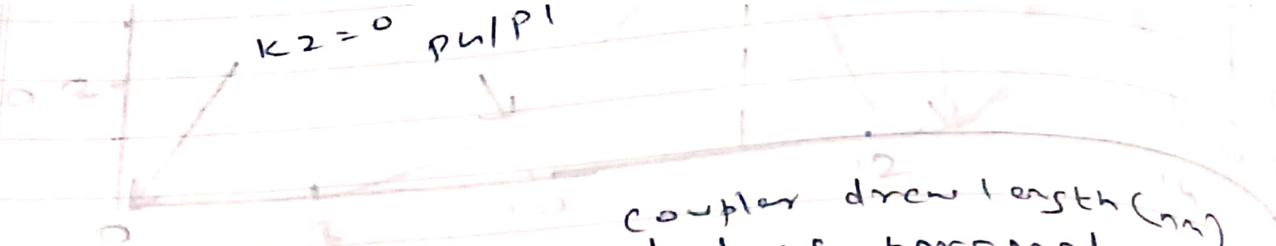

b) Performance and loss parameters for FBT coupler:

Splitting or coupling ratio $= \left[\frac{P_3}{(P_3+P_4)}\right] \times 100$

Excess loss (~~fort~~ four-port coupler) =
$10 \log_{10} \frac{P_1}{(P_3+P_4)}$ (dB)

Insertion loss (ports 1 to 4) $= 10 \log_{10} \frac{P_1}{P_4}$

Crosstalk (four-port coupler) =
$10 \log_{10} \frac{P_2}{P_1}$ (dB)

Problem statement:

1) A four port multimode fiber FBT coupler has 60 µW optical power launched into port 1. The measured power

at ports 2, 3 and 4 are 0.004, 26.0 and 27.5 mW. Determine excess loss, insertion loss, crosstalk and the split ratio of the device.

2) The measured optical powers from port 3 and 4 of fiber FBT coupler are 47.0 μW and 52.0 μW respectively. If the excess loss specified for the device is 0.7 dB, calculate the amount of optical power that is launched into port 1 in order to obtain these output levels. Determine insertion loss, as well as split ratio for the device. When specified crosstalk for coupler is -45 dB, calculate the optical output power level that would be measured at port 2 when the above input power level is maintained.

Conclusion:
In this experiment we studied characteristics of FBT coupler.

Q-1

→ Given, $P_1 = 60\ \mu W$, $P_2 = 0.004\ \mu W$

$P_3 = 26.0\ \mu W$, $P_4 = 27.5\ \mu W$

Hence,

i) Excess loss $= 10 \log_{10} \left(\frac{P_1}{P_3 + P_4} \right)$ dB

$= 10 \log_{10} \left(\frac{60 \times 10^{-6}}{(260 \times 10^{-6}) + (27.5 \times 10^{-6})} \right)$

$= 0.4979$ dB

ii) Insertion loss (port 1 and port 4) $= 10 \log_{10} \frac{P_1}{P_4}$ (dB)

$= 10 \log_{10} \left(\frac{60 \times 10^{-6}}{27.5 \times 10^{-6}} \right)$ dB

$= 3.3881856$

iii) Insertion loss $= 10 \log_{10} \left(\frac{P_1}{P_3} \right)$ dB

$= 10 \log_{10} \left(\frac{60 \times 10^{-6}}{26.0 \times 10^{-6}} \right)$

$= 3.6317790$

iv) Crosstalk $= 10 \log_{10} \frac{P_2}{P_1}$ (dB)

$= 10 \log_{10} \left(\frac{0.004 \times 10^{-6}}{60 \times 10^{-6}} \right)$ dB

$= -41.760912$

v) Splitting ratio $= \left[\frac{P_3}{(P_3 + P_4)} \right] \times 100\%$

$$= \left[\frac{26 \times 10^{-6}}{(26 \times 10^{-6} + (27.5 \times 10^{-6})}\right] \times 10\ldots$$

$$= 48.598131$$

Q-2

→ Given, $P_3 = 47\ \mu W$, $P_4 = 52\ \mu W$

Excess loss : 0.7 dB

i) Power at Port 1

$$\text{Excess loss} = 10 \log_{10}\left(\frac{P_1}{P_3 + P_4}\right) dB$$

$$0.7 = 10 \log_{10}\left(\frac{P_1}{(47 \times 10^{-6}) + (52 \times 10^{-6})}\right)$$

$$P_1 = (47 \times 10^{-6}) + (52 \times 10^{-6}) \times 10^{(0.7/10)}$$

power at port 1 is 116.314857 μW

ii) Insertion loss (Port 1 and Port 3)

$$= 10 \log_{10}\left(\frac{P_1}{P_3}\right) \text{ in dB}$$

$$= 10 \log_{10}\left(\frac{116.314857 \times 10^{-6}}{47 \times 10^{-6}}\right)$$

$$= 8.3276607\ d$$

iii) Insertion loss (port 1 and port 4)

$$= 10 \log_{10}\left(\frac{P_1}{P_4}\right) \text{ in dB}$$

$$= 10 \log_{10}\left(\frac{116.314857 \times 10^{-6}}{52 \times 10^{-6}}\right)$$

$$= 8.4963 1047\ dB$$

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iv) Split ratio $= \frac{P_3}{P_3 + P_4} \times 100\%$

$= \frac{47 \times 10^{-6}}{(47 \times 10^{-6}) + (52 \times 10^{-6})} \times 100$

$= 47.47\%$

Since, cross talk $= 45$ dB

v) Power at Port 2 in mW

cross talk $= 10 \log_{10} \frac{P_2}{P_1}$ dB

$P_2 = P_1 \cancel{*} 10^{(crosstalk/10)}$

$P_2 = 116.314877 * 10$

$P_2 = 0.00367819$ mW