The radars had all been recently installed and are presumed to have been identical in all respects.

WSR-74C (Figs. 16b and c). Coaxial magnetrons. A measurement error (fig. 16c) occurred at 5732 MHz causing the 5 MHz wide peak in that region.

WSR-74C (Fig. 17a). Coaxial magnetron. This extended radar spectrum of a C-band weather radar was continued until the received signal level dropped below the measurement system noise level.

WSR-74C (Fig. 17b). Coaxial magnetron. This figure and figure 17C, following, illustrate the same radar measured with (figure 17b) and without (figure 17c) a band reject filter at 6200 MHz.

WSR-74C (Fig. 17c). Coaxial magnetron. A feature of this spectrum is the attenuation of the radar emission over 5950-6450 MHz, resulting from use of a special filter designed to protect a local microwave link. Comparing this spectrum with Figure 17b illustrates the effectiveness of using filters to protect collocated users of the frequency spectrum.

WR100-2/77 (Figure 17d). Coaxial magnetron. This C-band weather radar is operated by a local television station, and is described by the manufacturer as being essentially the same as a WSR-74C. The extended spectrum was made in full cooperation with the television station personnel and spectrum data collection was continued until the signal level fell below the measurement system noise level.

8. CONCLUSIONS

Different types of radar output tubes vary markedly in the amount of spectrum they “consume” in normal operation. In many cases, much more spectrum is used than is needed for proper radar operation. The extra spectrum is consumed by spurious sidebands produced by radar output tube operation. The amplitrons and twystrons are particularly “dirty” and generally do not meet the RSEC limits used in this report. On the other hand, they can produce high-power, frequency-agile outputs with high efficiency in a small package. Bandpass filters can be used to reduce out-of-band emissions, but this could hamper frequency agility in some operations.

Klystrons produce very clean spectra. When klystrons are combined with narrowband diplexers, the spectra are improved even more. The rapid fall-off and the deep suppression of sidebands make it possible to site radars closer together in frequency and space than would be possible with other types of output tubes. Klystrons, however, are large and expensive and possibly best suited to fixed installations.

The conventional magnetron is small and cheap, and is extensively used in many types of equipment. There is a wide range of spectra produced by conventional magnetrons, compare the spectra of Figure 2a and 2b, for example. This may be because conventional magnetrons are subject to wide variations in equipment design and operational maintenance. When the conventional magnetron is combined with narrowband filters or diplexers, as in the GPN-20, excellent spectrum characteristics are possible.

The coaxial magnetron produces a cleaner spectrum (near center frequency) than the conventional magnetron, completely eliminating the "porch" which is present with conventional magnetrons. Farther away in frequency, however, the improvement is not particularly noticeable. A "hump" about 100 MHz above the fundamental frequency is present in many coaxial magnetron spectra. Whether the [1, 2, 1] mode "hump" of a coaxial magnetron spectrum is more objectionable than the frequency pulling "porch" (produced by conventional magnetrons) is a matter of question.

The spectrum used by various combinations of output tubes and bandpass filters is one factor in determining how much value is gained from the spectrum allocated to radar. Many factors besides the level of unnecessary sidebands must obviously be included in the choice of radar output tubes. However, the difference between the amount of spectra used by various tube types is very substantial and must not be totally ignored. A majority of the frequency spectrum allocated to radar is currently filled by unnecessary spurious sidebands produced by dirty radar output tube technology. The widespread use of cleaner output tube technology would provide room for many more radars in existing bands.

9. REFERENCES

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