A PRACTICAL APPROACH TO BI-DIRECTIONAL SYSTEMS

by

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INTRODUCTION

In recent years there has been considerable discussion of Bi-Directional CATV systems. Most of these disucssions have directed themselves to a particular approach and spent most of the time innumerating the information and services that could be carried by the system.

I have spent considerable time in analyzing the various methods of providing Bi-Directional Transmission. The two techniques which become obvious are Dual Cable and Single Cable with diplexing filters. The techniques are not new or revolutionary, but simply show that today's system owner can build a good quality two-way system at minimal cost.

REVIEW OF VARIOUS TECHNIQUES

1. Closed Loop

In a closed loop system the system feeds out from Head End and physically returns to it in one continuous path (fig.1). This usually preclueds that the feeder system is not Bi-Directional. Needless to say this technique is extremely costly and sometimes impossible, due to available continuity.

2. Single Cable

A single cable technique, which I will discuss in more detail later, requires diplexing filters and sub-band amplifiers (fig.2). When using standard diplexing filters considerable care is required in design because a cascade of any length (10 or more) will cause bandwidth shrinkage.

3. Converters

This technique usually requires large and costly installation and the converter itself must be mounted within an outdoor enclosure. In addition to this, this system will usually utilize a single cable or dual cable technique for signal transmission. In some cases a multitude of cable are required with large switching centers and specialized converters at the home.

4. Dual Cable

A Dual Cable system is basically two separate systems connected only at the Head End and at the subscriber's home. This describes a total Dual Cable system; however, as I will discuss later, by carefully selecting feeders the Dual Cable technique becomes a versatile Bi-Directional system.

BI-DIRECTIONAL TRUNK:

Single Trunk Cable: It appears at first look that the single cable trunk Bi-Directional system would be to most, desirable from an operator's point of view. This is probably the case for existing single cable CATV systems. In order to upgrade the existing single cable system, a diplexing filter package can be used, which enables a system operator to make this conversion at a minimal expense. It should be noted however, that little is known at this point about the differential time delay of a single cable Bi-Directional system. In addition to the time delay question, the added noise of the sub-band amplifiers in the return loop must be added to the total signal-to-noise ratio of the Uni-Directional system.

Single Cable System - Diplexing Filters: By means of the diplexing filters and sub-band amplifiers, you can convert your existing CATV system to a Bi-Directional Trunk system. The package (fig.3) utilizes low loss diplexing devices, and a sub-band amplifier. The sub-band amplifiers utilize an automatic gain control to compensate for temperature changes in the coaxial cable below 54MHz.

DUAL TRUNK BI-DIRECTIONAL SYSTEMS:

The Dual Trunk method of providing a Bi-Directional transmission system is at this point in time, the most desirable. The features of a dual cable Bi-Directional system are:

1. Trunk Integrity - Adding devices to any trunk line can only degrade picture quality and add noise.
2. Band-Width (Channel Capacity) - When using a two cable system, it would be possible to carry as many channels in the forward direction as in the reverse direction.

Dual Cable : When constructing a new system using dual trunk cable the most desirable method would be to use a standard broadband push-pull 54-300 MHz amplifier in the forward direction, and an amplifier capable of 15 to 90 MHz for the return loop (fig. 4). It should be noted that return amplifiers are not needed at every location if the cable is the same in both forward and return loops. It can be shown that with careful design a return system using 0.500 cable and 90 MHz amplifiers on the return trunk is not very much more expensive than the basic uni-directional system. It should be noted that the return amplifier could be replaced by a trunk amplifier (54 - 300 MHz) and provide full return channel capacity. Alternately, the return amplifier could be a 6 - 90 MHz amplifier and provide added return channels below 54 MHz.

A unique feature of a system of this type is that the frequency range of 15 - 40 MHz can be used for return signals from selected feeders while the band from 54 - 90 MHz can be used for return signals originating along the trunk (fig.5).

BI-DIRECTIONAL FEEDER SYSTEMS

All of the techniques described above can utilize the standard line extender for Uni-Directional feeder systems. Under some conditions, it may be necessary to provide a return signal from a feeder leg. This return path can be provided by means of a diplexing filter and sub-band amplifier (fig.6).

This system utilizes a standard line extender coupled with diplexing filters and a return sub-band (15 -40 MHz) amplifier.

It should be noted that sub-band amplifiers are not needed at every station. The reason diplexing filters can be used so easily at these stations is that in a feeder system, the cascade does not exceed a maximum of 4.

In a Bi-Directional Feeder system the available bandwidth would allow for both video transmission and data; however, it does not appear to be feasible at this time to transmit video through all the passive devices because of the amount of input energy required.(fig.6) If a picture were to be transmitted from the home on a time-shared basis signals of the order of +60 dbmv would be required. At the present time I know of no RF modulator in the band below 40 MHz that can produce this type of output at a cost attractive to this application. Therefore, if only data is transmitted from the home, considerably less bandwidth is required, and much looser specifications can be tolerated on the return amplifier and filters.

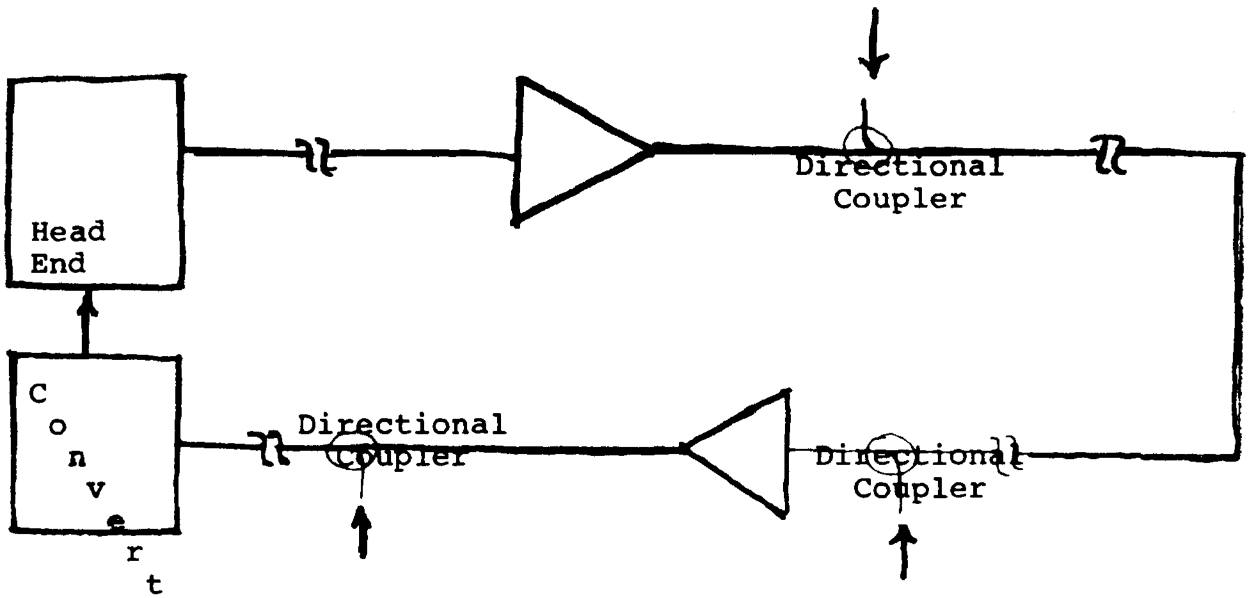

Figure 1 Closed Loop System

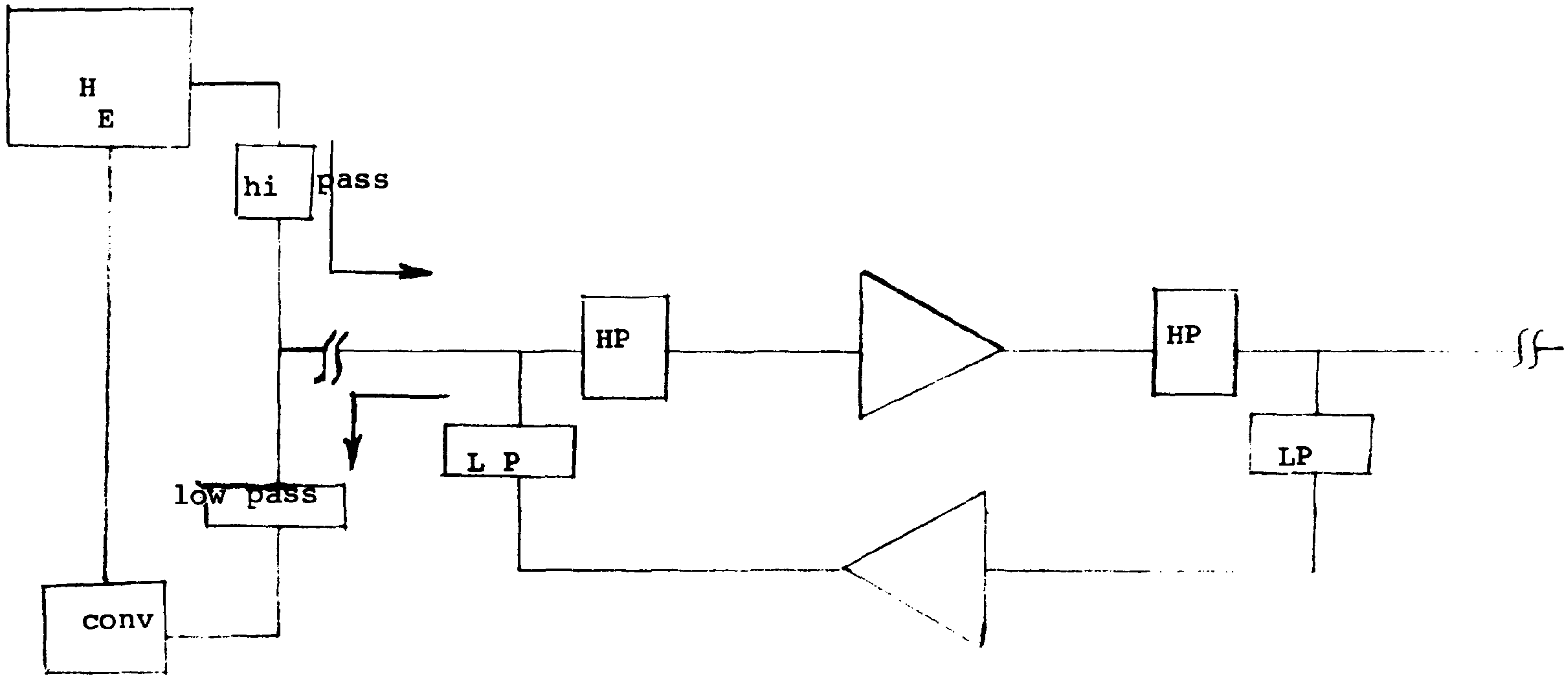

Figure 2 Single Cable System using standard diplexing filters

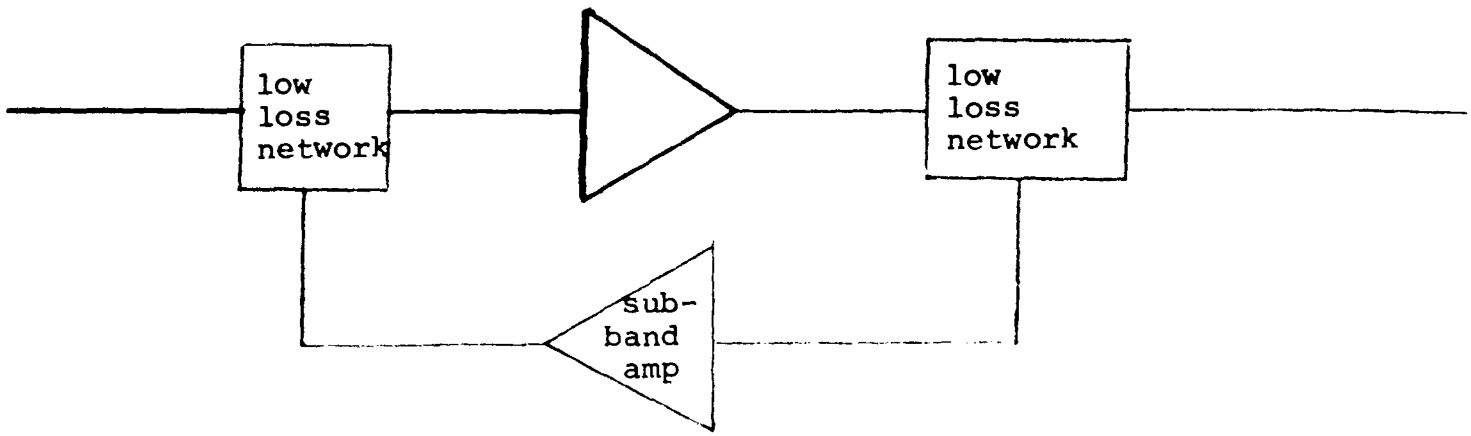

Figure 3 Single Cable System using loss filter networks

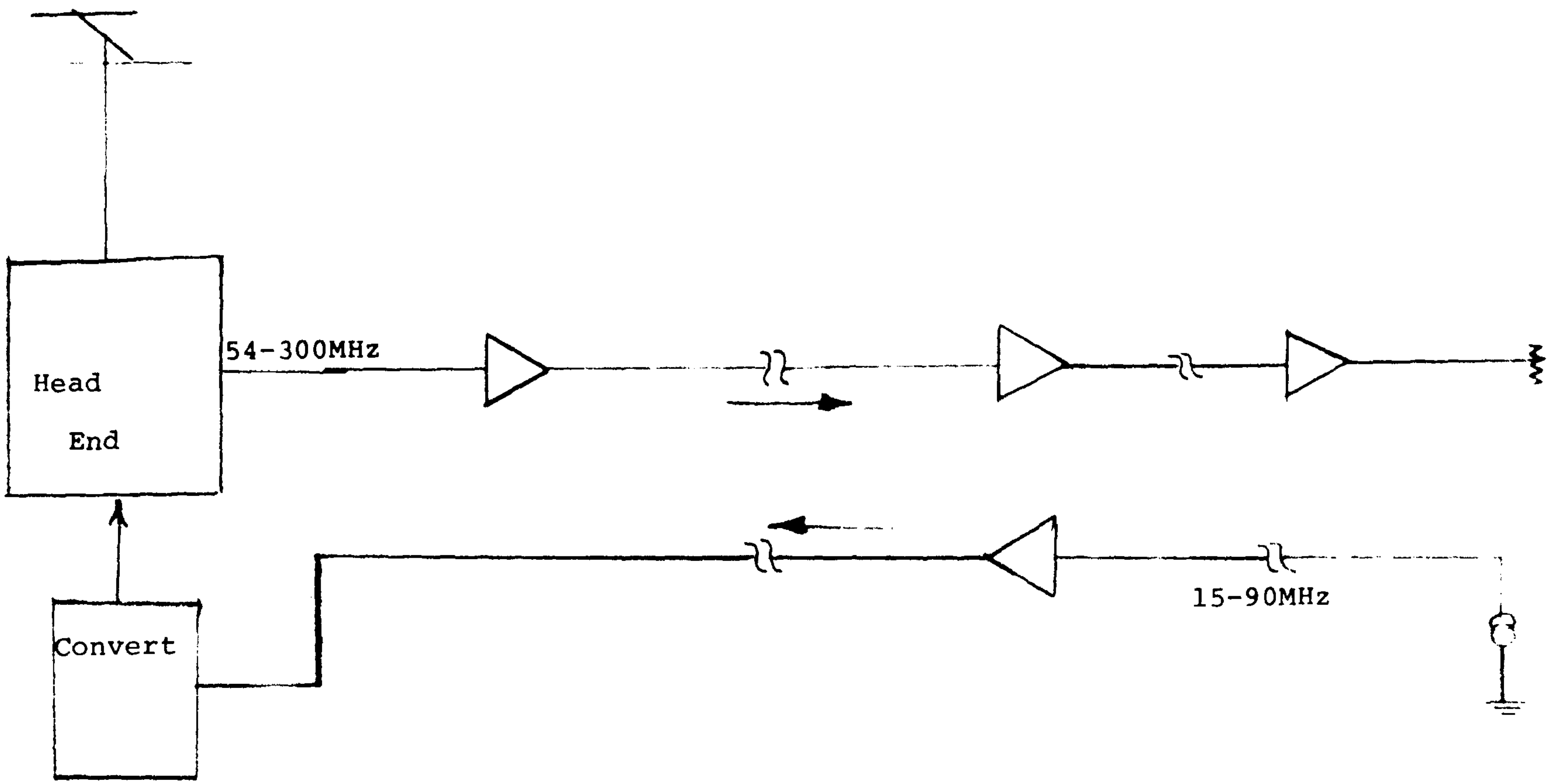

Figure 4 Dual Cable Bi-Directional System

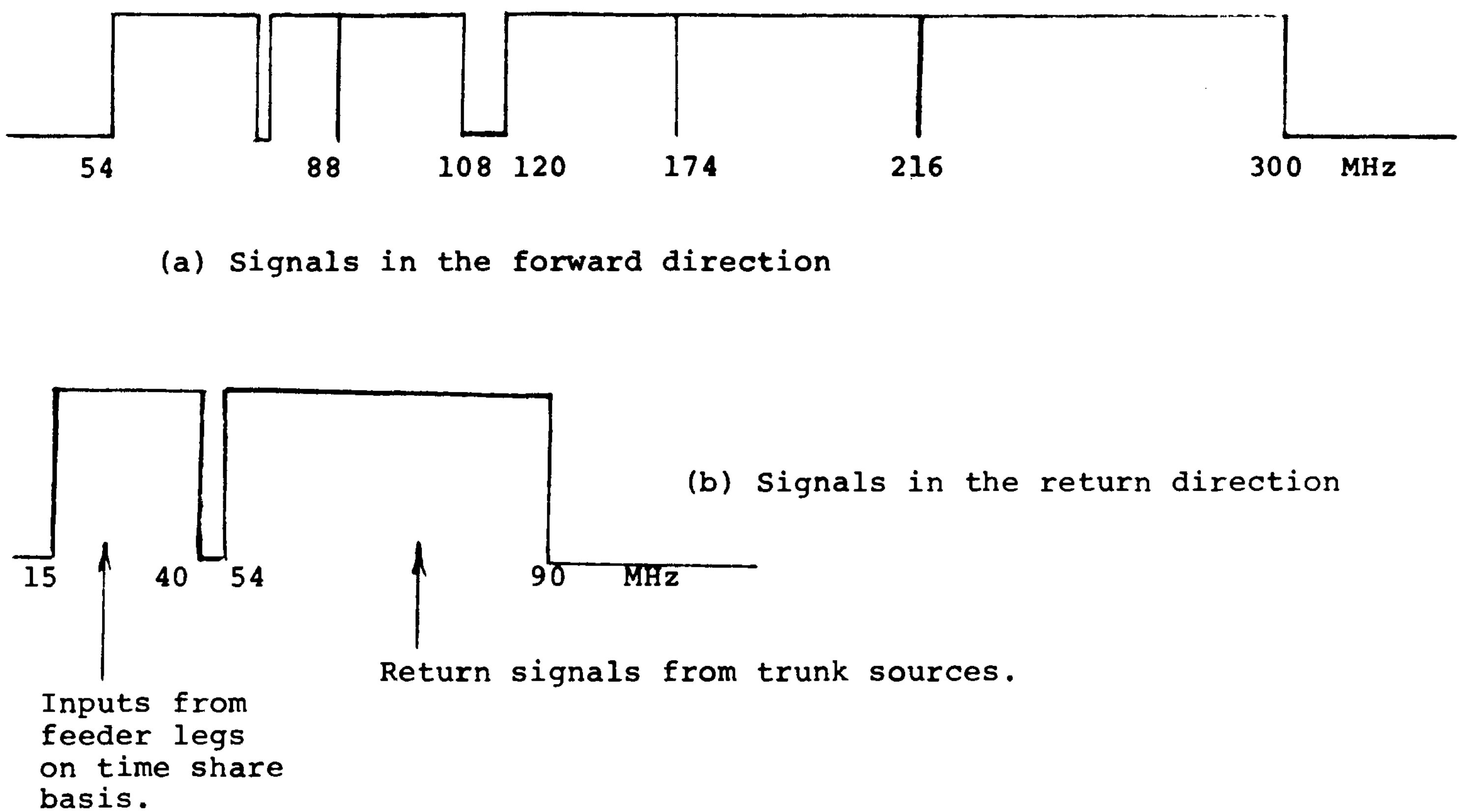

Figure 5 Band Pass of Dual Cable Bi-Directional System

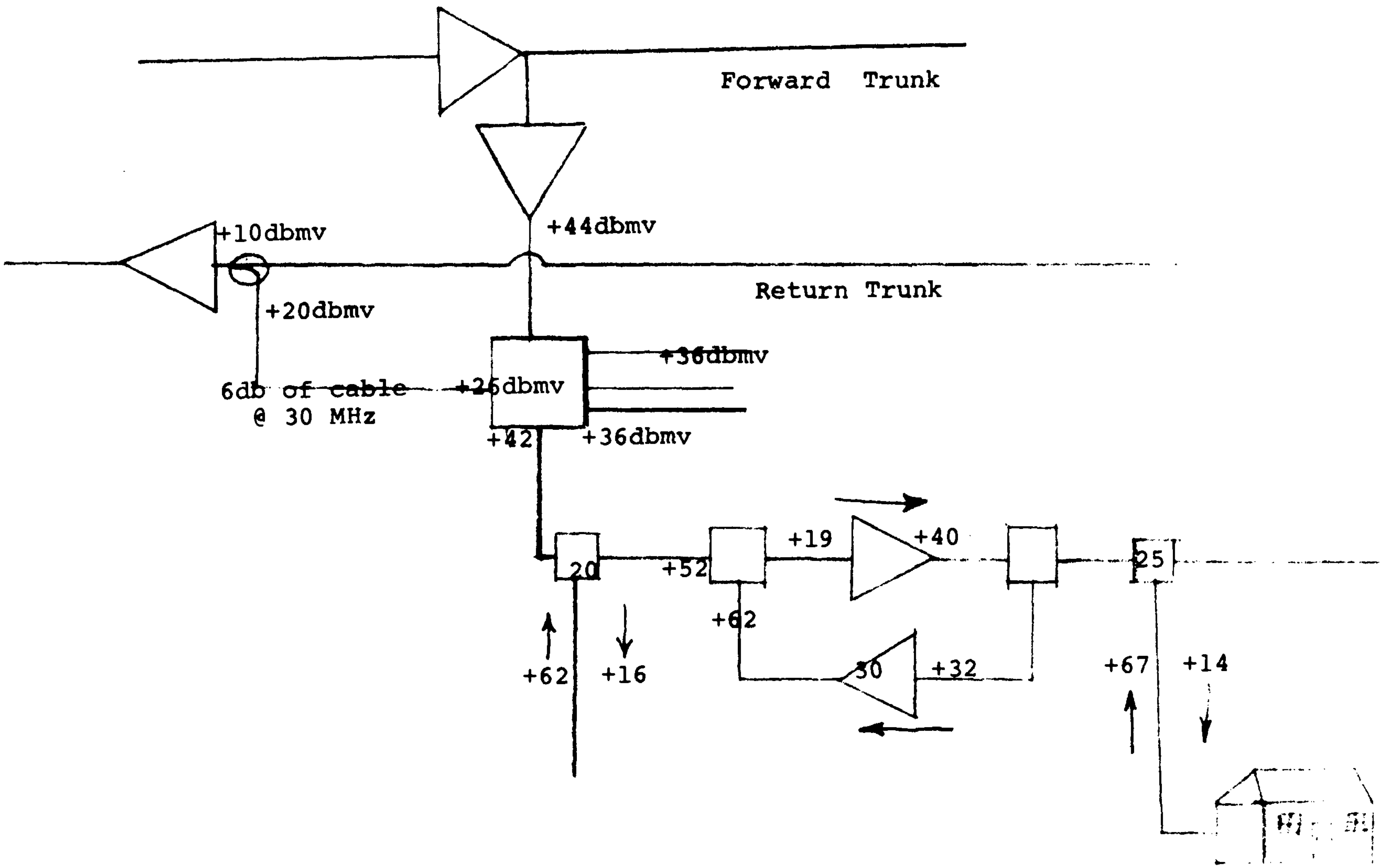

Figure 6 Bi- Directional Feeder System