Original Issue A
14th June 1998

RF MULTICOUPLERS - PRODUCT BRIEFING

INTRODUCTION

This briefing has been designed to provide an insight into multicouplers, some of their uses and their main selection criteria. Multicouplers form only part of the comprehensive range of RF, IF and audio signal distribution products designed and manufactured by Raven Research.

MULTICOUPLER CONFIGURATION

The multicoupler (sometimes called a distribution amplifier) is designed allow a set of radio receivers, to simultaneously connect to a single antenna. As well as providing improved radio system performance, the Raven Research range of multicouplers can provide the system with comprehensive protection from high-level signals and electrostatic discharge. Special filtering and noise equalization attenuation can be used to optimize the dynamic range. The functional block diagram of a typical 1 input to 8-output multicoupler is shown in figure 1.

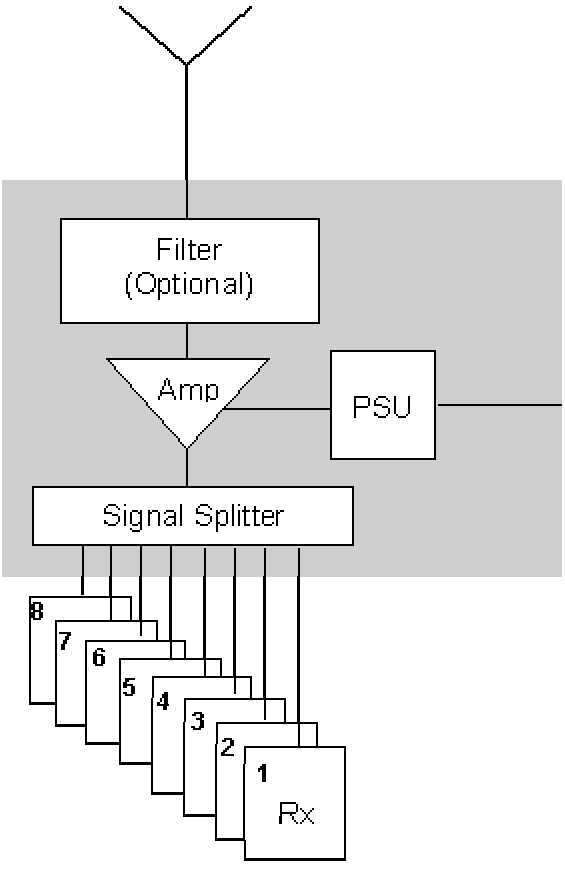

Fig 1 - Multicoupler Block Diagram

This simple RF distribution will suit most applications but where the requirement is more complex, the multicoupler can be used as a basic building block for more sophisticated signal distribution systems.

MULTICOUPLERS IN SWITCHING SYSTEMS

The block diagram of a typical switching matrix is shown in figure 2, where a range of antenna inputs is feeding a range of receiver outputs. By selecting different types of antennas and multicouplers a broad band receiver can easily be switched between antennas covering different parts of the frequency spectrum, from VLF through to SHF if needs be.

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Gain equalization can be incorporated into the multicoupler input. At VHF/UHF this is often required to compensate for the variation of

losses in a long feeder cable, which can typically be in excess of 7-8 dB over the frequency range from 30MHz to 1000MHz. In such cases, the cable equalizer is used to prevent lower frequency signals from overloading the following receiver and restricting the dynamic range over the whole frequency band.

At HF, front-end gain equalization can be used to compensate for the higher level of ambient noise at the lower part of the spectrum. By placing attenuation in the lower end of the

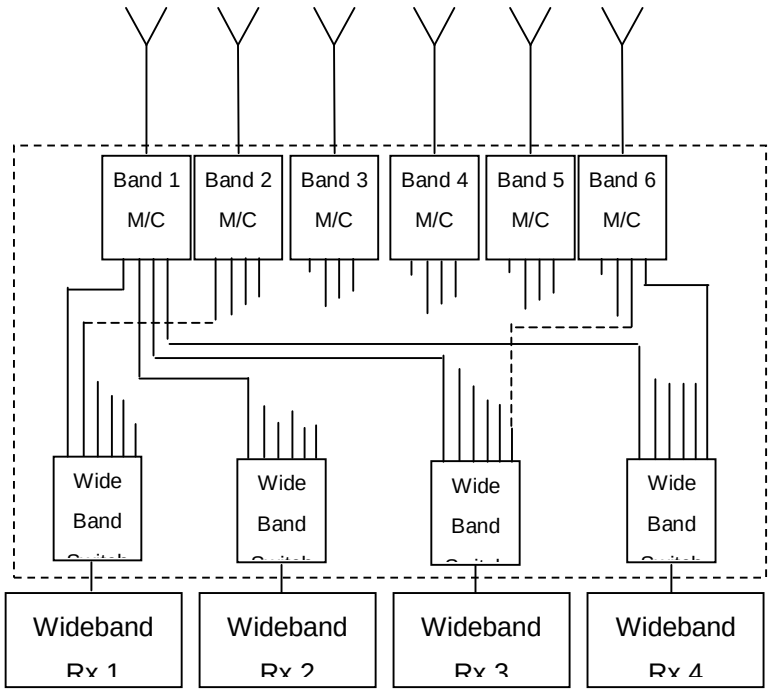

Figure 2 – Block Diagram of 6 x 4 Signal Exchange Unit

frequency range, while simultaneously maintaining low noise performance at the higher frequency end, the overall dynamic range of the total system can be optimized. This makes it easier to detect weak signals in the presence of much larger ones, a vital performance factor in a surveillance system.

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MULTICOUPLER PERFORMANCE

The main consideration when evaluating the suitability of a particular multicoupler for a particular application are the noise figure, intermodulation intercept points, gain, protection and MTBF.

Noise Figure - an improvement in overall system noise figure can be achieved if the front-end multicoupler has a lower noise figure than the receiver itself and there is sufficient gain to overcome the noise figure of the receiver (the second stage).

Intermodulation Intercept Points - given the potentially disruption caused by spurious intermodulation products, 2nd and 3rd order intermodulation suppression is very important in both communications and surveillance systems. Intermodulation levels should be specified to give spurious free dynamic range commensurate with the necessary system performance. Third order IP suppression is usually most important for communications but both 2nd and 3rd order IP suppression are vital to surveillance applications.

Gain - if the multicoupler introduces loss, the noise figure of the system is compromised; if the multicoupler introduces too much gain, the dynamic range of the system is compromised. The Raven Research multicouplers are designed to allow factory adjustment of the gain, so as to introduce the minimum gain needed to compensate for subsequent losses and noise/gain over-ride.

Protection - In the RR1110 HF multicoupler, protection of following stages is achieved by means of a gain fold-back circuit within the multicoupler, which begins to operate when the input signal level rises above 16dBm. Without this circuit, the amplifier would be capable of delivering up to10W to the following stages. The protection circuit limits the multicoupler output to +20dBm.

Both the HF and VHF/UHF multicouplers are protected from electrostatic discharge (such as a nearby lightning strike) by means of a combination spark arrester and diode circuitry. At VHF/UHF, this circuit is optional, as a slight penalty on noise figure is always incurred. In lightning discharge, most of the energy is carried at frequencies below 20MHz. This allows a high pass filter to be used as an alternative and effective protection device.

MTBF and MTTR - The Raven Research multicouplers offer excellent performance in both these areas, with typical mean time between failures of 160,000 hours.

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EQUIPMENT OPTIONS

Through continuous development we have produced a portfolio of standard multicoupler products, covering both multi-octave and communication frequency bands. Options include variation in number of outputs (up to 96 at HF), different power supplies, filters and diplexed inputs/ outputs and mechanical arrangements.

The basic package for the multicoupler is the 19" rack mounting enclosure. These are usually 1U or 2U high and house 1 multicoupler circuit. The RR1150 series is intended for larger systems and houses up to 16 multicoupler modules in a single 19" housing, each multicoupler with 4, 6, 8 or 12 outputs.

Based on the standard product portfolio, Raven Research can offer an extensive range of multicouplers, which can be tailored to individual technical requirements and system criteria.

COOLING ARRANGEMENTS

The both VHF/UHF and HF multicouplers are designed to cool by conduction and convection within a 19" equipment bay, where there is free circulation of air at the rear of the bay.

In the case of HF multicouplers, much higher energy is dissipated. Where a single multicoupler is housed in a 19" enclosure 1U or 2U high, up to 4 multicouplers can be stacked. More units stacked will need an air space between groups of four.

The RR1150 series cools by free circulation of air through the unit from the bottom to the top. The units are rated for a 55°C ambient (chassis) operating temperature but if the ambient temperature is likely to exceed 35°C then a cooling fan-tray is recommended, arranged to force air through the unit from bottom to top. This will prolong operational life.

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