Systems Design Review

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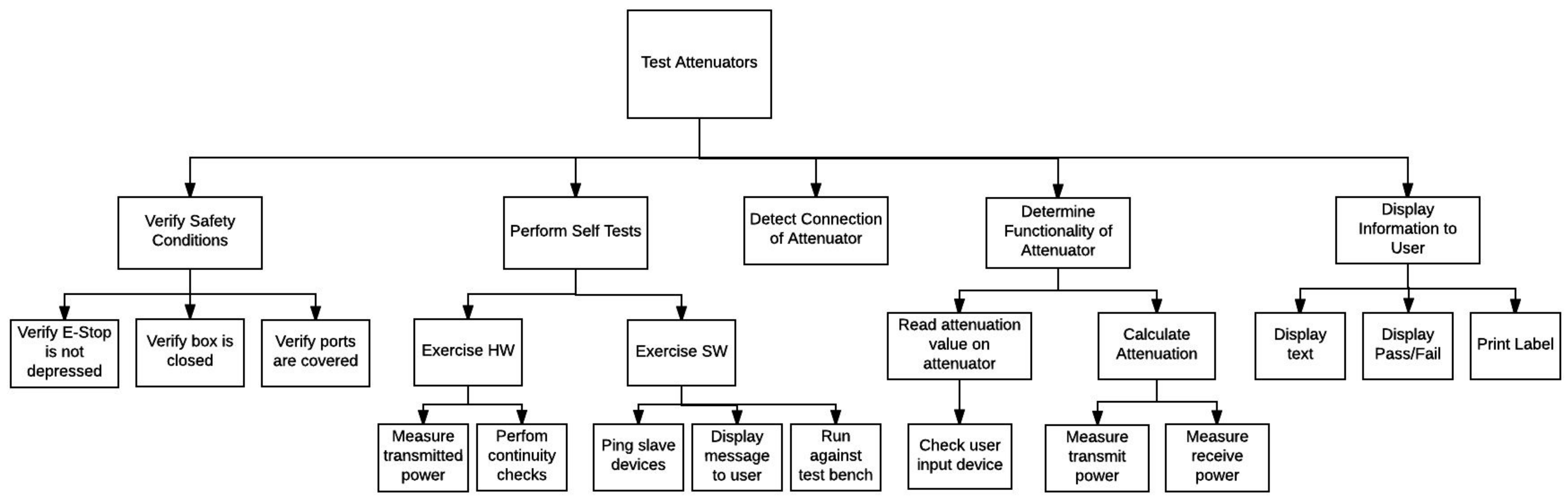
Functional Decomposition



Engineering Metrics

RGMT#	Importance	Function	Engineering Metric	Unit of Measure	Marginal Value	Ideal Value
S1	9	Speed of attenuation test per unit	Time	sec	120	60
S2	3	Size of test fixture	Dimensions	inches	15 X 17 X 3.5	8 X 17 X3.5
S3	9	Measurement Accuracy vs calibration equipment	Percentage	%	10	5
S4	3	Test frequency per unit	Frequency	Tests/Day	3	1
S5	3	Amount of coverage for failure cases	Percentage	%	50	80
S6	9	Wavelength supported by test fixture	Wavelength range	nm	1310, 1550	850, 1310, 1550
S7	3	Laser Power	Power	mW	50	100
S8	9	Optical SNR	Ratio	dB/dB	10	20
S9	9	Resolution of measurement	Power	dB	0.1	0.05
S10	9	Number of attenuator uses	Quality	#	100	128

Test Plan (how are we going to test that requirements are met)

Accuracy test: Test POTATO attenuation measurement vs reference attenuation measurement systems.

Failure mode test: Perform failure tests on attenuators for most failure modes and record the POTATO system’s test results for each failure mode.

SNR test: Probe each optical sensor’s output with oscilloscope to measure signal and noise levels.

Pugh Chart

Criteria	Option 1	Option 2	Option 3
User input	External Keyboard	Touch Screen	Number pad, push buttons
User display	LCD screen	Touch Screen	7 Seg display, 3 LEDs
Measure attenuation	Light Source, Power Meter, OCWR	Light Source, Power Meter, OTDR	Light Source, Power Meter
Hardware self test	Output power of laser, Temperature monitor, Interlock monitoring	Cleanliness with camera, Interlock monitoring, BIST, Output power of laser	Interlock monitoring, Output of laser
Software self test	Testbench	Ping, Testbench	Testbench
Safety(laser)	All interlocks	All interlocks	All interlocks
Calibration	Adjust laser feedback	Adjust laser feedback, Clean port	Adjust laser feedback
Detect Connection	Push button	Light Sensor	Mechanical click
Optical Path	Fibers	Free Space	Fibers

Design Selection Criteria

Criteria	***Importance***
Time to develop	9
Cost	9
Accuracy	9
Safety	9
Complexity of implementation	9
Test speed	6
Ease of use	6
Serviceability (Design for test)	6
Manufacturability (feasibility)	3
Throughput	3
Form factor	1

Design Selection

User input: Touch screen, ON/OFF button, E-stop button

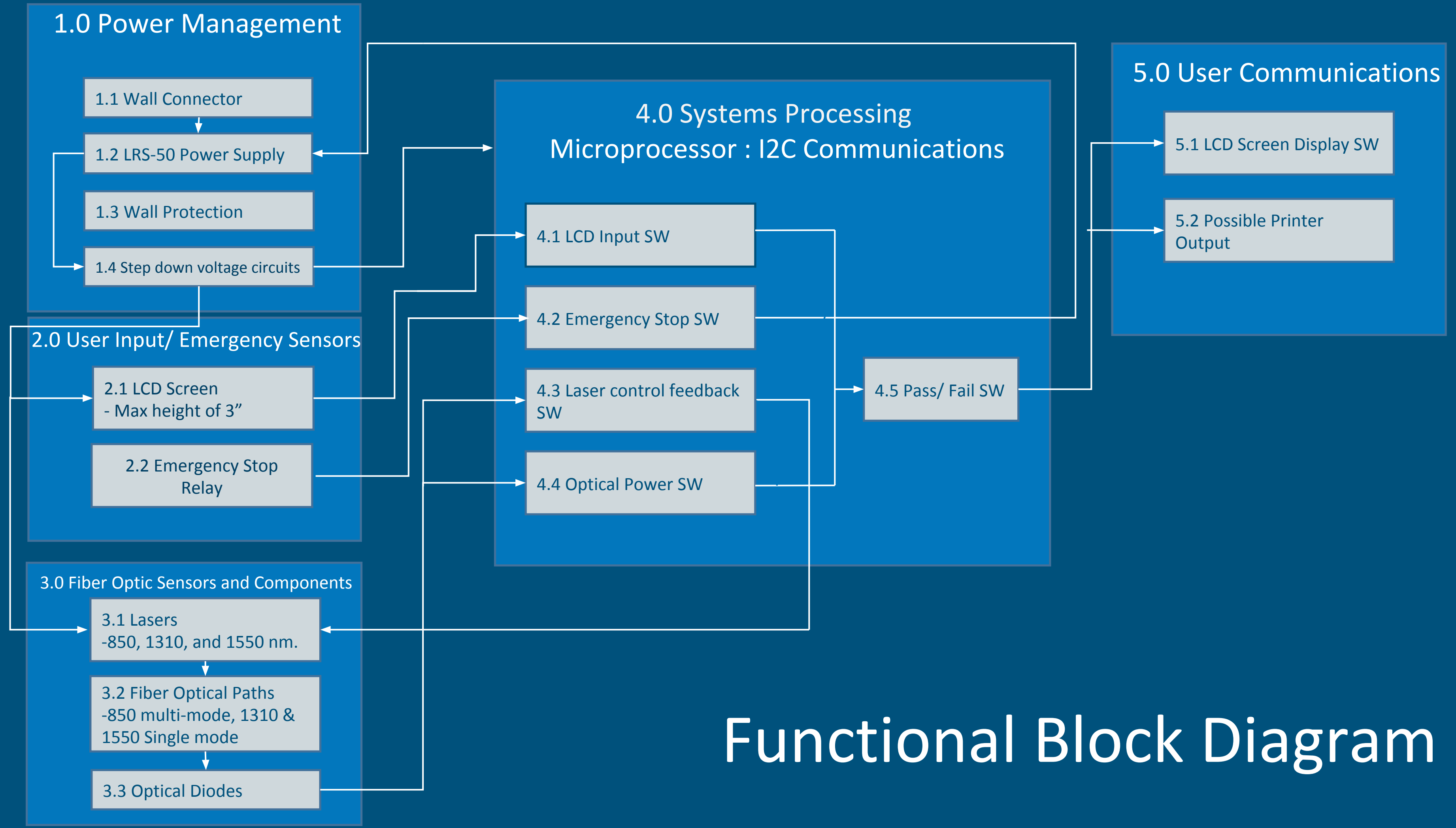
User display: Touch Screen

Measurement methods: Insertion loss & Return Loss (OCWR)

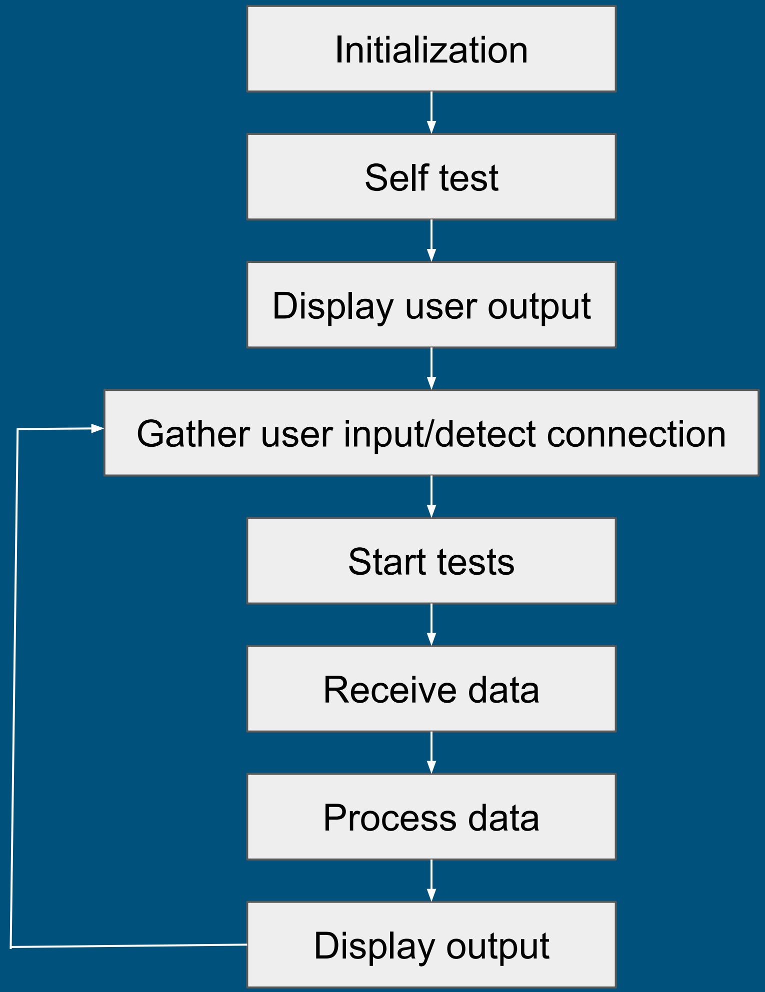
Self test method: Measure laser power

Laser safety: Interlock system connected to E-stop, box lid, and optical port

Functional Block Diagram



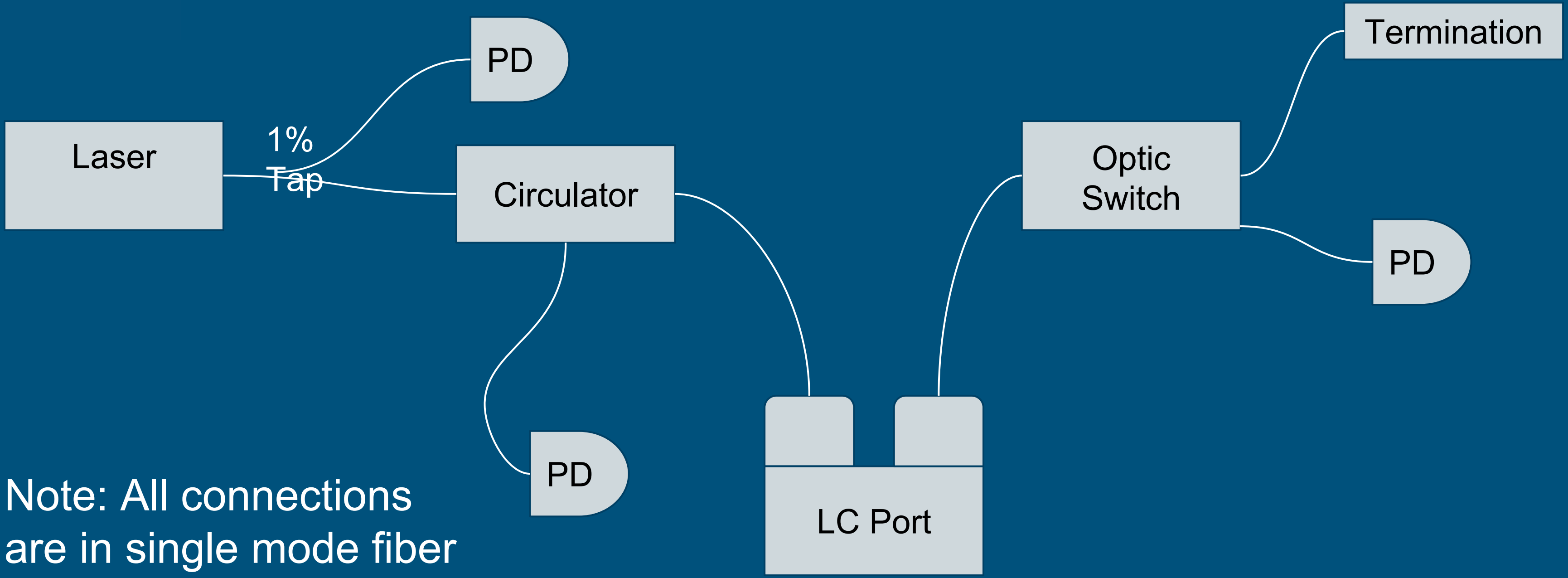
High Level Software Flowchart



Results of Initial Attenuation Testing

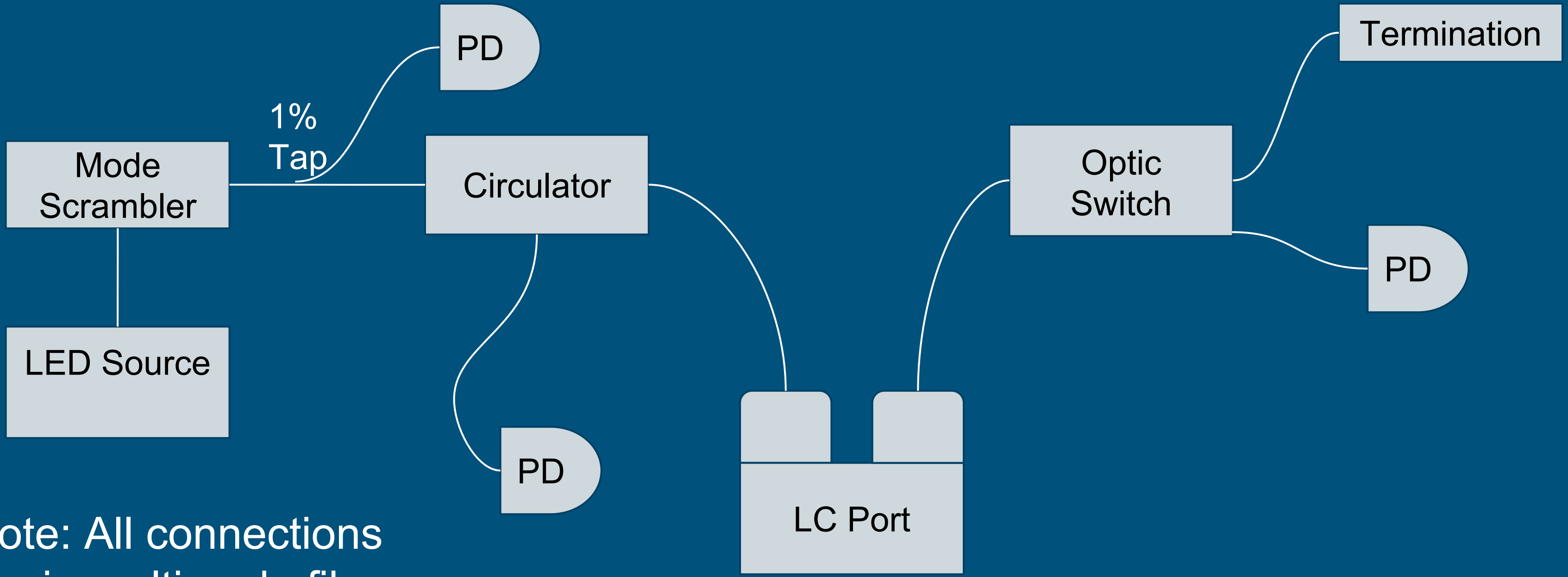
Measurement #	Column1	Device Under Test	Conditions	Labelled Attenuation [dB]	Pin [mW]	Pout [mW]	Loss [dB]
1	a	1 Jumper Fiber	As is		1.25	0.84	1.726307269
1	b	2 Jumper Fibers	As is		1.25	0.82	1.830961606
1	c	2 Jumpers w/ LC adapter	As is		1.25	0.65	2.839966564
2	a	Loopback	As is	0.11	0.65	0.494	1.191864077
3	a	Loopback	Cleaned	0.11	0.65	0.575	0.53245512
3	b	Loopback	Cleaned	0.11	0.65	0.59	0.42061345
3	c	Loopback	Cleaned	0.11	0.65	0.591	0.413258758

Optical Path Configuration 1
1310 & 1550 nm (IL & RL)



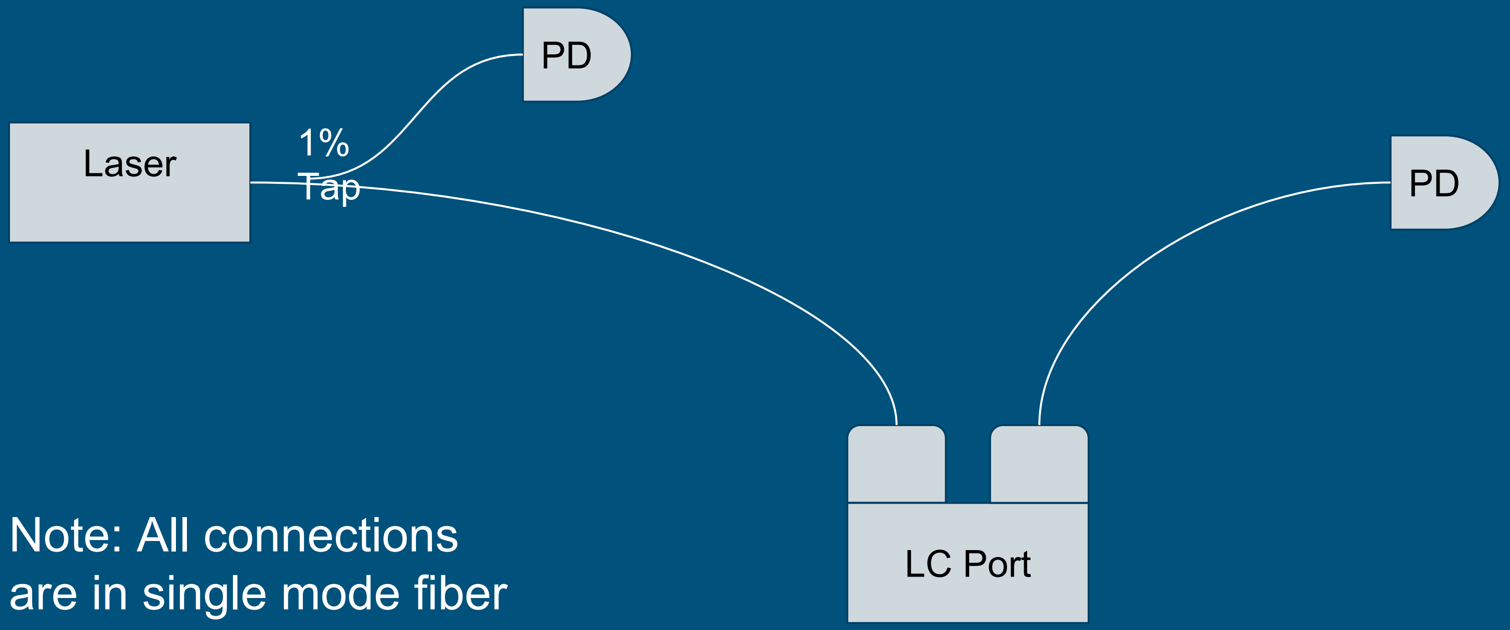
Note: All connections are in single mode fiber

Optical Path Configuration 1
850 nm (IL & RL)



Note: All connections are in multimode fiber

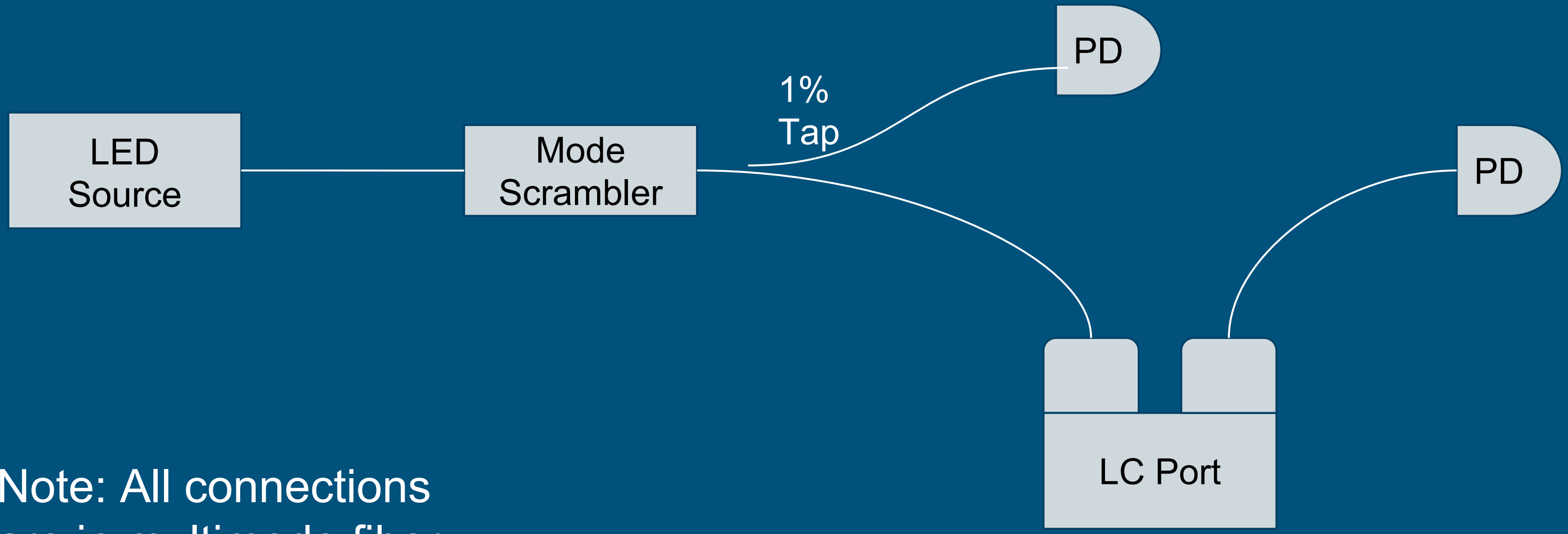
Optical Path Configuration 2
1310 & 1550 nm (IL Only)



Note: All connections are in single mode fiber

Insertion Loss [db]= -10log10(Pout/Pin)

Optical Path Configuration 2
850 nm (IL Only)



Note: All connections are in multimode fiber

Insertion Loss [db]= -10log10(Pout/Pin)

Optics Cost Breakdown

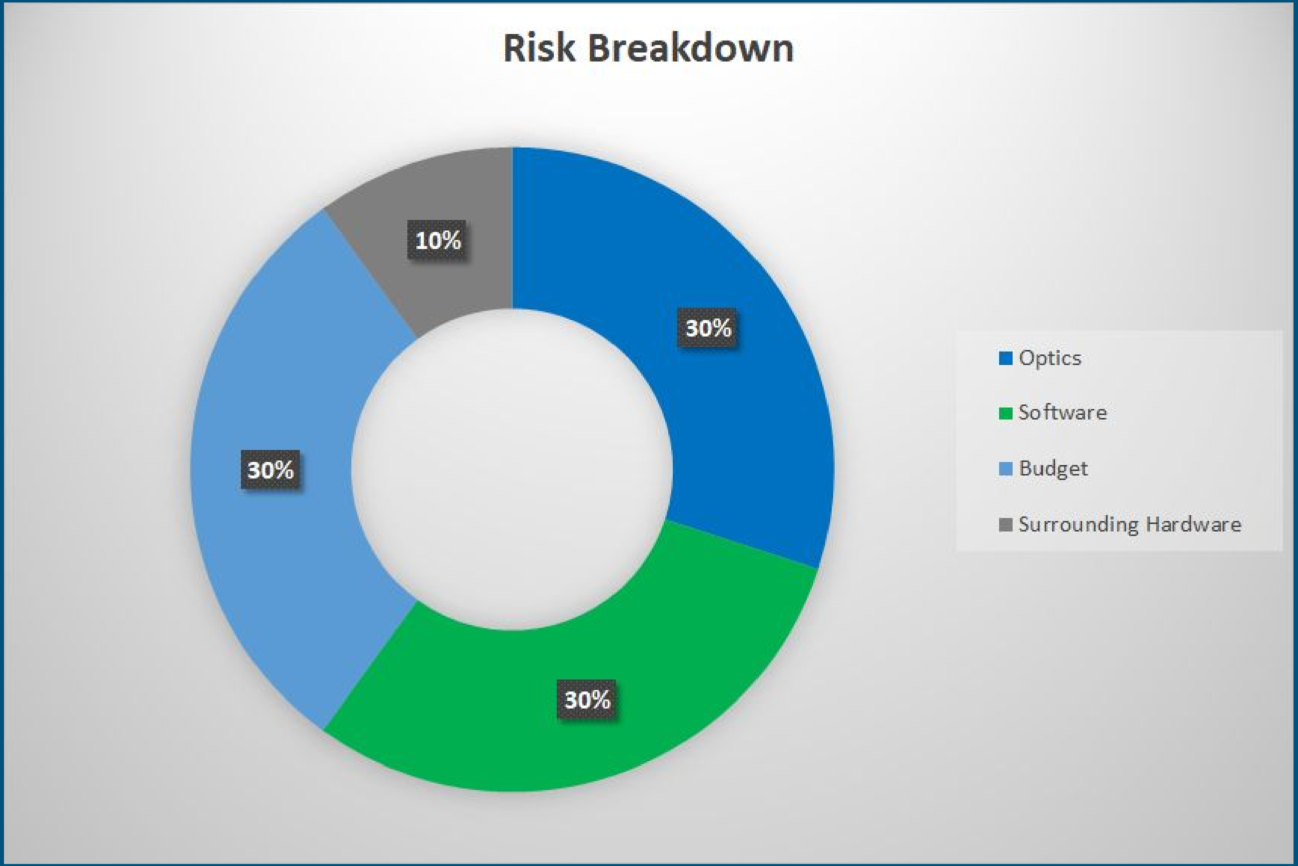
Configuration 1

Component	Quantity	Cost
1m Single mode fiber	7	$184
Circulator	2	$530
Photodiode	6	$69
1m multimode fiber	8	$160
IR LED	1	$0.6
Single mode fiber optic laser	1	$344
	Total Cost	$1287

Configuration 2

Component	Quantity	Cost
1m Single mode fiber	3	$78
Photodiode	4	$46
1m multimode fiber	5	$100
IR LED	1	$0.6
Single mode fiber optic laser	1	$344
	Total Cost	$569

Risk Assessment



Mitigation Plan

Software:	Choose MCU Platform With Libraries Software Block Diagram Initial Testing / Programing of User Interface
Optics:	OCWR Testing Multimode Insertion Loss Measurements
Budget:	Optics Cost Analysis MCU Cost Analysis Cost Breakdown of Supporting Subsystems
Surrounding Hardware:	Purchase Fixture Thermal Management Analysis Prototype Signal Conditioning Circuits

Next Steps

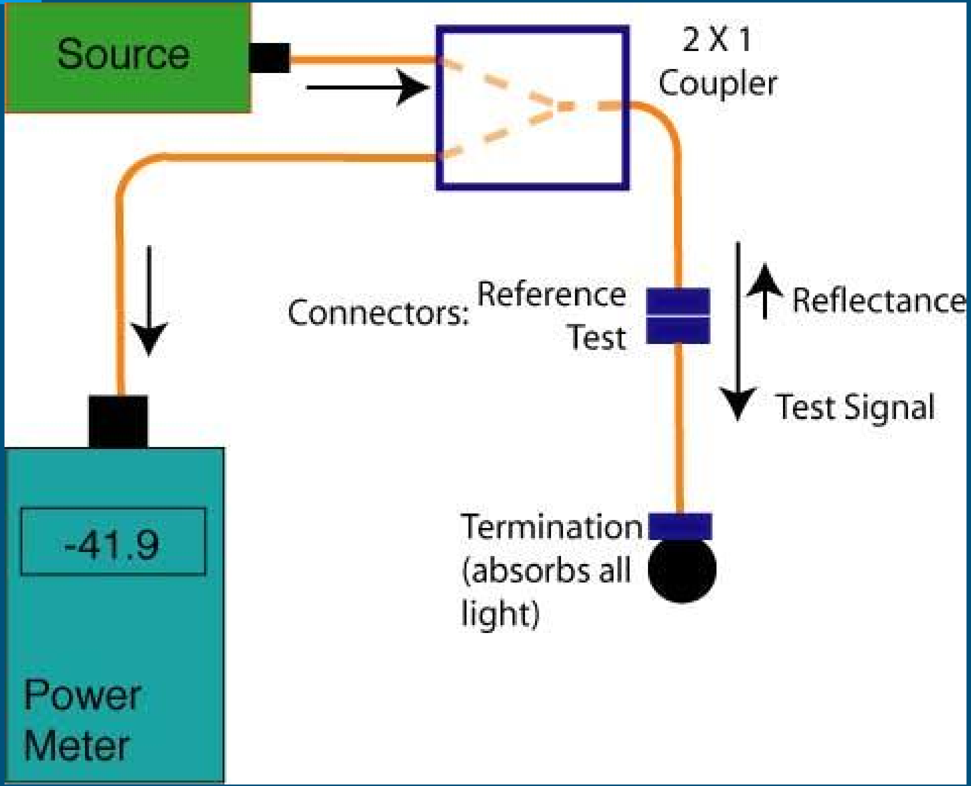
Preliminary Detailed Design:

- Further Optical Testing
- Subsystems Specifications
- Signal Processing Circuit Prototyping
- Software Development
- Lean Implementation Plan
- BOM
- CAD Design Simulation & Prototyping

Questions?

Back-up Slides

OCWR



http://www.thefoa.org/tech/ref/testing/test/reflectance.html

Multimode fiber LED vs Laser