THE S.E.M. QRM ELIMINATOR

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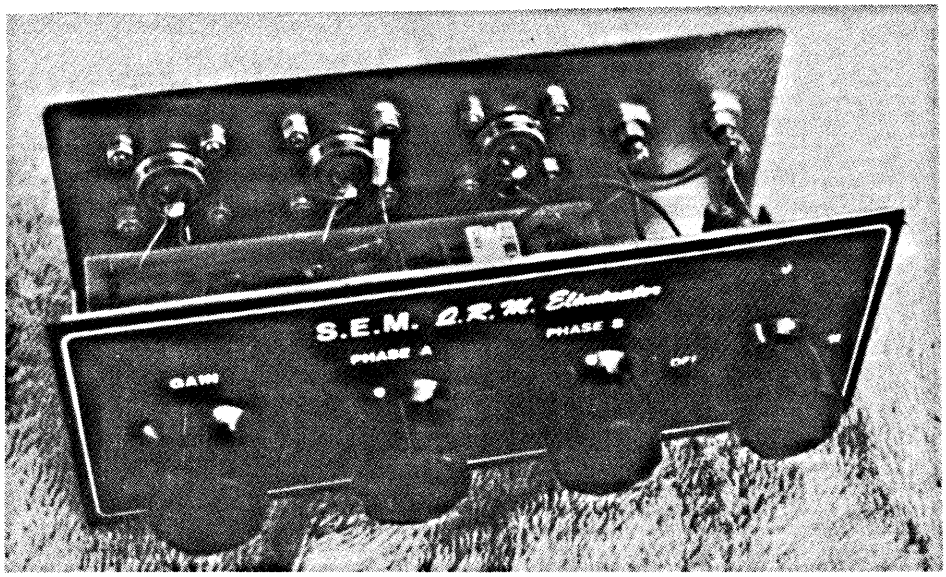

There are many ways of dealing with interference, most of them acting within the receiver or between the receiver and the headphones or loudspeaker. The 'QRM Eliminator', manufactured by S.E.M. on the Isle of Man, U.K., reduces or eliminates the interfering noise or signal BEFORE it reaches the antenna terminals.

There is a lot to be said for this approach, because apart from the unpleasant intrusion into the audio, the presence of the interference within the set may upset the detector action, the automatic gain control and other internal functions.

Remember that if your receiver is connected to the AC power line, local noise may be picked up by direct conduction. The Eliminator is designed to reduce radiated interference coming in via the antenna.

GENERAL DESCRIPTION

The aluminum case is black, 6" x 2" x 3" deep (15 cm x 5 cm x 8 cm), with silk-screened panel markings. Except for the controls and connectors, all components are mounted on a 4" x 2" (10 cm x 5 cm) foil board.

The back panel has three SO-239 coaxial connectors (MAIN ANTENNA, RECEIVER and AUXILIARY ANTENNA) and two RCA phono type sockets (DC INPUT +10-15V 150 mA, and CONTROL).

The unit tested is a Mark 2, with three transistors, four diodes and good quality tantalum and mica capacitors. The CONTROL point is diode-protected, the cathode (positive) connected to the CONTROL terminal.

The frequency range is specified to be 100 kHz-60 MHz. There is a LORAN-C station a few hundred miles from me, so I confirmed that it works at 100 kHz, but I could only test it to 30 MHz.

The MAIN antenna, a separate AUXiliary antenna and the RECEIVER are connected to the Eliminator. The interference is received by both antennas but it arrives first at one and then at the other, depending on the direction from which it comes . The signals from the main antenna go straight through to the receiver. Those from the auxiliary antenna pass through the phase-changing circuits. The controls are adjusted to delay the interference picked up by the auxiliary antenna and apply it at the receiver antenna terminal to cancel out the interference picked up by the main antenna.

USING THE ELIMINATOR

If the interference is coming in from one general direction it really does cancel out, usually completely.

There are three variable controls (GAIN, PHASE A, and PHASE B) and an on-off switch, all on the front panel. With the GAIN at maximum, the two PHASE controls are adjusted to minimize the interference. (Turn

one to reduce it, the other to reduce it more). If it is still audible, the GAIN is adjusted, and a final tweaking of the phase controls may be necessary. If the interference is from a local source that's all there is to it, and the controls can be left alone. If it is coming via sky wave the setting will not stay constant when the vertical angle of arrival changes. It is very effective and stable in taking out groundwave interference from a broadcasting station. During the tests it has always been possible to reduce or eliminate local noise, whether impulse or hash, strong or weak. By careful adjustment an S9 hash can often be completely suppressed, with little or no effect on the desired signal. Sometimes the adjustment is sharp, sometimes quite broad.

Although the device is called a QRM Eliminator, it is intended to remove QRN (manmade or natural noise). But it often works on undesired radio signals too, if they are arriving from a direction other than that of the desired signal. For example I sometimes listen after dark to hockey commentaries broadcast on CKNW 980 kHz, located about 130 km from me. With the Eliminator I can 'phase out' a troublesome heterodyne, and often remove an interfering station that is zero-beat. One or other of the phasing controls has to be shifted once in a while, but it will improve the audio from chaos to acceptability. It is easy to check the effectiveness, because switching to 'OFF' connects the main antenna directly to the receiver and grounds the auxiliary pickup antenna.

If the interference is coming from the same direction as the signal it can be phased out, but the signal may be phased out as well. Occasionally the Eliminator INTRODUCES noise, when the auxiliary antenna picks it up but the main one does not.

Most of the testing was done using a Yaesu FRG-7700. The main antenna was a 600 ft horizontal loop about 60 ft high. For auxiliary antenna I tried other antennas (a 600 ft vertical Delta, a three element Yagi, a trapped vertical groundplane), unused coax feeders coiled up just outside the shack, random wires laid on the ground. Sometimes one arrangement worked best, sometimes another. Everything worked to some extent.

S.E.M. does not provide a schematic, but did send a sketch (Figure 1) to show the principle on which the design is based. Details of bypass switching are not shown.

To bypass, two relays are used to route the signal from the main antenna straight past the Eliminator, at the same time grounding the auxiliary antenna.

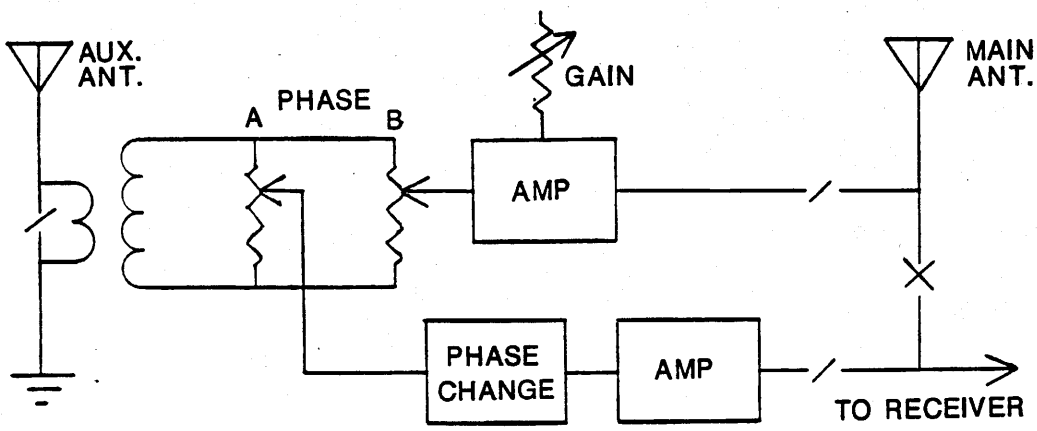

FIGURE 1 PRINCIPLE OF OPERATION OF THE S.E.M. 'ELIMINATOR'

Switching the unit off, removing the 12V DC, or applying a ground to the control terminal will put the unit in this bypass condition. So at the point marked X there is an open circuit when the unit is in operation, a closed circuit when in 'bypass'. Other contacts on these relays make or break connection to wide band amplifiers in the antenna circuits.

There are no tuned circuits. The input from the auxiliary antenna is coupled through a wideband toroidal transformer. The amplifiers are n-channel J-FETs.

ANTENNAS

The circuit presents a 50 ohms load to the main antenna except when in the bypass mode. Then it allows the receiver to do the terminating.

S.E.M. says almost anything can be used as an auxiliary antenna for noise pickup because local interference can be picked up well with a poor antenna. An unused HF or VHF antenna, even a length of unused coax or a random length of wire indoors or outdoors will do. The AUX input impedance is not critical, and S.E.M. recommends that if a coax cable is used on the AUX antenna, just the center pin should be plugged into the AUX socket, with the ring of the plug making no contact. S.E.M. says that polarization of the AUX antenna is not

important. The only essential is that the AUX antenna be physically separated from the main antenna.

I thought a vertical AUX antenna should be better than a horizontal, reasoning that a horizontal wire does not have such a specific position in space. One part of it may be closer to the source of noise than another part. But S.E.M. says it does not matter, and indeed in testing the unit there was no advantage in having a vertical AUX antenna. Whatever the shape or size of the antenna, there seems to be a single effective 'center' that determines the phase of the signal, and if there is any difference in the effectiveness of pickup it can be compensated for with the gain control. If there is a known source of noise, a power line transformer for example, a short whip close to the transformer works well and has the advantage that it does not pick up noise from other more distant sources.

Of course if you want to phase out interfering distant signals, the AUX antenna has to be good enough to hear them. This is an interesting thing to play with, because the combination of two good antennas and the Eliminator works as a directional array with a variable null. You can't have everything though. You can't phase out local interference from one direction and also phase out a distant signal coming in from another direction!

I figured that if the unit could cancel a signal by antiphasing it, it could enhance it by cophasing. Maybe it does and maybe it doesn't. I just haven't been able to make up my mind. The gain control affects the strength of the signal passed on to the receiver, so at some gain settings it is acting as a preamplifier.

USING WITH A TRANSMITTER

The Eliminator may be connected in the antenna feeder of a transceiver with up to 200 watts output. The CONTROL terminal is then switched to ground on transmit (making sure the ground occurs before the transmitter develops power). Alternatively the Eliminator can be switched off or the 12V input removed before transmitting. The switching relays fail safe, so in all these cases the AUX input is grounded for transmit. An r-f sensing circuit is fed from the RCVR terminal and switches the relays to BYPASS mode if r-f power appears. If a power amplifier is used with the transmitter the Eliminator goes in the feed from transceiver to amplifier.

Another way to use the device would be to feed the MAIN ANTENNA terminal from the receive side of the T/R switching in the transceiver, and connect the RECEIVER terminal to the transceiver receiver section input. Bandpass filters are normally between the T/R switching and the antenna in solid state transceivers, and would prevent overloading from strong local signals under some circumstances.

PRODUCT CHANGES

My unit, bought in mid-1991 is a Mark 2. I have not had the opportunity to test it in a location near powerful broadcasting transmitters. One bought more recently has two more transistors in the r-f sensing circuit, making the circuit more sensitive. Used a few miles from medium wave broadcasting stations, the user reports hearing intermodulation from them when listening on 1.8 MHz without a medium-wave-rejection filter. He also reports that if he removes both antennas and switches the unit on he hears white noise above the noise floor of the receiver, audible but not strong enough to move the S-meter needle. I tried this with my unit, on a receiver with .25 uV sensitivity (a Ten-Tec Corsair 2), but could not discern any difference between on and off. But when using it on the FRG-7700 below the M-W broadcast band some added white noise is audible.

While testing with the Eliminator in the coaxial cable between transceiver and linear amplifier I blew the amplifier transistors in the Eliminator (S.E.M. replaced them). Maybe the more sensitive sensing circuit in the later model would have saved them, although I still don't know why they blew.

PRICE, DELIVERY ETC.

The address of the manufacturer is S.E.M., Union Mills, Isle of Man, United Kingdom. Telephone: Marown (0624) 851277 or 662131. The price in early 1992 was 85 Pounds Sterling including VAT (Value Added Tax) and delivery in the U.K. (about $150 U.S. or $180 Cdn at the time of writing). For export to North America the VAT is not added, but the extra cost of carriage and insurance outweighs the saving in VAT exemption. Credit card orders are accepted.

S.E.M. ships very promptly, and responds willingly and promptly to queries or problems. Circuit details are not provided, but nothing is encapsulated and the circuit board is easy enough to trace out. S.E.M. says thousands have been sold. I do not know of any plans to distribute through a North American outlet.

CONCLUSION

Although I seldom suffer any harmful local interference, I am glad I bought this device. It is interesting to play with it as a 'pseudo-directional-antenna-array'. I am well equipped with selective filters and audio processors, but sometimes the more effective place to deal with a problem is before the signal gets to the receiver.