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AN EXPERIMENTAL UHF TELEVISION CONVERTER

RADIO CORPORATION OF AMERICA
RCA LABORATORIES DIVISION

RADIO CORPORATION OF AMERICA
RCA LABORATORIES DIVISION
PRINCETON, N. J.

E. W. ENGSTROM
VICE PRESIDENT IN CHARGE OF
RESEARCH

January 30, 1950.

Mr. T. J. Slowie, Secretary
Federal Communications Commission
Washington 25, D. C.

Re: Docket Nos. 8736, 8975,
9175 and 8976

Dear Sir:

In our progress report of December 30, 1949, on the subject dockets, we included as attachment Part B - Item 3c, a report on a UHF converter. This report has been put into bulletin form for wider distribution and has the title, "An Experimental UHF Television Converter." One hundred copies of this ninth bulletin* are filed herewith and copies will be mailed to the list of persons and organizations attached to Mr. Robert Zeller's letter of October 26, 1949.

Very truly yours,

E. W. Engstrom

E. W. Engstrom

*See attachment

*Bulletins previously filed and distributed:

"A 15 by 20-Inch Projection Receiver for the RCA Color Television System" (letter dated October 20, 1949)

"Synchronization for Color Dot Interlace in the RCA Color Television System" (letter dated October 31, 1949)

"A Two-Color Direct-View Receiver for the RCA Color Television System" (letter dated November 9, 1949)

"An Experimental UHF Television Tuner" (letter dated December 12, 1949)

"A Three-Color Direct-View Receiver for the RCA Color Television System" (letter dated January 9, 1950)

"An Experimental Determination of the Sideband Distribution in the RCA Color Television System" (letter dated January 17, 1950)

"A Study of Co-Channel and Adjacent-Channel Interference of Television Signals, Part I" (letter dated January 17, 1950)

"A Study of Co-Channel and Adjacent-Channel Interference of Television Signals, Part II" (letter dated January 30, 1950)

An Experimental UHF Television Converter

Radio Corporation of America

January 1950

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An Experimental UHF Television Converter

Introduction

This bulletin describes a u-h-f television converter developed to aid in the field tests of an NBC experimental television transmitter scheduled to commence operation in Bridgeport, Conn., early in 1950.

It is designed to extend the frequency tuning range of a v-h-f type television receiver to include the band from 500 to 700 Mc. The converter intermediate-frequency amplifier has a bandwidth of 12 Mc., from 204 to 216 Mc; therefore, either Channel 12 or 13 of the v-h-f receiver may be used for u-h-f reception. A high i.f. is used in the converter to improve the image and spurious responses, and to reduce the oscillator radiation. The design embodies low cost, simplicity of production and ease of operation.

Since the Bridgeport transmitter will operate in the lower frequency region (529-535 Mc) of the u-h-f band, it has been possible to attain satisfactory performance using conventional tubes in this particular converter which covers the range from 500 to 700 Mc. A converter which is to perform satisfactorily in the frequency region above 700 Mc would probably require a different tube complement, and perhaps other design changes. For this reason, the converter described here is not intended to represent a finished commercial design, but rather is an experimental model to be used on a limited basis to acquire further technical information pertinent to u-h-f television transmission and reception. This converter was used during the recent color television experiments in Washington when transmissions were being made in the u-h-f band.

Electrical Circuits

Fig. 1 is the schematic diagram of the converter circuit. The u-h-f incoming signal from the u-h-f antenna is first fed to a high-pass filter, having a cut-off frequency at about 475 Mc, through a cable connector and short length of 75-ohm low-loss cable (extreme left of circuit diagram). Only an r-f tuned circuit, with proper impedance transformation networks to maintain high operating circuit Q, is employed between the high-pass filter and the crystal mixer. The local-oscillator signal is injected into the crystal mixer in a manner which provides uniform injection for optimum operation of the crystal mixer.

The i-f system consists of a low-noise high-gain cascode stage followed by a conventional pentode stage. The output from the last i-f stage is developed across a balanced 300-ohm load to match the input circuit of v-h-f type television receivers.

A power supply is included in the converter. Only antenna connections to the v-h-f type television receiver are required upon installation. The heater of the oscillator tube is left on continually to minimize the warm-up frequency drift. The power consumption during the stand-by period is about 9 watts.

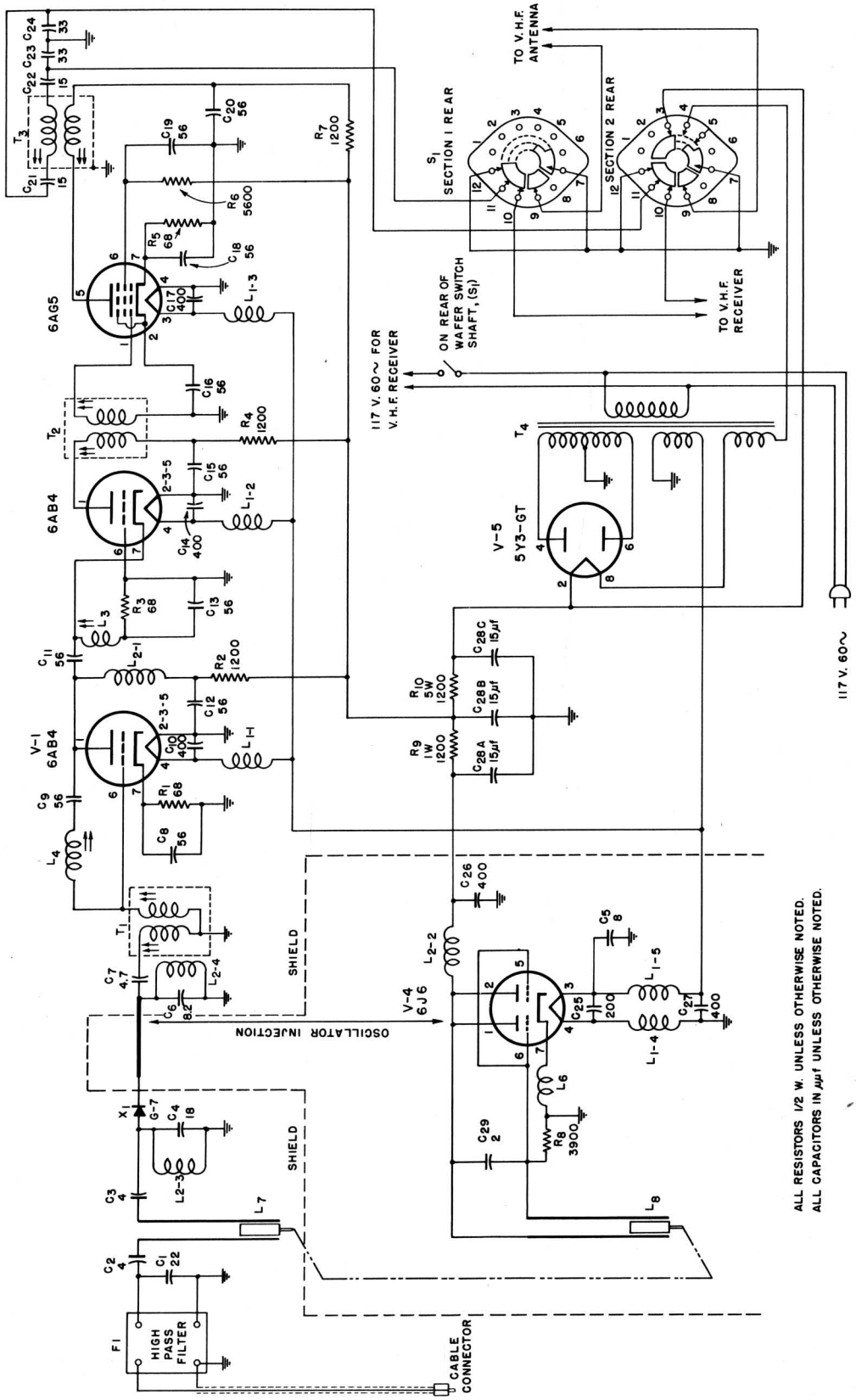

Fig. 1 - Schematic diagram of u-h-f converter.

Tube Complement

1 G-7 Crystal
1 6J6 Oscillator
2 6AB4 Cascode I-F Amplifiers
1 6AG5 Last I-F Amplifier
1 5Y3GT/G Rectifier

Performance Data

1. Frequency Stability - The maximum warm-up frequency drift is within 200 kc and stabilization is reached in less than 2 minutes after the power is switched on.

Time in Minutes	Kc Frequency Drift at 500 Mc	600 Mc	700 Mc
0	-	-	-
½	100	200	50
1	25	90	0
1½	0	30	0
2	0	0	0
2½	0	0	0
3	0	0	0

2. Oscillator Radiation -

Frequency Mc	Radiated Power Microwatts
500	.015
550	.015
600	.015
650	.015
700	.035

3. Image and Spurious Responses -

Freq. Mc	Image Rejection db	Half I-F Rejection db	Rejection to Responses Caused by the Oscillator Second Harmonics db
500	60	55	60
550	60	55	40
600	60	55	30
650	60	55	30
700	55	50	40

4. Selectivity - See graphs (Figs. 2 and 3).

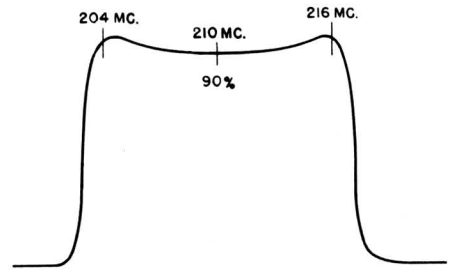

Fig. 2 - Converter selectivity curve

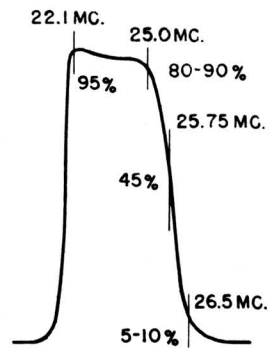

Fig. 3 - Receiver selectivity curve.

5. Sensitivity - Input signal required to give 10 to 1 ratio between peak-to-peak modulation and peak-to-peak noise. The modulation on the carrier is 400 cycles at 30 per cent. The measurement is made with the carrier at the top of the selectivity curve.

Freq. Mc	Sensitivity Microvolts
500	300
550	250
600	250
650	250
700	250

Mechanical

The converter is housed in a wooden cabinet with a 7 × 8 × 2½-inch chassis. Two knobs are accessible on the cabinet front: a u-h-f tuning knob and a three-position switch knob (power off/vhf/uhf). The converter is tuned with a wormdrive mechanism to minimize back lash. A fairly linear dial calibration is read through the cabinet window.

SUPPLEMENTAL DATA

ATTACHED IS A SHEET OF SUPPLEMENTAL DATA ON THE UHF TUNER DESCRIBED IN THE BULLETIN "AN EXPERIMENTAL UHF TELEVISION TUNER", RADIO CORP. OF AMERICA, DECEMBER 1949.

FOR READY REFERENCE, PLEASE ATTACH THIS DATA SHEET TO YOUR COPY OF THE BULLETIN.

Supplemental Data on UHF Tuner Described in Bulletin "An Experimental UHF Television Tuner"

Introduction

The u-h-f tuner referred to herein and described in the Bulletin is being installed in RCA Victor Type 9T246 television receivers. These receivers are thus changed from v.h.f. only to complete vhf-uhf television receivers which will be used in the Bridgeport area for observations on the u-h-f experimental transmissions by NBC.

The following measurements were made on one of these complete receivers.

Sensitivity Measurements

Input signal required to give a 10-to-1 ratio between peak-to-peak modulation and peak-to-peak noise. The modulation on the carrier is 400 cycles at 30 per cent. The measurement is made with the carrier at the top of the selectivity curve.

Frequency in Mc	Input in Microvolts
500	140
600	200
700	270

Oscillator Radiation

Power measured across 75 ohms at the antenna terminals - less than 0.2 microwatts over tuning range (500-700 Mc).

Selectivity

Curves in Fig. 1 show the 135-Mc i-f selectivity, u-h-f head-end selectivity (including 135-Mc i.f.) at 500 Mc, and the 21-27-Mc i.f. of the 9T246 receiver. Fig. 2 shows the overall curve for the u-h-f tuner and receiver, the u-h-f tuner set at 500 Mc.

Image and Spurious Responses

Signal Freq.	Image Rejection	Half I-F Rejection	Rejection to Responses Caused by Oscillator 2nd Harmonics
500	>78 db	>78 db	42 db
550	>73 db	>73 db	42 db
600	>66 db	>66 db	58 db
650	>67 db	>67 db	59 db
700	>70 db	>70 db	

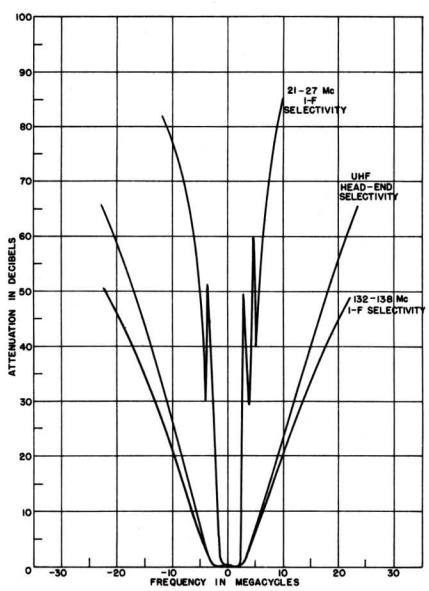

Fig. 1 - Selectivity curves of 135-Mc i.f., u-h-f head end, and the 21-27-Mc i.f. of the 9T246 receiver.

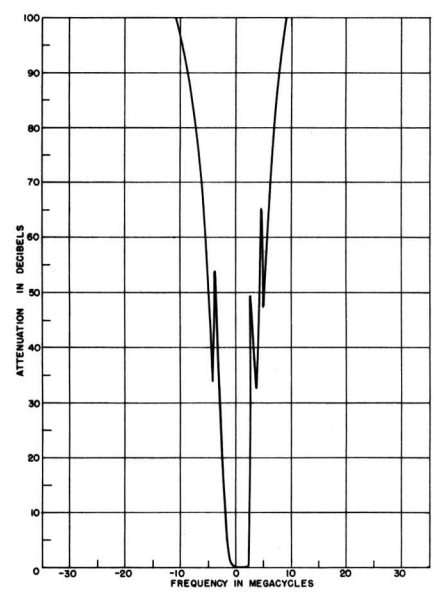

Fig. 2 - Overall selectivity curve for u-h-f receiver.