Experiment # 4

OPTICAL LINK

INTRODUCTION:

From your lecture notes you know that optoelectronic devices are widely used in many industrial applications. One of these application is information transmission between distant points. This information can be in a digital or analog form. The major intention of this experiment is to investigate the design and operation of a simple optical link. It is assumed that the data to be transmitted is in an analog form, for example the output of a transducer, say a microphone. The output voltage of the microphone will be converted into current which, in turn, will be converted into light. This light can be visible or infrared. This depends on the type of LED used. The light will be transmitted via the link which can be a fiber cable or simply the air. At the receiving end the light will be converted into current which, in turn, will be converted into voltage. This voltage will be used to derive a transducer, say a loudspeaker. The complete circuit which have been discussed in the lecture is shown in Fig. 1.

THE TRANSMITTER:

This is essentially a voltage-to-current transducer, changing the voltage changes at the input to current changes through the infrared LED. The LED is the sender of an optical coupler.

THE RECEIVER:

This is essentially a current to voltage converter. The capacitor C_1 blocks DC, so only AC changes are amplified by the amplifier built around the 741. The resistor R_4 sets the gain, with the resistors R_2,R_3 and the capacitor C_3 maintaining DC bias (the high value of R_4 would lead to unacceptably large offsets due to leakage currents on its own). C_2 ensures that the AC gain is unaffected. Obtain an expression for transfer function of the transmitter circuit between the collector of the phototransistor and the output of the operational amplifier. What is the function performed by this circuit? Do you know why the resistor R_5?

In the laboratory an optical coupler will be used. Thus there is no possible interference from the surrounding light. But if the light is transmitted through the air then it is necessary to place the LED and the phototransistor at the focus of parabolic mirrors. A hand torch can be a useful case for building the circuit in as a parabolic mirror is already available. Glass lenses should be discarded as glass blocks infrared. For maximum sensitivity, a Wrattan 88A filter should be used in front of the phototransistor. This blocks visible light, but passes infrared without attenuation.

YOU ARE REQUESTED TO CONSTRUCT THE CIRCUIT SHOWN IN AND TO TEST IT AT THE DIFFERENT TEST POINTS SHOWN. MAKE SURE THAT THE CIRCUIT WORKS PROPERLY AND TRY TO FIND THE MAXIMUM WORKING FREQUENCY OF THE CIRCUIT. WHAT MEASURES CAN BE TAKEN IN ORDER TO EXTEND THE WORKING FREQUENCY RANGE OF THIS OPTICAL LINK!