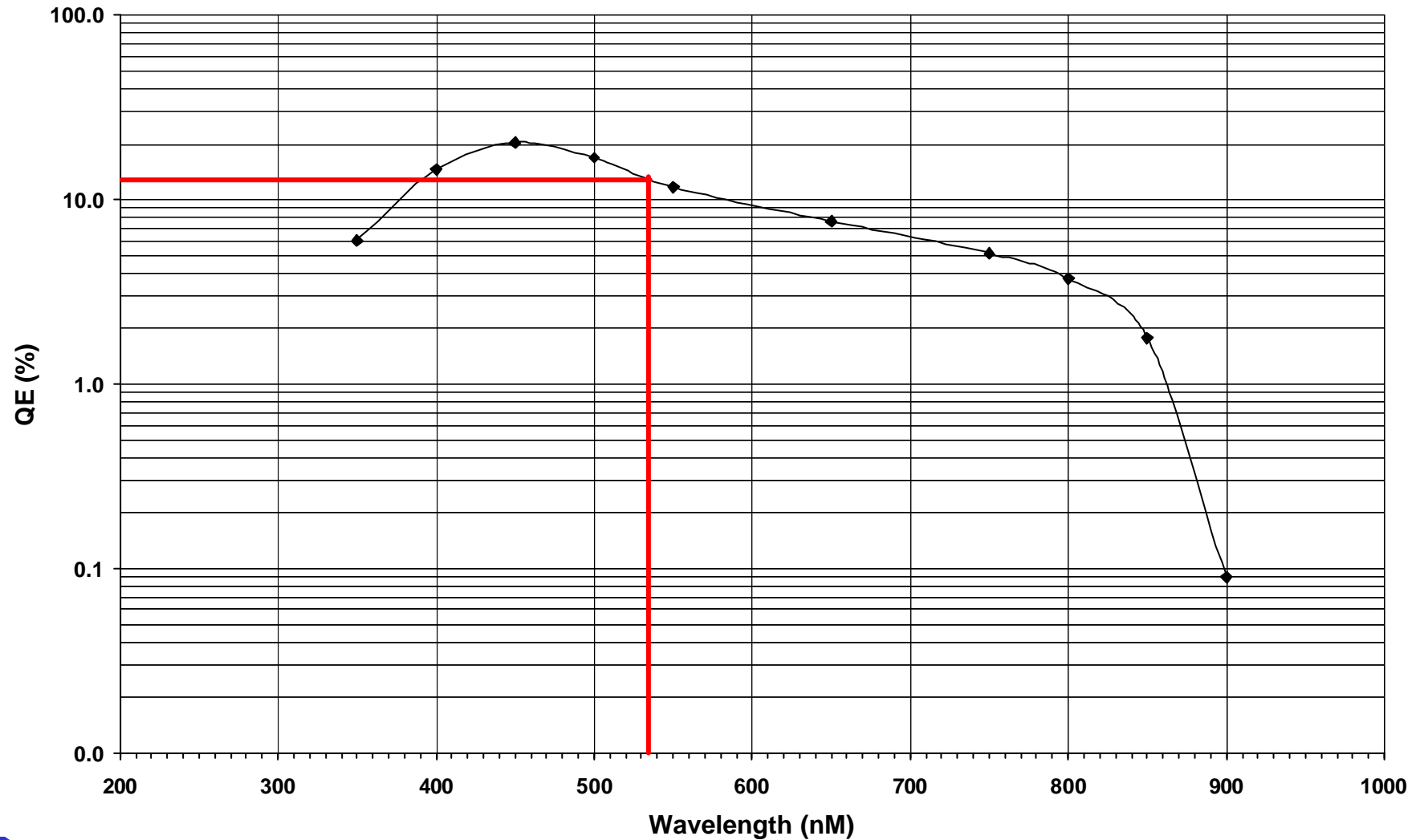


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QMCP Spectral Response per Manufacturer

Serial Number: 42981001

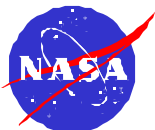


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QMCP Performance Matrix

Characteristic	Specification	QMCP	QMCP	Test Method	Result
		41981001	42981001		
Expected Input to Detector	532 nm @ 2KHz	N/A	N/A	N/A	N/A
Rise Time	<125 ps all quadrants	Q1-178 ps Q2-178 ps Q3-172 ps Q4-174 ps	Q1-180 ps Q2-179 ps Q3-179 ps Q4-181 ps	Lab Measurement	Accepted
Timing Offset	0 ps between all quadrants	6 ps	8 ps	Lab Measurement	Accepted
Timing Jitter at Anode (Method 1)	<28 ps RMS on any quadrant, <40 ps between any two	Q1-34 ps Q2-34 ps Q3-37 ps Q4-45 ps	Q1-39 ps Q2-42 ps Q3-42 ps Q4-47 ps	Lab Measurement	Accepted
Gain	3X10 ⁶ with a Goal of 10X10 ⁶	3.5X10 ⁶ @ -4700	3X10 ⁶ @ -4400	Manufacturers Data Sheet	Accepted
External Gating	<20 ns turn-on	~3 ns	~3 ns	Lab Measurement	Accepted
Anode Output Connectors	Four SMA Connectors	Concur	Concur	Lab Observation	Accepted
Active Cathode Area	12 mm	8mm	8mm	Lab Measurement	Accepted
Anode Structure	Quadrant - 4 pie shaped wedges of 90 degrees each	Quadrant - 4 square shaped wedges	Quadrant - 4 square shaped wedges	Lab Measurement	Accepted
Quantum Efficiency	>15% @ 532	12.59%	13.60%	Manufacturers Data Sheet	Accepted
High Voltage Bias Supply	External DC power supply	Concur	Concur	Lab Observation	Accepted
Mounting	Precision mounting with quadrant axis indexed	Concur	Concur	Lab Measurement	Accepted



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