Magnetostatic-wave Signal-to-noise Ratio Enhancer

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In rainy countries like Japan, rain attenuation, or a reduction in the carrier-to-noise ratio (C/N), affects broadcasting satellite (BS) receivers that are equipped with small antennas.

This invention relates to a BS receiving apparatus that can enhance the C/N of received frequency-modulated (FM) signals in the microwave frequency range by using a magnetostatic-wave (MSW) signal-to-noise (S/N) ratio enhancer.

While propagating through the conventional MSW S/N enhancer, the input microwave signal is transduced into a magnetostatic wave in proportion to its power level, and also attenuated by its power. The enhancer is a kind of level filter, namely the inverse of a power limiter that exhibits a low loss for large signals and a high loss for small signals. Another important feature of the enhancer is frequency selectivity, which means that even when many signals with different frequencies and levels exist at the same time, each signal behaves independently of the other signals, and thus, the enhancer can selectively reduce the undesired signals or noise included in the desired signal.

However, the threshold level and saturation level (the level at which the enhancer starts operation and the level of maximum enhancement, respectively) in the conventional enhancer are high and the slope between those two levels is gentle, so that sufficient enhancement cannot be achieved for a very low C/N signal.

The enhancer of this patent is composed of two identical MSW filters, two directional couplers, a phase shifter and an attenuator in order to overcome the above disadvantage and to meet requirements for noise reduction in BS reception. The MSW filters are employed because their saturation level is significantly lower than that of the conventional MSW enhancer. One directional coupler act as a power divider, splitting the received microwave signal between two signal paths which are different in power level, so that the higher power level signal goes to one filter input and the lower power one goes to the other filter input. The filter with the higher power input is operated as a frequency-selective power limiter. After inverting one of the two signals by the phase shifter, the other coupler combines the two signals, for output.

When the input signal is small enough for both filters to be in linear operation, no signal appears at the output port because the two signals are combined with equal amplitude and opposite phase. When the input signal is large enough to saturate one of the filters, most of the signal through the other filter appears at the output because the loss of the filter in saturation operation is much larger than that of the other. This enhancer can lower both of the threshold level and saturation level markedly, and can make the slope between them become steeper compared with that of the conventional enhancer, which makes it possible to reduce noise of even a low C/N signal.

By inserting the MSW S/N enhancer between an outdoor unit and an indoor unit in a BS receiving apparatus, the C/N of the received microwave signal can be improved, which leads to an increase in the S/N of the demodulated video signals.

Figure 1 and Figure 2 show a block diagram of the MSW S/N enhancer of this patent and a perspective view of the MSW filter used in the enhancer, respectively.

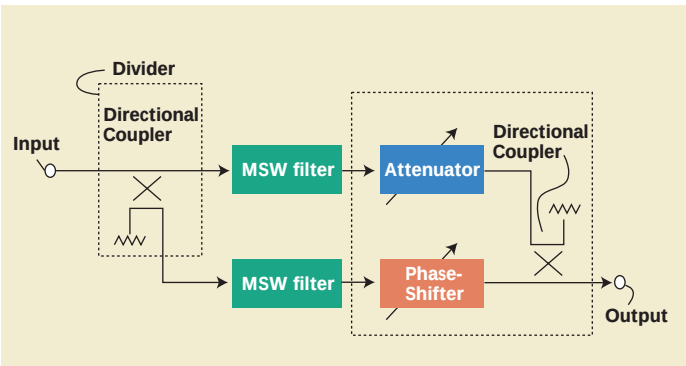

Figure 1: Block Diagram of the MSW S/N Enhancer

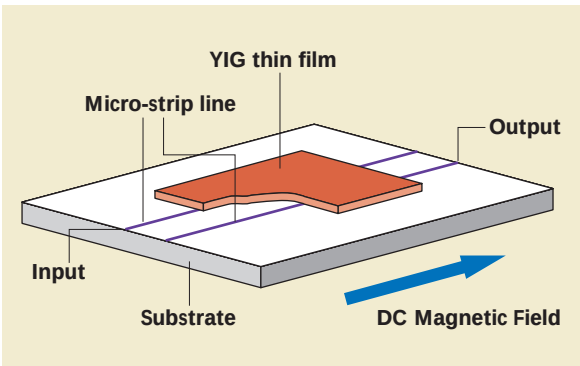

Figure 2: Perspective View of a MSW Filter