EE431/531

SIGNAL LEVEL CALCULATION

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EXPLORE ISSUES SENDING A SIGNAL FROM AN INFRARED EMITTER DIODE TO AN INFRARED DETECTOR DIODE (MATCHED WAVELENGTHS).

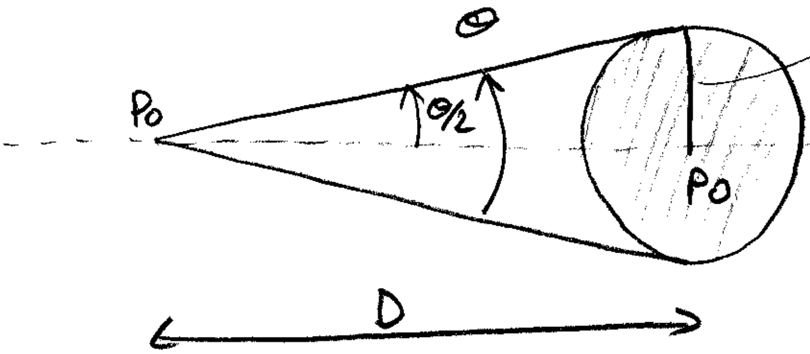
FOR DATA, ASSUME THE FOLLOWING:

INFRARED EMITTER HAS A RADIATED POWER OF 0.08 mW/mA

INFRARED DETECTOR DIODE HAS A SENSITIVITY OF 0.05 mA/mW OR 50 mA/W

EMITTER; THE POWER EMITTED FOR 10 mA CURRENT IS 0.8 mW. IF THE DIAMETER OF THE EMITTER IS 5 mm, THEN THE AREA IS .2 cm^2. THE POWER DENSITY AT THE EMITTER IS 4 mW/cm^2 OR <u>40 W/M^2</u>.

NOW CONSIDER VIEWING ANGLE – A MODERATELY NARROW ANGLE MIGHT BE 20°. HOW DOES THE POWER DENSITY GO DOWN WITH DISTANCE? FOR SIMPLICITY WE WILL ASSUME CIRCULAR DIVERGENCE WITH UNIFORM POWER DENSITY.



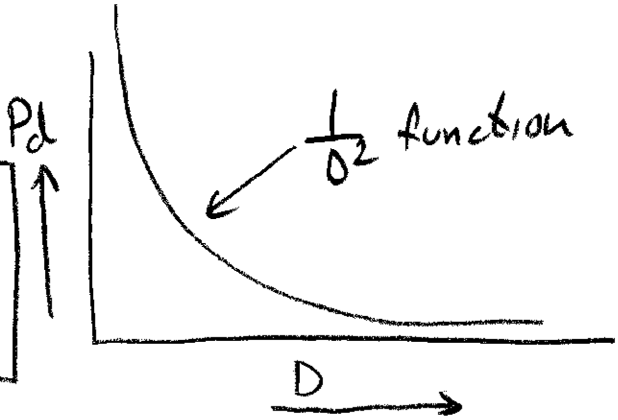
$$r = D\tan\left(\frac{\theta}{2}\right)$$

$$\text{area} = \pi r^2 = \pi D^2\left(\tan\frac{\theta}{2}\right)^2$$

$$\text{Power density} = \frac{P_o}{\text{area}} = \frac{P_o}{\pi D^2\left(\tan\frac{\theta}{2}\right)^2}$$

D IS in M
area IS in M^2

> ASSUMPTION: θ IS A SMALL ANGLE AND POWER DENSITY IS UNIFORM ✱



Conclusion: THE POWER DENSITY FALLS WITH THE SQUARE OF DISTANCE.

RECEIVER

A TYPICAL PHOTODIODE HAS A DIAMETER OF 5 mm FOR AN EFFECTIVE AREA OF 0.2 cm^2.

THUS, $P_{RECEIVED} = P_d * \text{area}$.

AND

$I_{DIODE} = P_{RECEIVED} * .05\,mA/mW$ (50 mA/W)

THE NEXT PAGE HAS A CHART SHOWING THE FOR VARIOUS DISTANCES.

TRANSMITING DIODE CURRENT = 10mA + P_0 = .8 mW
20° BEAM ANGLE

DISTANCE IN METERS	Power Density mW/M²	5 mm dia aperture Power Received nW	DETECTOR Diode Current
0.1	820.	16,400.	820. nA
0.3	91.	1820.	91. nA
1.0	8.2	164.	8.2 nA
3.0	.91	18.2	.91 nA
10.0	.082	1.64	.082 nA
30.0	.0091	.182	.0091 nA

IF A WAVELENGTH MATCHED PHOTOTRANSISTOR IS USED INSTEAD OF A PHOTODIODE THEN THESE CURRENTS CAN BE MULTIPLIED BY ABOUT 100.