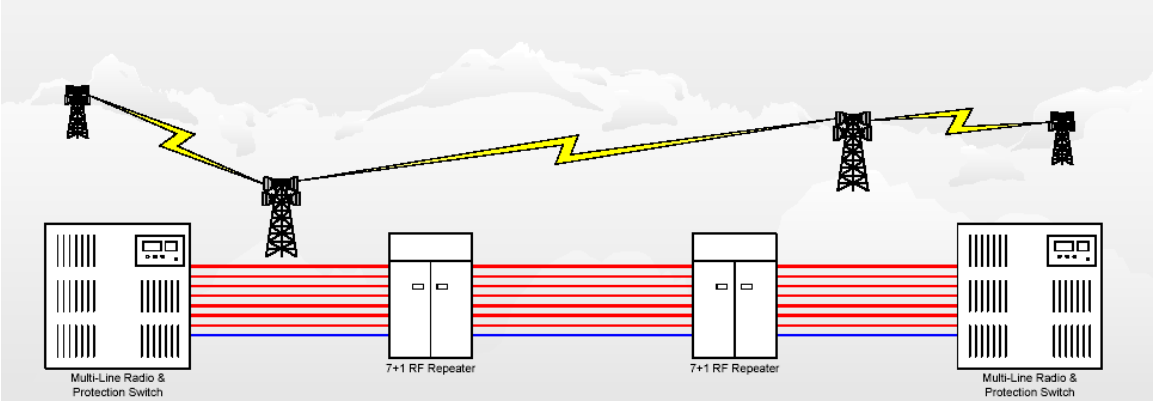
Multi-Line Capability in Microwave RF Repeaters

Introduction

While the most common use of Microwave RF Repeaters is in 1+0 and 1+1 systems, multi-line capability up to 7+1 is available in the higher capacity frequency bands. The modular repeater designs allow growing the simpler configurations into those capable of supporting a fully loaded radio route.



Multi-Line Concept

When a microwave system operator needs more route capacity than a single protected radio can provide, it is common practice to install parallel radios on the same path. Each added radio increases the total route capacity.

A practical equipment protection scheme in multi-line service is to reserve one or two radios as protection channels. When one of the working channel radios has a failure or path fade, the traffic is parallel switched to the protection radio to restore the link. Once the working radio returns to normal service, the traffic is released from the protection channel radio. The protection channel is then ready to serve another failed channel.

Further economies are achieved by combining several hops of radio into a switching section. The traffic switches are then installed at the ends of the section only. Any failure or fade between the switches is detected and restored by the section protection channel. There may be as many as five hops of radio in a switching section.

Considering a several hop switching section, the radios operate independent of the protection switch. The protection switch monitors the traffic quality in the section and applies the protection channel when a traffic failure is detected.

Multi-Line and RF Repeaters

RF Repeaters can easily be used in multi-line microwave routes since the detection and switching is performed at the section ends. Simply, one or more of the RF Repeater channels become the protection channels and the rest are working channels.

The most common microwave bands where multi-line routes are used are: 4, 5, 6, 7, 8 and 11 GHz. Each of these bands can support single radio traffic of STM-1, OC-3 or 155 Mb/s capacity and have adequate bandwidth to support parallel radio channels as well.

The RF Repeaters are configured much the same as the radios. Additional duplex radio or RF amplifier channels are added, each on independent channel frequencies. Bandpass filters in branching manifolds route the particular channel frequencies to each radio or amplifier and then combine again to a common antenna feeder.

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Configurations

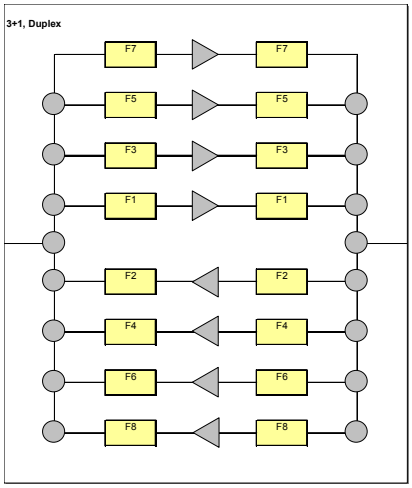
Common configuration designations are:

Designation	Working Channels	Protection Channels	Total Channels
1+1	1	1	2
2+1	2	1	3
3+1	3	1	4
4+1	4	1	5
5+1	5	1	6
6+1	6	1	7
7+1	7	1	8
6+2	6	2	8
8+0	8	0	8

Example

An example of how multi-line service is configured in RF Repeaters is the RF-6000E/EW-56. This repeater has four duplex channels combined in one outdoor rated enclosure. This configuration can serve 3+1, 2+2 or 4+0 routes. Figures 1 and 2 show this model.

When two of the RF-6000E/EW-56 repeaters are used with two dual polarized full route antenna systems, eight parallel channels are supported. Thus, routes of 7+1, 6+2 or 8+0 are served.



It is normal practice to use two or three dual polarized high performance antennas on full routes to control the effects of multi-carrier intermodulation interference. The RF Repeaters can be configured in a similar way. Two antenna ports per direction are used at the RF Repeater generally with transmit on one and receive on the other.

A full route example is shown in Figure 3.

Arrangements can be configured to meet the particular needs of most radio routes.

Group Delay Equalization

High capacity multi-line RF Repeater configurations normally include Group Delay Equalization for each channel. The equalization allows each channel to be independently optimized for best digital radio performance. Delay slopes due to flanked branching filters are properly corrected with the delay equalizers.

Applicable Repeater Models

The RF Repeaters that can support multi-line service are:

RF-4000	3.4 ~ 4.2 GHz
RF-4500	4.4 ~ 5.0 GHz
RF-6000E	5.9 ~ 7.1 GHz
RF-6000EW	6.4 ~ 7.1 GHz
RF-7000E	7.1 ~ 7.9 GHz
RF-8000E	7.7 ~ 8.5 GHz
RF-11000	10.7 ~ 11.7 GHz

Experience

Peninsula Engineering Solutions and it's predecessor organizations have build RF Repeaters from 1+1 up to 7+1 configurations serving high capacity, main-line microwave radio relay routes in North America, South America and Asia.

Contact Peninsula Engineering Solutions' sales and technical support section with your multi-line repeater needs at:

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Let us help you build reliable, remote, solar powered, microwave radio sites.

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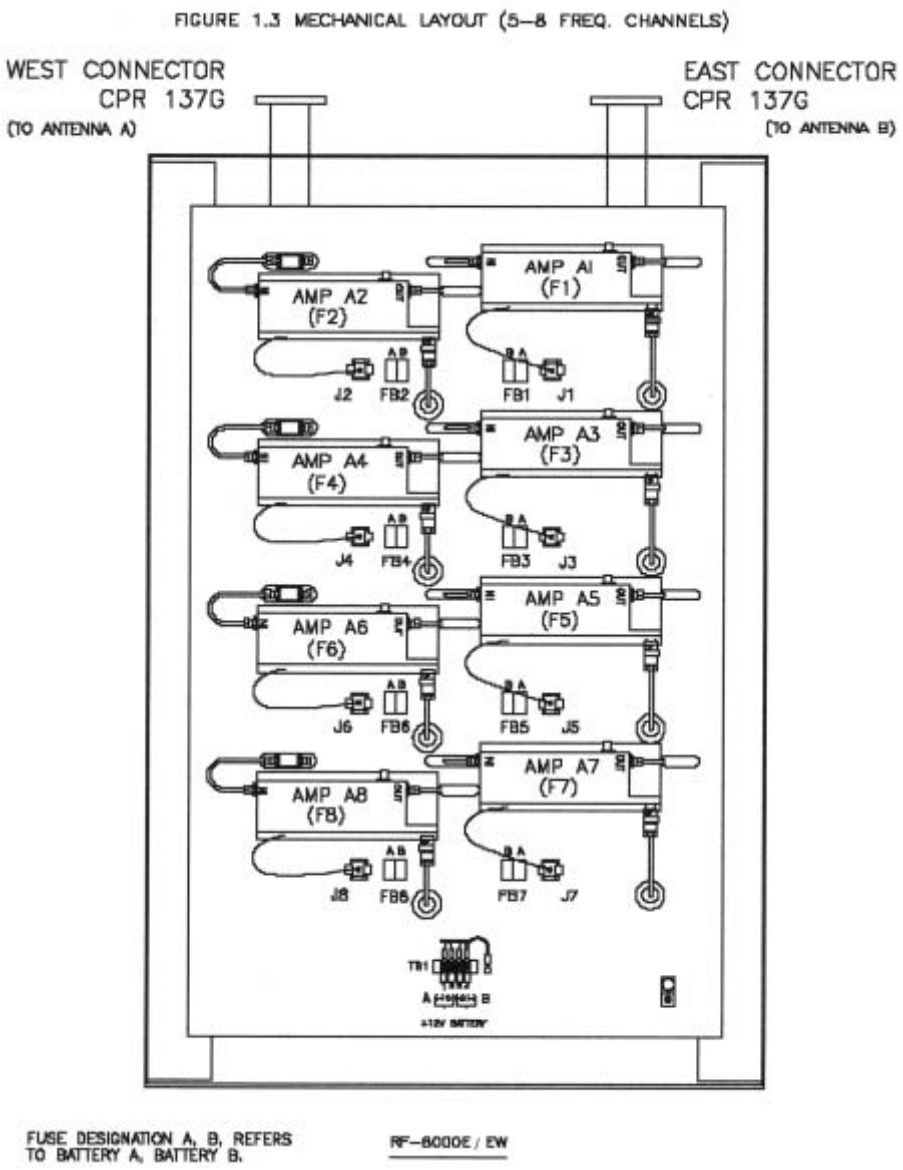

Figure 1, RF-6000E/EW-56 Layout
(From the Operations Manual)

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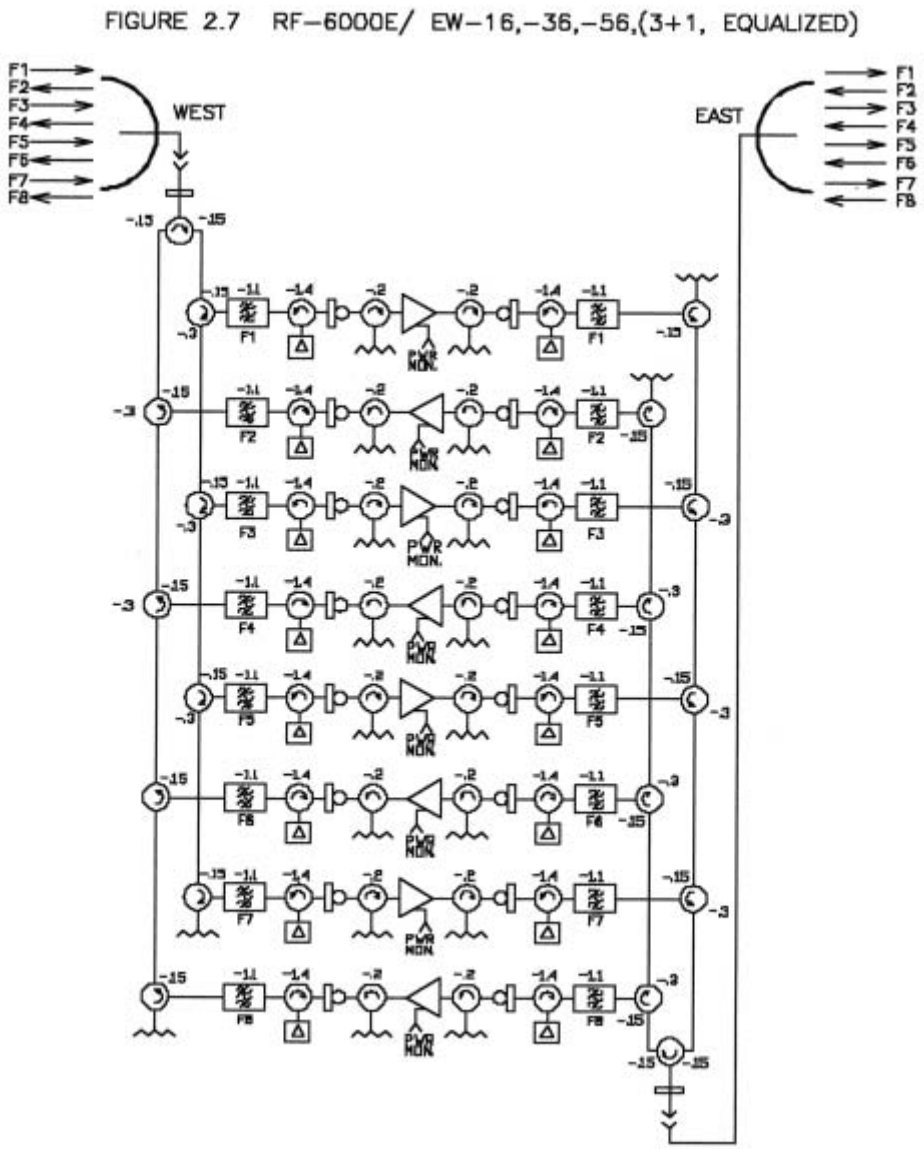

Figure 2, RF-6000W/EW-56 Block Diagram
(From the Operations Manual)

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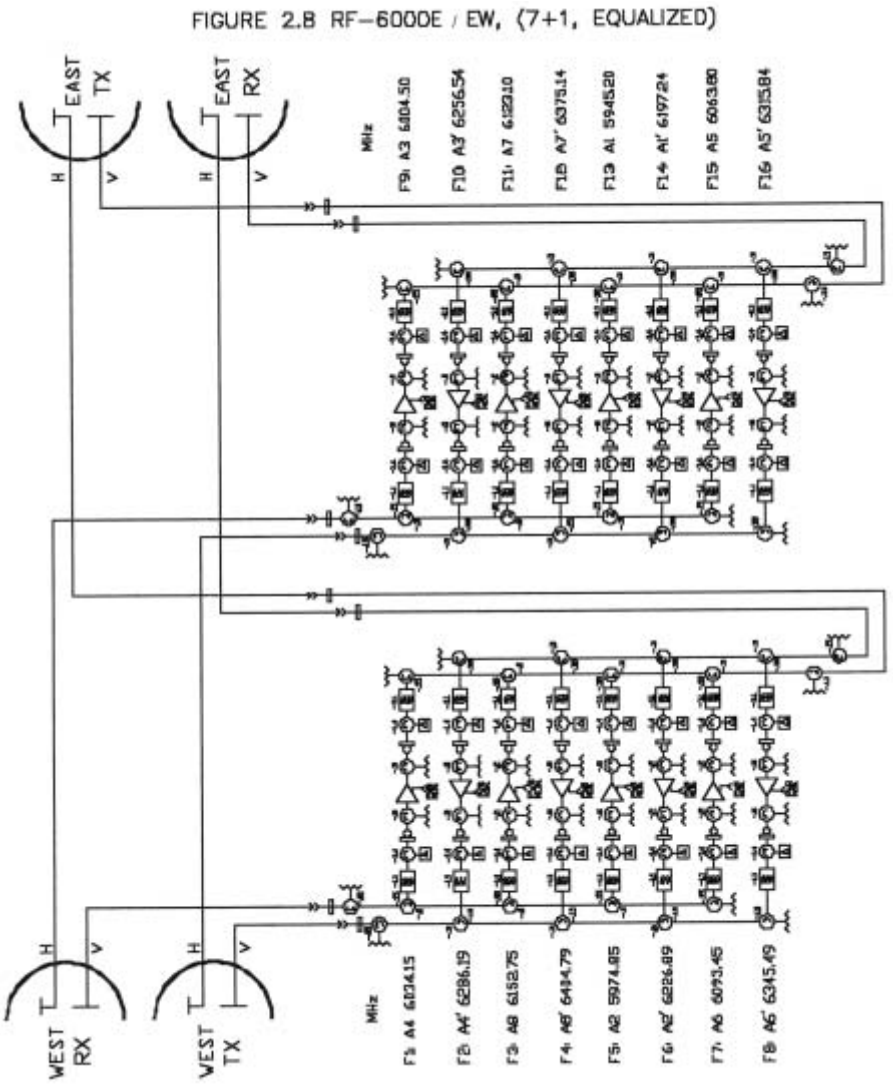

Figure 3, Two RF-6000E-56 in 7+1, 6+2 or 8+0 Configuration (From the Operations Manual)

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