

Subject: Spurious and Harmonic Radiations  
from Television Transmitters

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Report on the Work of RETMA Sub-Committee TR-4.1 on  
TV Program Transmitters and of Task Force TF-2  
on Transmitter Spurious Radiation

to

Task Group 7 on Transmitter Spurious Radiation

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by

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TR-4.1 (Sub-Committee on TV Program Transmitters) and TF-2 (Task Force on Transmitter Spurious Radiations) have been actively engaged in the problems of Spurious and Harmonic Radiations from Television Transmitters for about two years. This work was initiated as a result of a request from the F.C.C. in April, 1952, asking for establishment of such a program. The RETMA members have participated in a gratifying manner. To date about 2,000 man days of Engineering have been expended on these problems. Approximately 250 man days of additional work is foreseen.

On June 10, 1953, the F.C.C. issued an order in Docket No. 10353 requiring all spurious radiations from Television transmitters to be 60 db or greater below the fundamental field intensity at all frequencies 3 MC or more removed from the edges of the channel.

Initial Program

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The program initiated called for the following:

- 2.1 Survey available measuring equipment, specifications, etc.
- 2.2 Investigate and report on means which have been found successful in reducing spurious radiations.
- 2.3 Measure and report performance of transmitters and filters being manufactured. Make available filters, etc. as required.
- 2.4 Establish realistic goals for spurious radiation performance.
- 2.5 Set up timetable for attainment of these goals.

Results Accomplished

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- 3.1 A considerable amount of literature and equipment availability information was circulated to the members. In particular, this contained information on modifications of a Type APR-4 Radar Receiver to permit measurements in the 1,000 MC to 4,000 MC range and on construction of rejection filters for use in the measurements.
- 3.2 A suitable technique of measurement was evolved and tested. A description of the method is attached to this report. Note that this method provides for measurements to be made in the transmission line and, therefore, removes many of vagaries encountered when attempting off-the-air measurements.
- 3.3 The members have made measurements to date on about 43 transmitters of 22 different types. In very general terms the harmonics, without use of harmonic filters, were found to be stronger than -60 db up to the 6th; from the 4th to 10th the

strength might lie between -60 and -70 db; and harmonics higher than 8th might lie between -70 and -90 db. In some cases some of the lower order harmonics might be as strong as -30 db.

- 3.4 As it was evident that in most cases harmonic filters would be required, first emphasis was given to their development. 35 models of transmission line harmonic filters have been developed and are available to the broadcasters. The approximate attenuations obtainable with such filters is given as follows:

Channel Number	Expected Attenuations of Filter in DB			
	2nd Harm.	3rd Harm.	4th Harm.	5th Harm.
2-6	40 to 50	35 to 45	30 to 40	30 to 40
7-13	40 to 70	35 to 45	30 to 40	30 to 40
14-83	30 to 40	25 to 35	10 to 30	10 to 30

These filters are generally supplied as part of transmitters shipped after July 1, 1953. They are available for older transmitters at prices ranging from about \$475. to \$1,700. depending on power and channel.

- 3.5 As the harmonic content in the transmission line to the antenna is reduced to a low amount by the harmonic filtering, it is expected that radiation via other means, such as through cubicle windows, cracks of doors, wiring, etc., will be of increasing importance.

Measurements are being made at several installations to determine the magnitude of this problem. Present indications are:

1. Susceptibility to such radiation varies considerably between transmitters and between locations.
2. Techniques involving screening of windows and providing for adequate bonding of doors, transmission lines, etc., appear to be successful.

Two specific cases of 2nd harmonic interference to airplane services were investigated and cured. In one of these cases, cabinet measures giving about 15 db additional attenuation were found necessary.

#### Remaining Work

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- 4.1 Some additional measurements will be made to investigate if combining of visual and aural transmitter outputs through a diplexer introduces a spurious radiation problem.
- 4.2 Approximately 250 man days of engineering is expected to be required to complete measurements and cabinet modification data.

- 4.3 TR-4.1 and T-2 hope to be able to confine this spurious radiation work within the next few months.

### Conclusions

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- 5.1 With use of harmonic filters, the harmonic content in the transmission lines can be guaranteed to be better than 60 db below the fundamental. In most cases measurements have indicated that better than -80 db will be obtained.
- 5.2 In some cases cabinet radiation measures will be required so that such radiation is maintained lower than the values given in 4.1.
- 5.3 There will be some instances of specific cases of interference which will require specific corrective measures.
- 5.4 The spurious and harmonic reduction attainable by means evolved by this committee is more than sufficient for meeting the present Rules of the Federal Communications Commission.

The level of spurious radiation to be expected from television transmitters is much greater than the values suggested in Docket 9230 (which does not apply to transmitters).

- 5.5 There will always be some low level of spurious and harmonic radiation which must be recognized as an ambient level. Services making use of radio frequencies must recognize the existence of such an ambient level in design and use of their equipment.

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