CHAPTER III

MEASUREMENT DATA AND RESULT

Equipments

1 - Radio Receiver R-390A/URR: Stewart-Warner Electronics, Serial No. 55.

1 - PANORAMIC PANALYZOR Model SB-12b Type T-100 Center Frequency 500KC: Panoramic Radio Product Inc., Serial No.255A134.

1 - Power Supply PS-12 : Panoramic Radio Product Inc., Serial No. 255A134. (Use with PANALYZOR).

1 - Standard Signal Generator Type 1001-A : Frequency 5 KC-50 Mc; General Radio Company, Serial No. 4531.

1 - Signal Generator Model 606A : Frequency 50 KC - 65 Mc ; Hewlett-Packard ; Serial No. 301-04349.

1 - Electronic Counter 5243L ; Hewlett-Packard ; Serial No. 305-00522.

2 - Audio Oscillator Model 200CD ; Frequency 5cps - 600 KC ; Hewlett-Packard ; Serial No. 252 - 01542.

1 - Electronic Voltmeter and Amplifier Model 314; Ballantine Laboratories Inc., Serial No. 4790.

1 - 600 ohm Headset.

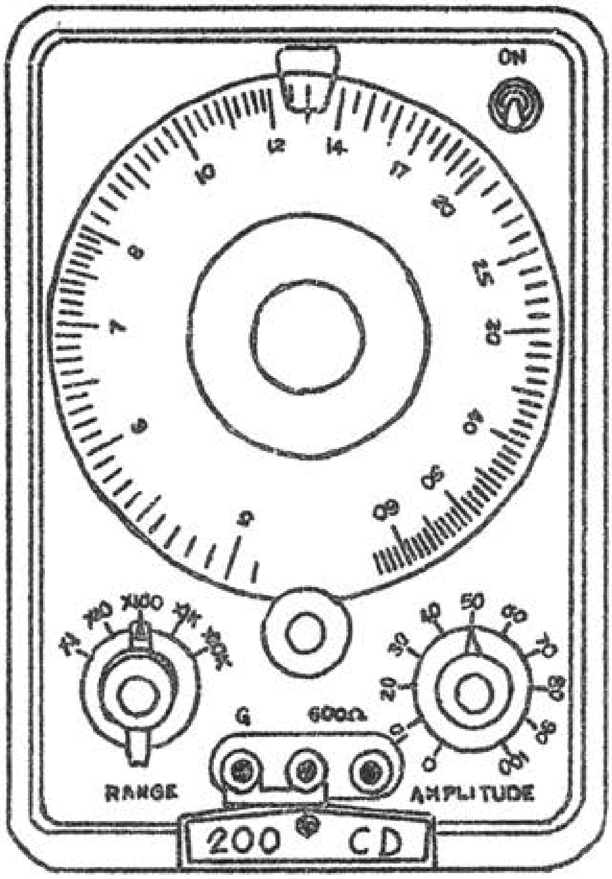


Fig. 15 — Model 200CD Oscillator (HEWLETT-PACKARD)

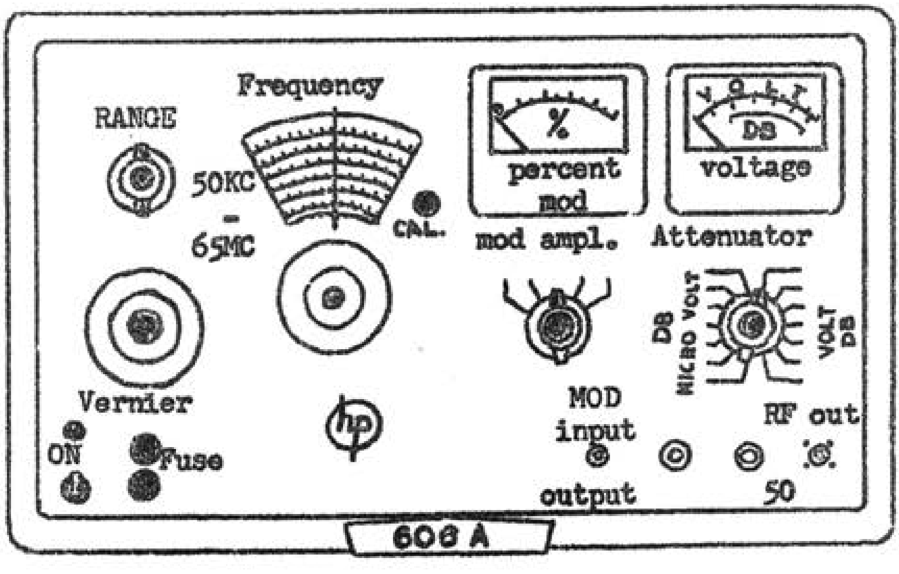


Fig. 16 — Model 606A High Frequency Signal Generator (HEWLETT-PACKARD)

Experimental Work

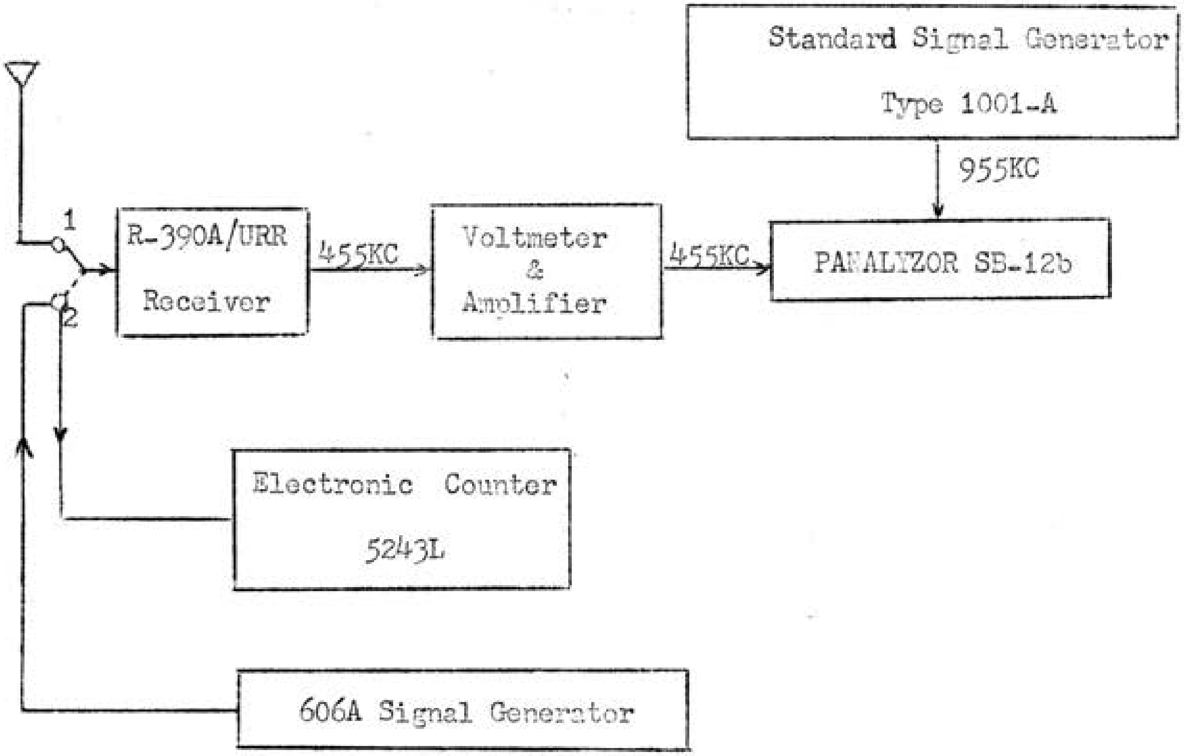


Fig. 17 —— Connection and types of the equipments used in experimental work.

Audio Frequency Spectrum

Calibrate the PANALYZOR SB-12b as previously described in Chap. 2, then connect the antenna to the UNBALANCED ANTENNA coaxial jack of the R-390A/URR receiver (point 1 in Fig. 17), tune R-390A/URR receiver to received the RF signal from the radio broadcast transmitter which is selected for measurements. At radio broadcast station, transmit only carrier frequency and the signal will be received by the R-390A/URR receiver at the SRI laboratory. The pip of this carrier frequency will be displayed on the screen of the PANALYZOR SB-12b, adjust switch GAIN for full scale amplitude and note down the RF voltage from a voltmeter. This voltage is related with the vertical scale of the PANALYZOR SB-12b and it is simply to change the amplitude from unit into volt.

Then radio broadcast transmitter transmit the modulated RF signal which modulating by a single tone from an oscillator, which varies from 1 KC, 2KC, ... up to 10 KC. Note down the amplitude of the sidebands at various modulating frequencies which displays on the screen of the PANALYZOR SB-12b in unit of the vertical scale.

Frequency Stability

The carrier frequency was measured by the method previously described in Chap. 2, and the connection of the equipments is shown in Fig. 17 when the R-390A/URR receiver contact with point 2. Note the frequency, which is counted by the Electronic Counter at different times approximately four.

Spurious Emission

The spurious emission was measured by the method previously described in Chap. 2, and the connection of the equipments is shown in Fig. 17 when the R-390A/URR receiver contact with point 1. Note the amplitude of the spectrum shown at F_c, F_c + 15KC, F_c + 30KC, F_c + 75KC, $2F_c$, $3F_c$, $4F_c$, and $5F_c$, respectively.

For accurate tuning of the receiver, the radio broadcast transmitter should be transmitting the tone 1,000 cycles in the same time with RF carrier. When tuning the receiver to second harmonic, and other harmonics, respectively; use headset to liston to the tone 1,000 cycles for accurate in tuning the receiver to a proper frequency too.

Data

This section includes the datas of :-

1. PUBLIC RELATIONS Dept. 8 Radio Broadcast Station, F_c=674.15KC.
2. PUBLIC RELATIONS Dept. Radio Broadcast Station, F_c = 927 KC.
3. PUBLIC RELATIONS Dept. Radio Broadcast Station, F_c = 830 KC.
4. PRD. 10 (Thammasart University) Radio Broadcast Station, F_c = 980 KC.
5. ROYAL THAI AIRFORCE Radio Broadcast Station, F_c = 540 KC.
6. POLICE Dept. Radio Broadcast Station, F_c = 1430 KC.
7. AGRICULTURAL UNIVERSITY Radio Broadcast Station, F_c = 662 KC.

In these datas, they include the amplitude of audio frequency spectrum at various audio frequencies, carrier frequency which^ is measured by Electronic Counter, and the spurious emission output from the transmitters.

Fig. 18——Shown the connection of the equipments in the SRI Lab.: 1.PANALYZOR SB-12b; 2.PS-12 power supply; 3. 606A Signal Generator; 4. Standard Signal Generator; 5. R-390A/URR receiver; 6. Electronic Counter; 7. 200CD Audio Oscillator (in Fig. is the 204B); 8. Voltmeter and Amplifier.

Station PUBLIC RELATIONS Dept.8 Frequency 674.15KC Power 2.5 KW

Time 1000 - 1045 ... Date 27 December 1965

AUDIO FREQUENCY SPECTRUM

Set amplitude of the carrier (F_c) = 1 unit all the time.

F_c for amplitude 1 unit = 20×10^{-3} volt.

Audio freq. mod.	Amplitude	
F_m KC	$F_c \pm F_m$ unit	$F_c \pm F_m$ volt
1	0.31	6.2×10^{-3}
2	0.29	5.8×10^{-3}
3	0.27	5.4×10^{-3}
4	0.24	4.8×10^{-3}
5	0.22	4.4×10^{-3}
6	0.19	3.8×10^{-3}
7	0.16	3.2×10^{-3}
8	0.14	2.8×10^{-3}
9	0.11	2.2×10^{-3}
10	0.08	1.6×10^{-3}

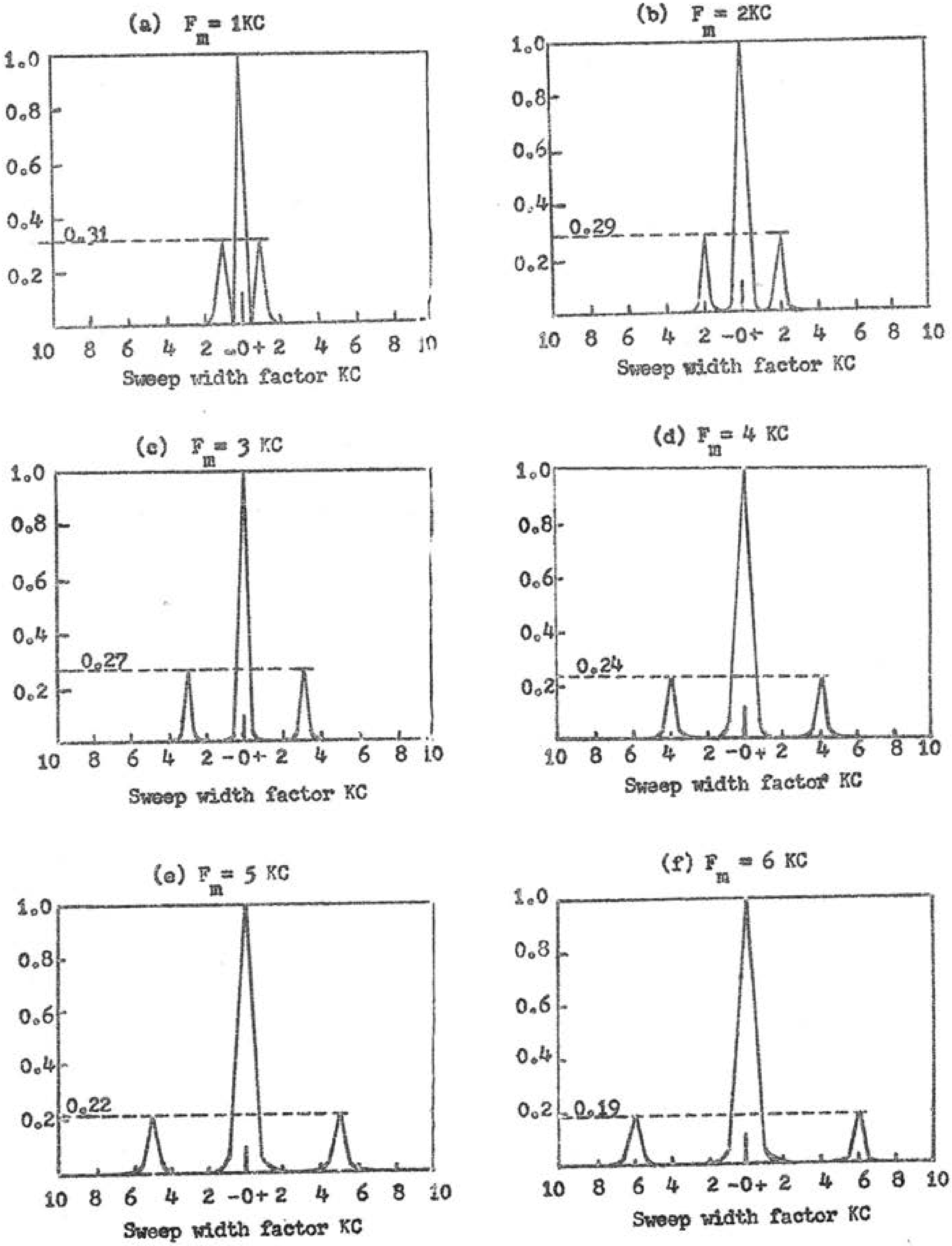
FREQUENCY STABILITY

1. 674.138 KC
2. 674.156 KC
3. 674.166 KC
4. 674.158 KC.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
674.15 (F_c)	1	20×10^{-3}	Reference
689.15 (F_c + 15KC)	0.02	0.4×10^{-3}	33.98 db
704.15 (F_c + 30KC)	0	0	
749.15 (F_c + 75KC)	0	0	
1348.30 ($2F_c$)	0	0	
2022.45 ($3F_c$)	0	0	
2696.60 ($4F_c$)	0	0	
3370.75 ($5F_c$)	0	0	

Fc = 674.15 KC


(a) F_m = 1KC
1.0
0.8
0.6
0.4
0.2
0.31
10 8 6 4 2 -0+ 2 4 6 8 10
Sweep width factor KC
(b) F_m = 2KC
0.29
Sweep width factor KC
(c) F_m = 3 KC
0.27
Sweep width factor KC
(d) F_m = 4 KC
0.24
Sweep width factor KC
(e) F_m = 5 KC
0.22
Sweep width factor KC
(f) F_m = 6 KC
0.19
Sweep width factor KC

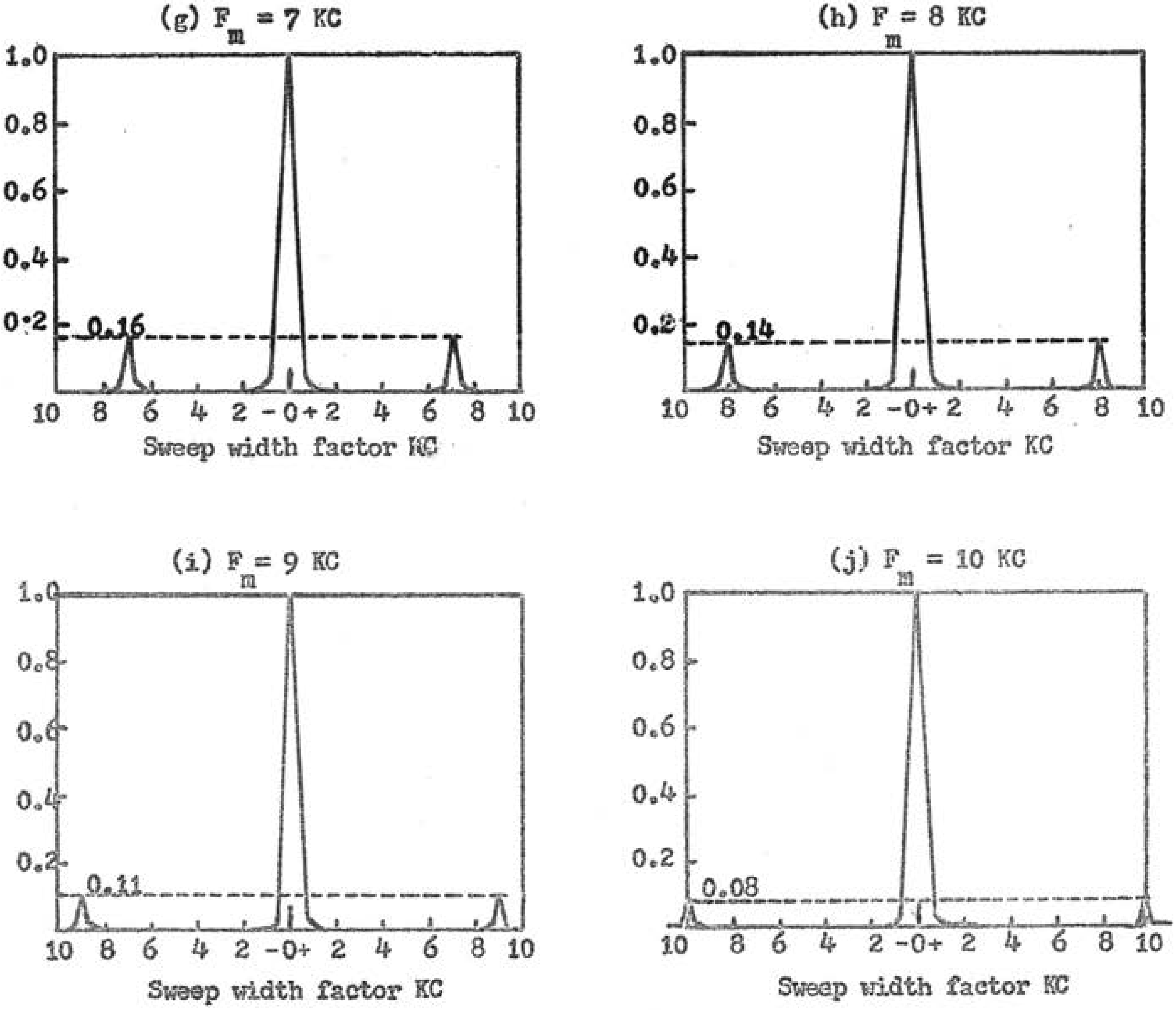


Fig. 19-(a)-(j). Spectrum components of RF signal of PUBLIC RELATIONS Dept. 8 at various modulating frequency which displays on PANORAMIC PANALYZOR SB-12b.

Station PUBLIC RELATIONS Dept. Frequency 927 KC Power 10 KW

Time 0900 - 1000 - . Date 6 January 1966

AUDIO FREQUENCY SPECTRUM

Set amplitude of the carrier (F_c) = 1 unit all the time.

F_c for amplitude 1 unit = 20×10^{-3} volt.

Audio freq. mod.	Amplitude	
F_m KC	$F_c \pm F_m$ unit	$F_c \pm F_m$ volt
1	0.28	5.6×10^{-3}
2	0.25	5.0×10^{-3}
3	0.23	4.6×10^{-3}
4	0.20	4.0×10^{-3}
5	0.19	3.8×10^{-3}
6	0.16	3.2×10^{-3}
7	0.15	3.0×10^{-3}
8	0.13	2.6×10^{-3}
9	0.11	2.2×10^{-3}
10	0.09	1.8×10^{-3}

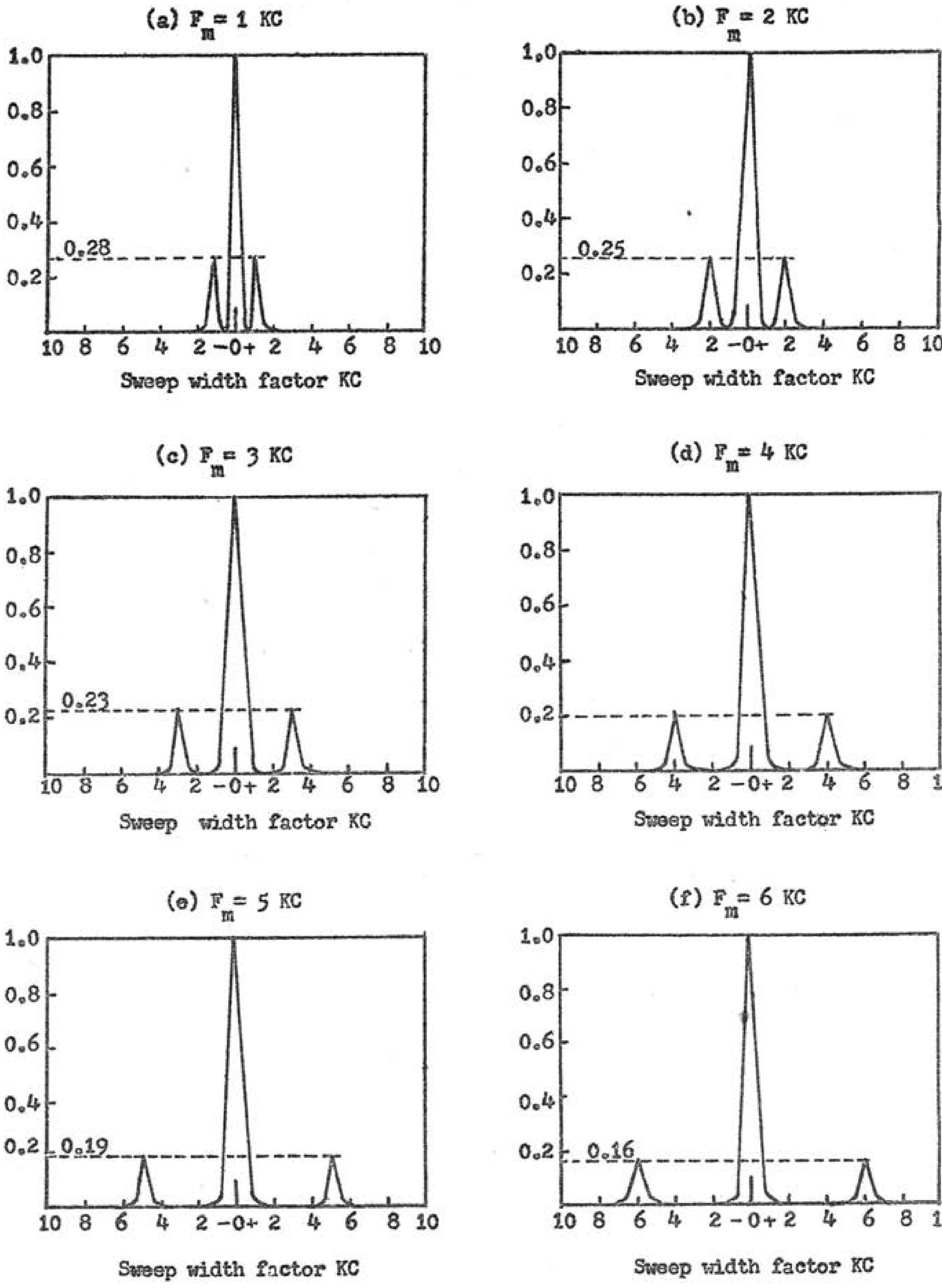
FREQUENCY STABILITY

1. 927.006 KC,
2. 926.994 KC,
3. 926.997 KC,
4. 927.008 KC.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
927 (F_c)	1	20×10^{-3}	Reference
942 (F_c + 15 KC)	----	----	Interfere from other
957 (F_c + 30 KC)	0	0	
1002 (F_c + 75 KC)	0	0	
1854 ($2F_c$)	0	0	
2781 ($3F_c$)	0	0	
3708 ($4F_c$)	0	0	
4635 ($5F_c$)	0	0	

F_c= 927 KC


(a) F_m= 1 KC
(b) F_m = 2 KC
(c) F_m= 3 KC
(d) F_m= 4 KC
(e) F_m= 5 KC
(f) F_m= 6 KC
0.28
0.25
0.23
0.19
0.16
Sweep width factor KC

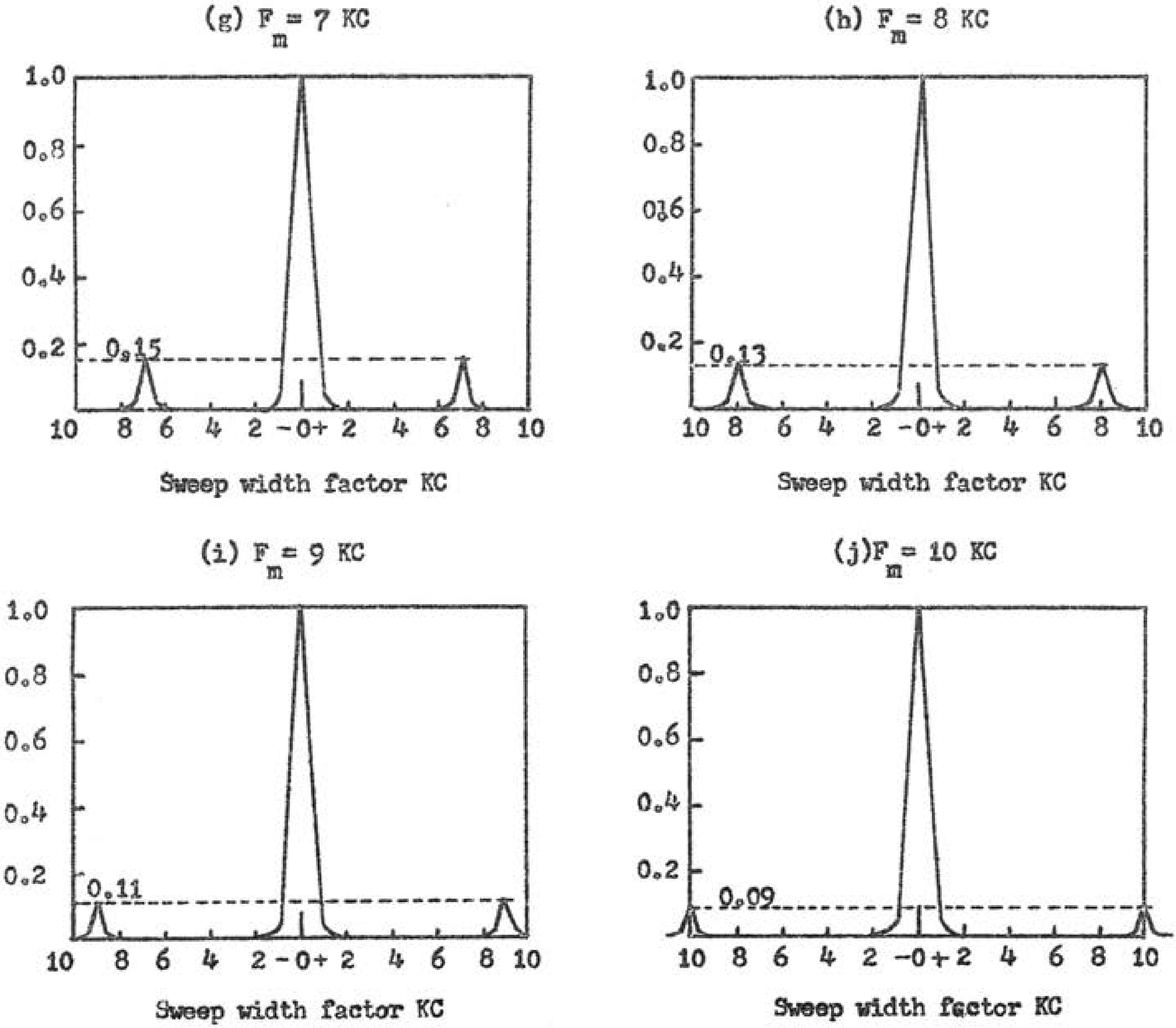


Fig. 20 (a)-(j). Spectrum components of RF signal of PUBLIC RELATIONS Dept. Radio Broadcasting Station at various modulating frequency which displays on PANORAMIC PANALYZOR SB-12b.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
830 (F_c)	1	100×10^{-3}	Reference
845 (F_c + 15 KC)	0.03	3×10^{-3}	30.46 db
860 (F_c + 30 KC)	0	0	
905 (F_c + 75 KC)	0	0	
1660 ($2F_c$)	0	0	
2490 ($3F_c$)	0	0	
3320 ($4F_c$)	0	0	
4150 ($5F_c$)	0	0	

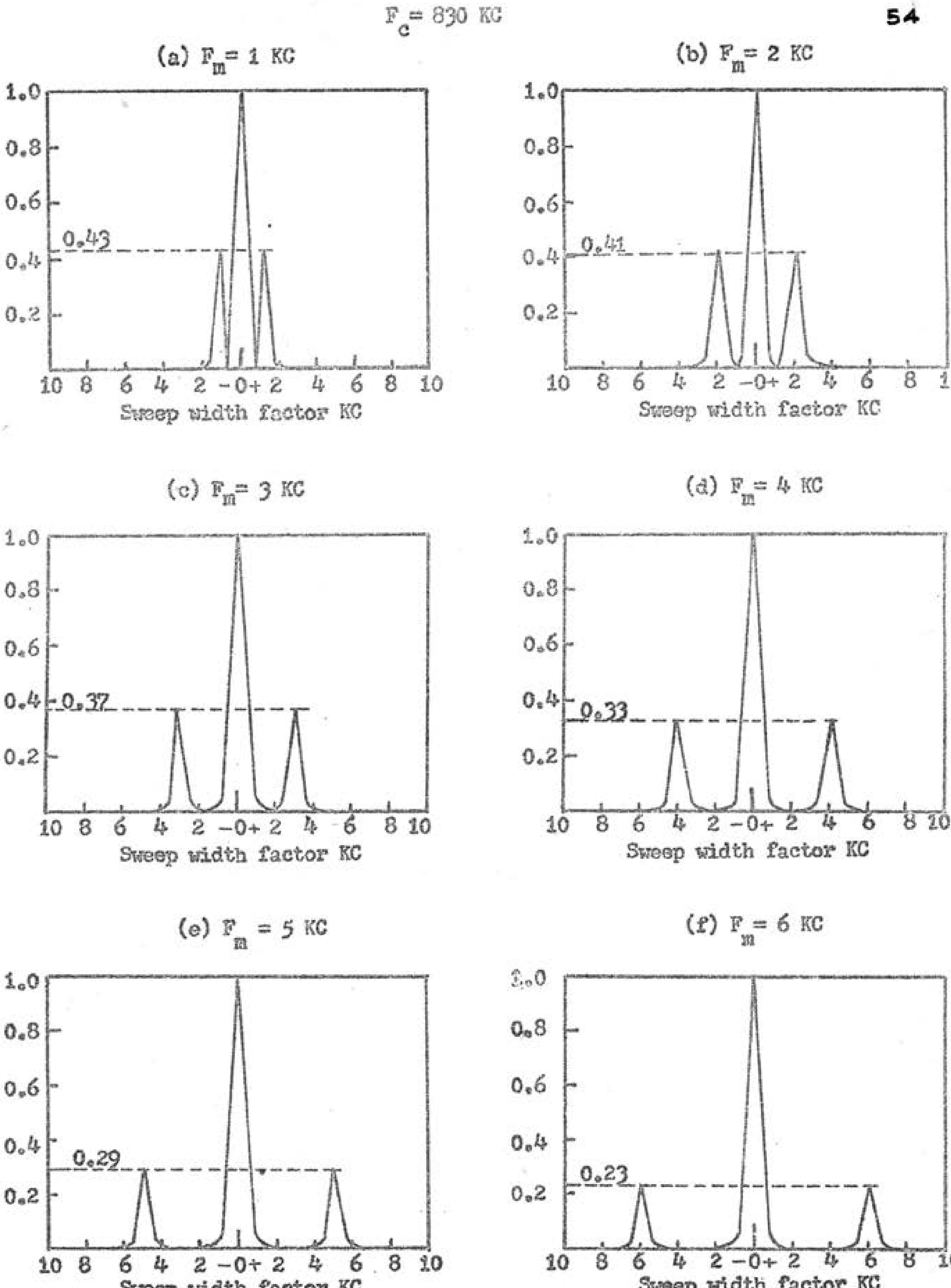


Fig. 21. (a)-(f). Spectrum components of RF signal of PUBLIC RELATIONS Dept. at various modulating frequencies which displays on PANORAMIC PANALYZOR SB-12b.

<u>Station</u> PRD 10 (THAMMASART UNIVERSITY) <u>Frequency</u> 980 KC <u>Power</u> 1 KW

<u>Time</u> 1100 - 1125 <u>Date</u> 11 February 1966

AUDIO FREQUENCY SPECTRUM

Set amplitude of the carrier (F_c) = 1 unit all the time.

F_c for amplitude 1 unit = 300×10^{-3} volt.

Audio freq. mod.	Amplitude	
F_m KC	$E_c \pm F_m$ unit	$F_c \pm F_m$ volt
1	0.39	117×10^{-3}
2	0.36	108×10^{-3}
3	0.33	99×10^{-3}
4	0.29	87×10^{-3}
5	0.26	78×10^{-3}
6	0.20	60×10^{-3}
7	0.16	48×10^{-3}

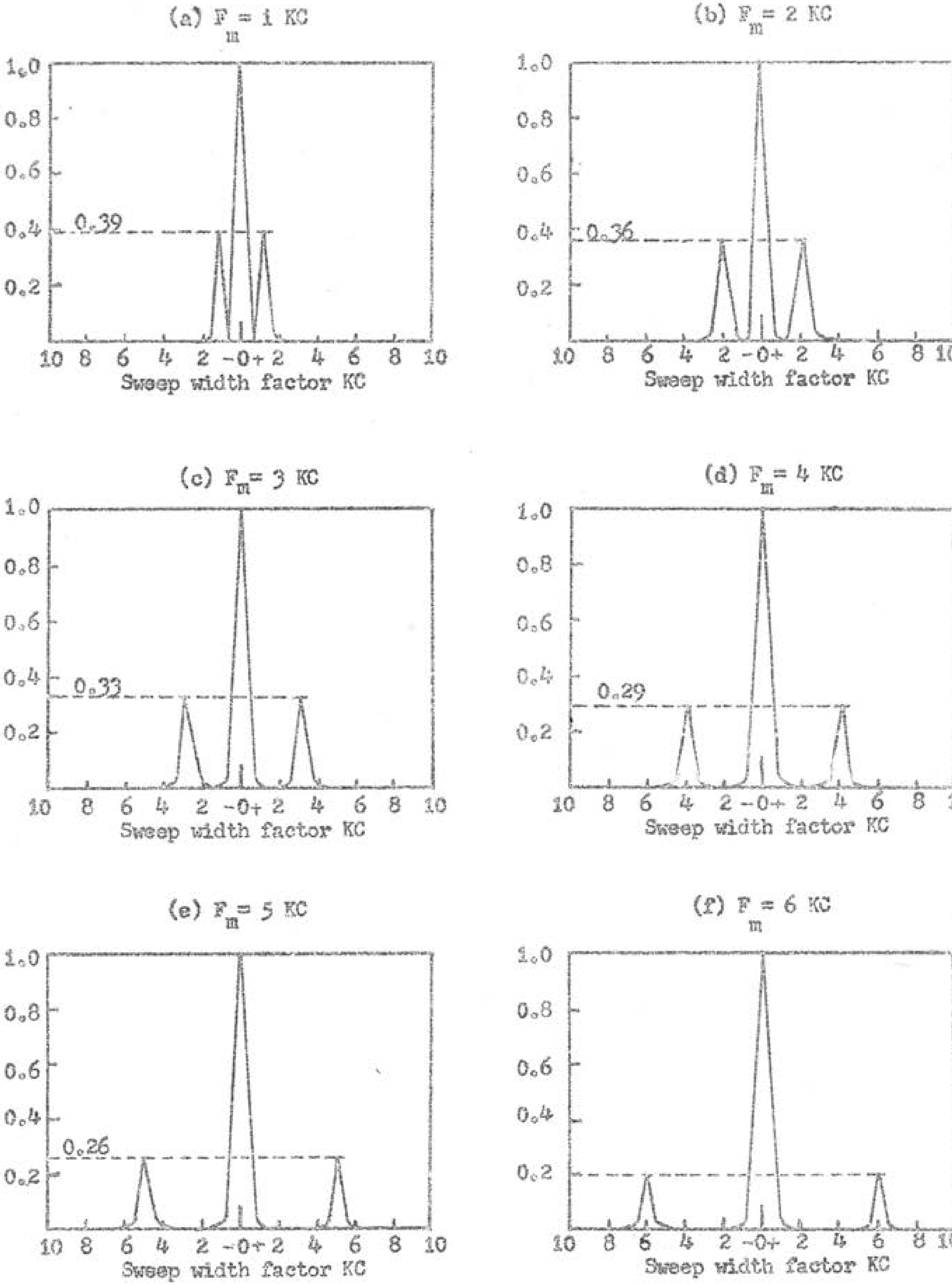
FREQUENCY STABILITY

1. 980.014 KC,
2. 980.005 KC,
3. 980.009 KC,
4. 980.011 KC.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
980 (F_c)	1	300×10^{-3}	Reference
995 (F_c + 15 KC)	---	---	Interfere from other
1010 (F_c + 30 KC)	---	---	"--------"
1055 (F_c + 75 KC)	0	0	
1960 ($2F_c$)	0	0	
2940 ($3F_c$)	0	0	
3920 ($4F_c$)	0	0	
4900 ($5F_c$)	0	0	

$F_c = 980$ KC


(a) F_m = 1 KC
0.39
Sweep width factor KC
(b) F_m = 2 KC
0.36
Sweep width factor KC
(c) F_m = 3 KC
0.33
Sweep width factor KC
(d) F_m = 4 KC
0.29
Sweep width factor KC
(e) F_m = 5 KC
0.26
Sweep width factor KC
(f) F_m = 6 KC
Sweep width factor KC

(g) F_m = 7 KC

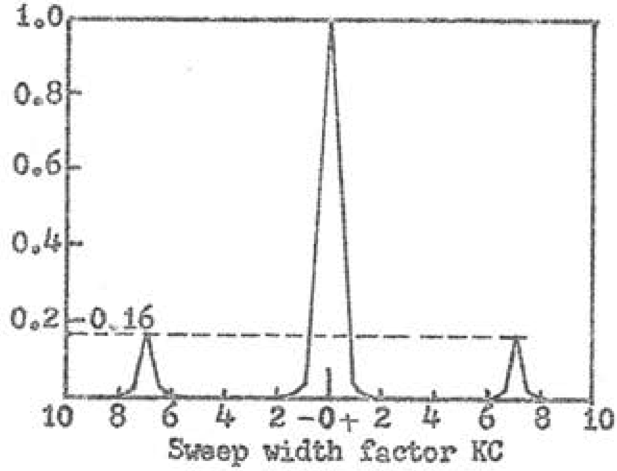


Fig. 22. (a)-(g). Spectrum components of RF signal of PRD. 10 (Thammasart University) radio broadcasting station at various modulating frequencies which displays on PANORAMIC PANALYZOR SB-12b.

Station ROYAL THAI AIRFORCE Frequency 540 KC Power 1 KW

Time 1545 - 1605 Date 14 February 1966

AUDIO FREQUENCY SPECTRUM

Set amplitude of the carrier (F_c) = 1 unit all the time.

F_c for amplitude 1 unit = 300×10^{-3} volt.

Audio freq. mod. F_m KC	Amplitude	
	$F_c \pm F_m$ unit	$F_c \pm F_m$ volt
1	0.20	60×10^{-3}
2	0.18	54×10^{-3}
3	0.16	48×10^{-3}
4	0.14	42×10^{-3}
5	0.10	30×10^{-3}
6	0.04	12×10^{-3}

FREQUENCY STABILITY

1. 539.985 KC,
2. 539.994 KC,
3. 539.988 KC,
4. 540.002 KC.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
540 (F_c)	1	300×10^{-3}	Reference
555 (F_c + 15 KC)	---	---	Interfere from other
570 (F_c + 30 KC)	0.02	6×10^{-3}	33.98 db
615 (F_c + 75 KC)	0	0	
1080 ($2F_c$)	---	---	Interfere from other
1620 ($3F_c$)	0	0	
2160 ($4F_c$)	0	0	
2700 ($5F_c$)	0	0	

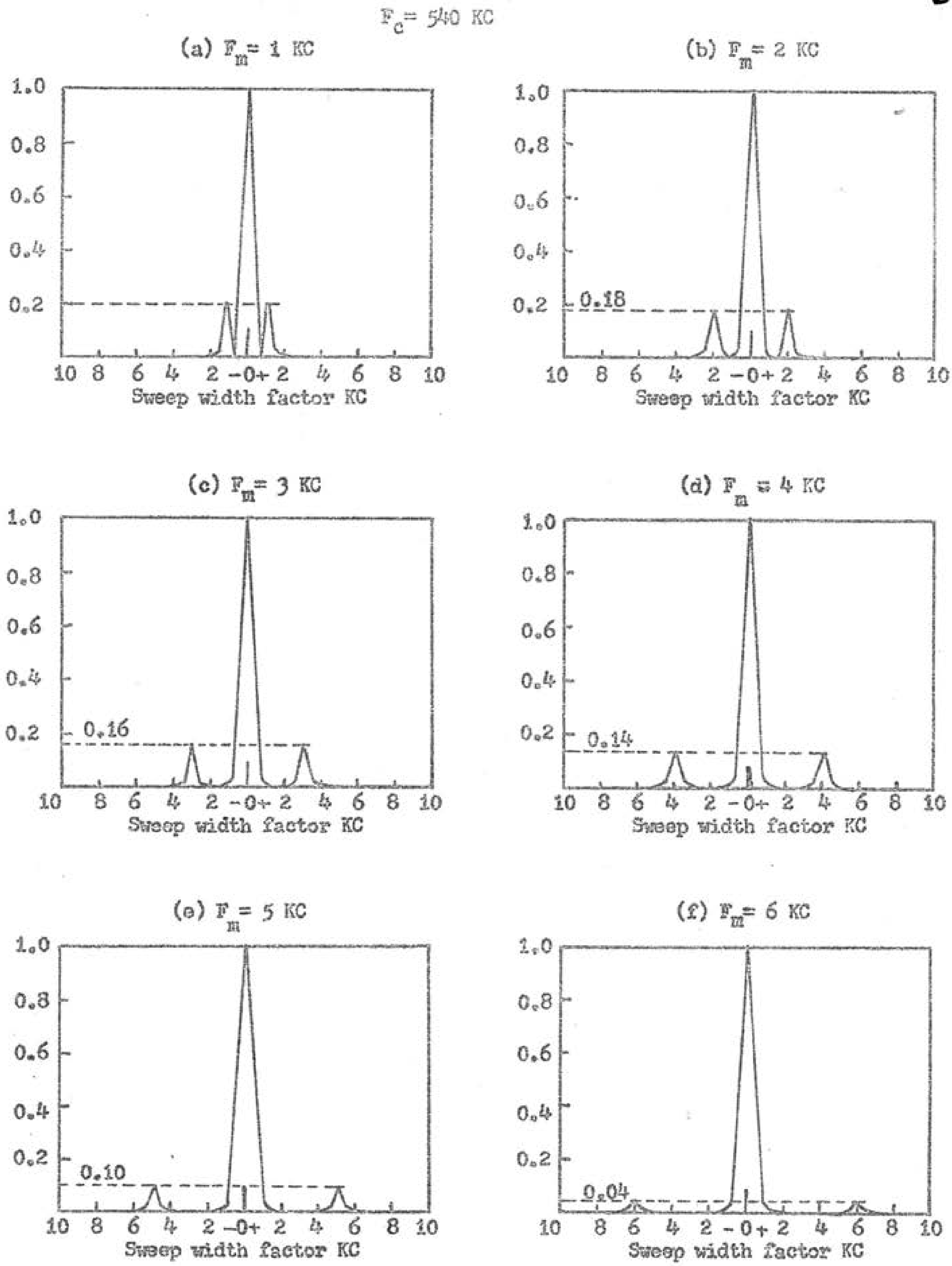


Fig. 23. (a)-(f). Spectrum components of RF signal of ROYAL THAI AIRFORCE radio broadcasting station at various modulating frequencies which displays on PANORAMIC PANALYZOR SB-12b.

Station POLICE Dept. Frequency 1430 KC Power 1 KW

Time 1340 - 1400 Date 16 February 1966

AUDIO FREQUENCY SPECTRUM

Set amplitude of the carrier (F_c) = 1 unit all the time.

F_c for amplitude 1 unit = 240×10^{-3} volt.

Audio freq. mod. F_m KC	Amplitude	
	$F_c \pm F_m$ unit	$F_c \pm F_m$ volt
1	0.45	108×10^{-3}
2	0.42	100.8×10^{-3}
3	0.39	93.6×10^{-3}
4	0.35	84.0×10^{-3}
5	0.31	74.4×10^{-3}
6	0.26	62.4×10^{-3}

FREQUENCY STABILITY

1. 1429.997 KC,
2. 1429.994 KC,
3. 1430.011 KC,
4. 1430.006 KC.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
1430 (F_c)	1	240×10^{-3}	Reference
1445 (F_c + 15 KC)	---	---	Interfere from other
1460 (F_c + 30 KC)	0.02	4.8×10^{-3}	33.98 db
1505 (F_c + 75 KC)	---	---	Interfere from other
2860 ($2F_c$)	0	0	
4290 ($3F_c$)	0	0	
5720 ($4F_c$)	0	0	
7150 ($5F_c$)	0	0	

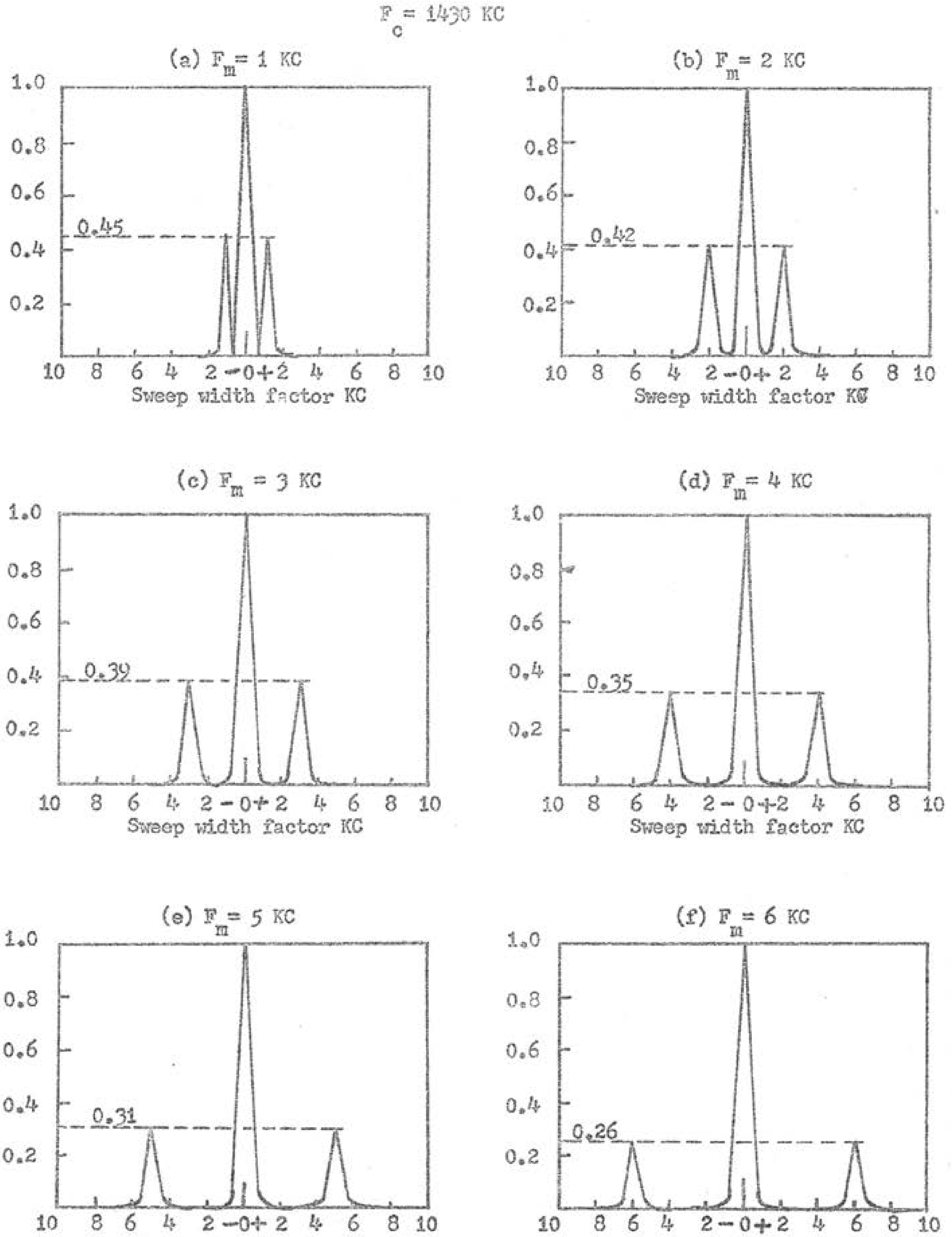


Fig. **24**. (a)-(f). Spectrum components of RF signal of POLICE Dept. radio broadcasting station at various frequencies modulating which displays on PANORAMIC PANALYZOR SB-12b.

Station AGRICULTURAL UNIVERSITY Frequency 665 KC Power 1 KW

Time 1410 - 1435 Date 16 February 1966

AUDIO FREQUENCY SPECTRUM

Set amplitude of the carrier (F_c) = 1 unit all the time.

F_c for amplitude 1 unit = 260×10^{-3}

Audio freq. mod. F_m KC	Amplitude	
	$F_c \pm F_m$ unit	$F_c \pm F_m$ volt
1	0.27	70.2×10^{-3}
2	0.25	65.0×10^{-3}
3	0.23	59.8×10^{-3}
4	0.21	54.6×10^{-3}
5	0.17	44.2×10^{-3}
6	0.13	33.8×10^{-3}

FREQUENCY STABILITY

1. 664.992 KC,
2. 664.989 KC,
3. 664.996 KC,
4. 664.995 KC.

SPURIOUS EMISSION

KC	Amplitude		Note
	unit	volt	
665 (F_c)	1	260×10^{-3}	Reference
680 (F_c + 15 KC)	0.04	10.4×10^{-3}	28 db
695 (F_c + 30 KC)	0	0	
740 (F_c + 75 KC)	---	---	Interfere from other
1330 ($2F_c$)	0	0	
1995 ($3F_c$)	0	0	
2660 ($4F_c$)	0	0	
3325 ($5F_c$)	0	0	

F_c = 665 KC

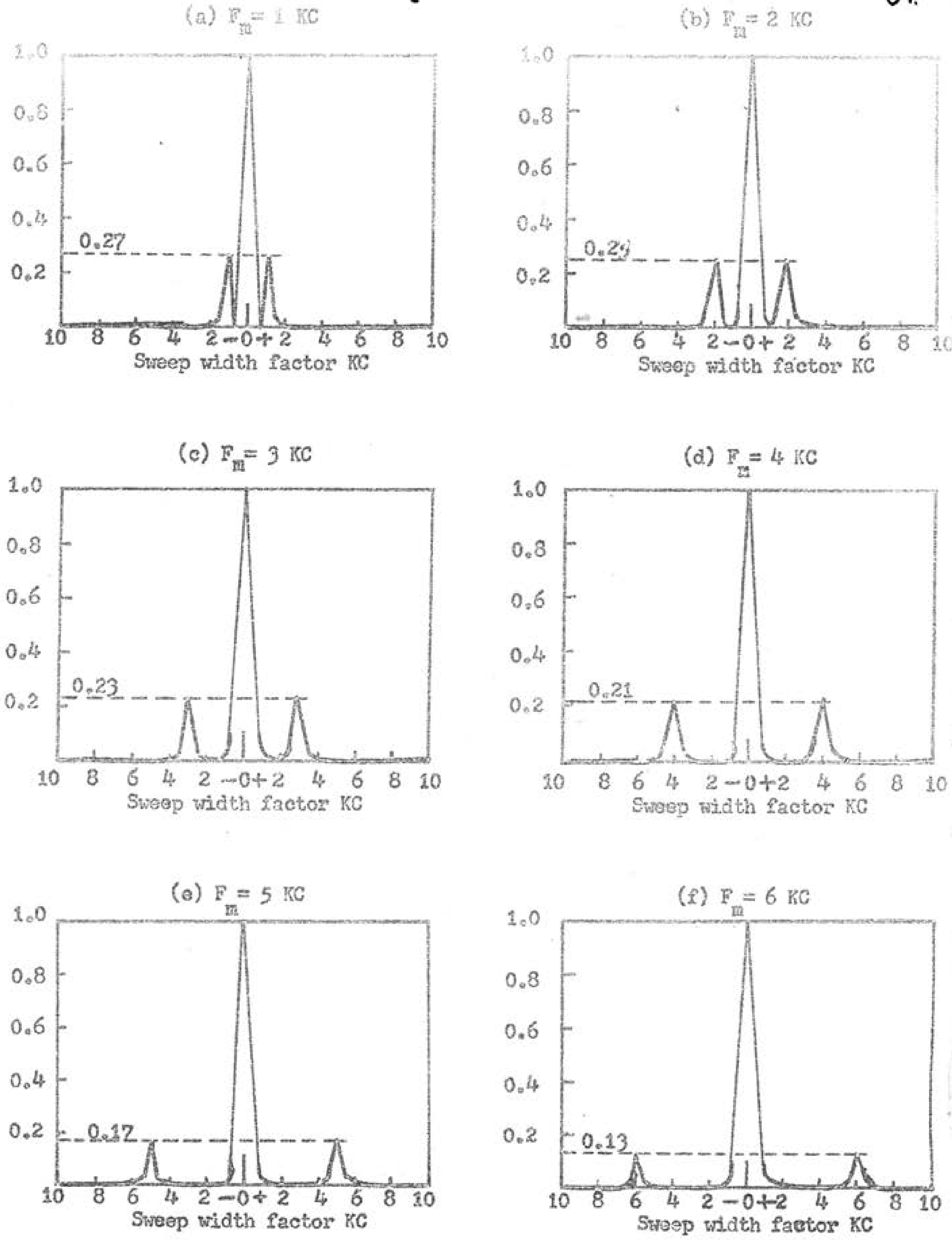


Fig. 25. (a)–(f). Spectrum components of RF signal of AGRICULTURAL UNIVERSITY radio broadcasting station at various modulating frequencies which displays on PANORAMIC PANALYZOR SB-12b.

Result

Bandwidth. From the tables of the audio frequency spectrum, plot the curve of each radio broadcast station on a graph paper which the amplitudes of the side bands spectrum are in volt. The maximum point of a curve is the approximate value of the audio spectrum which is the nearest point to the carrier frequency spectrum which enables us to find the 3-db down or half-power point of the voltage from these maximum points. The points on audio frequency spectrum which are related with the 3-db down of the voltage are the frequencies f_1 and f_2 far from F_c. Thus, the bandwidth is equal to $f_1 + f_2$ KC and is the bandwidth of that radio broadcast transmitter.

Carrier Frequency Shift. The carrier frequency can be noted down from the Electronic Counter by finding the maximum and minimum point of frequency which was shifted from the carrier frequency.

Per cent Modulation, From the tables of the audio frequency spectrum, at modulating audio frequency 1 KC, the amplitude in unit was used to find the per cent modulation:

$$\text{per cent modulation} = 2 \times (\text{amplitude in unit at } F_m = 1\text{KC}) \times 100 \quad \%$$

Spurious Emission. From the tables of the spurious emission, change the amplitude, in volt, of the RF signal at various modulating frequency in db down by comparing with the amplitude of the carrier frequency.

$$DB = 20 \log \frac{E}{E_c}$$

Compare these values of db down with the FCC Rules and Regulations of spurious

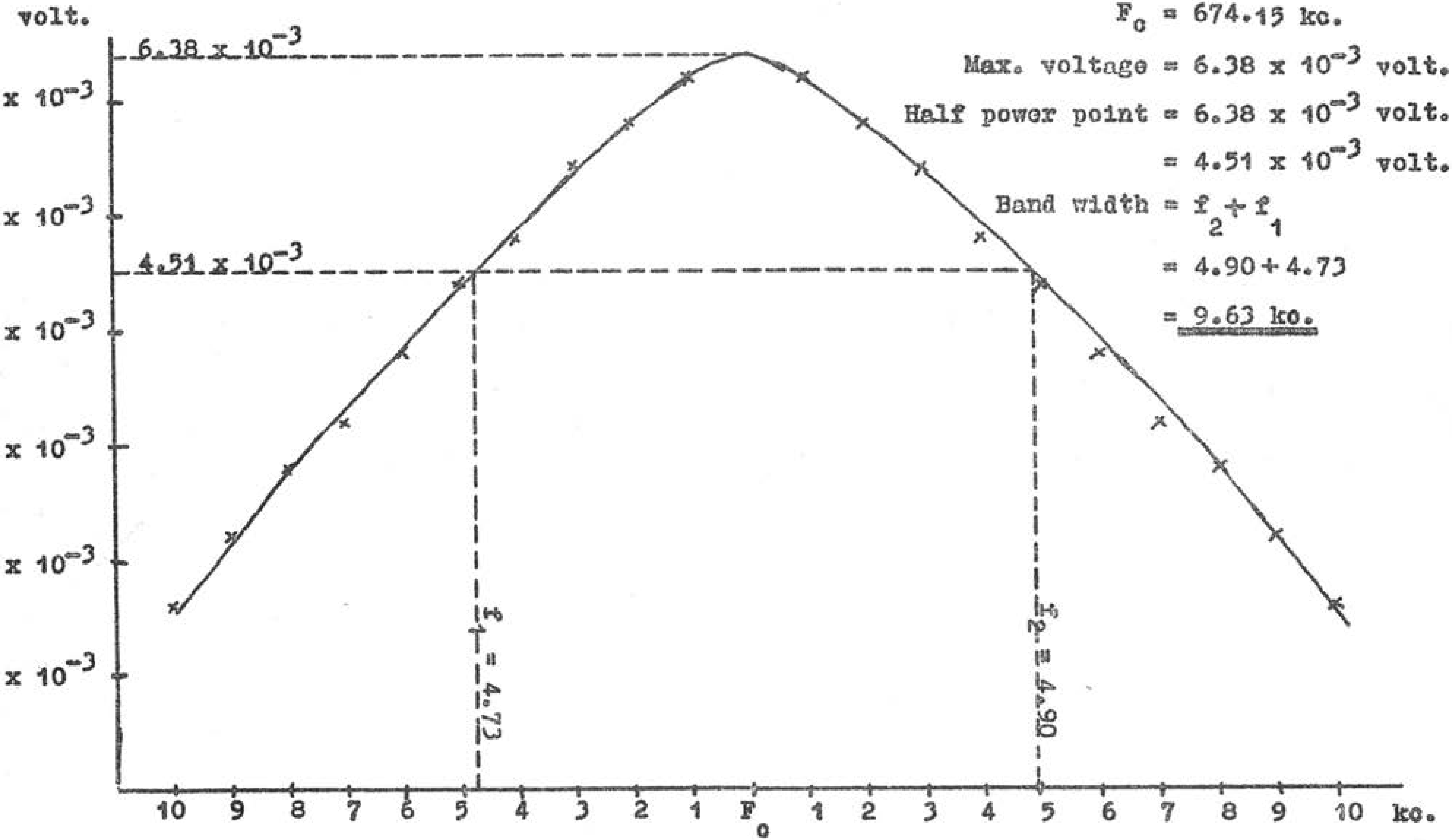


Fig. 26 Audio frequency spectrum of PUBLIC RELATIONS Dept.8 Radio Broadcasting Station.

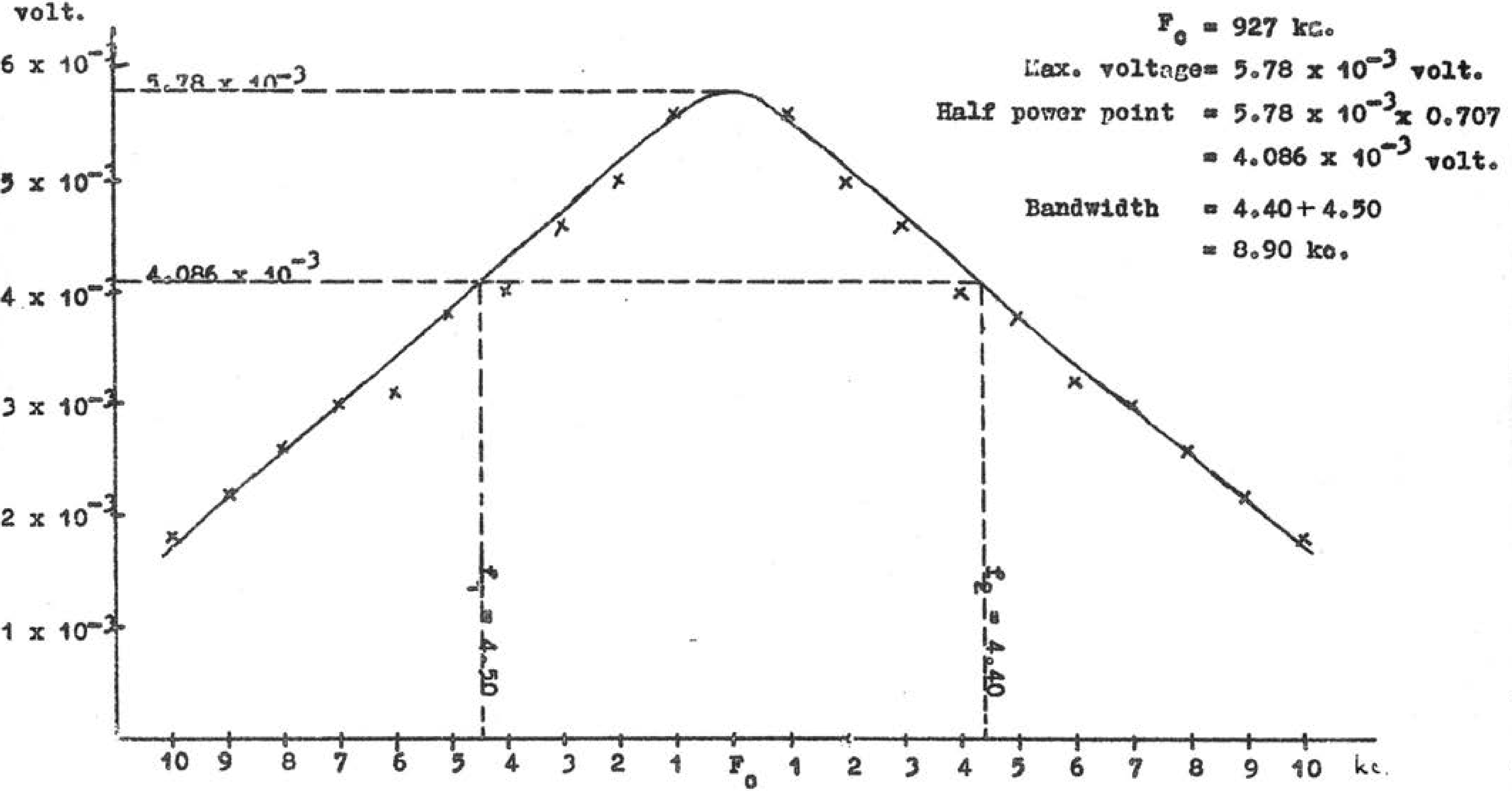


Fig. 27 Audio frequency spectrum of PUBLIC RELATIONS Dept.

Radio Breadcasting Station.

F_o = 830 kc.

Max. voltage $= 43.5 \times 10^{-3}$ volt.

Half power point $= 43.5 \times 10^{-3} \times 0.707$

$= 30.755 \times 10^{-3}$ volt.

Band width $= 4.50 + 4.50$

$= \underline{\underline{9.00 \text{ kc.}}}$

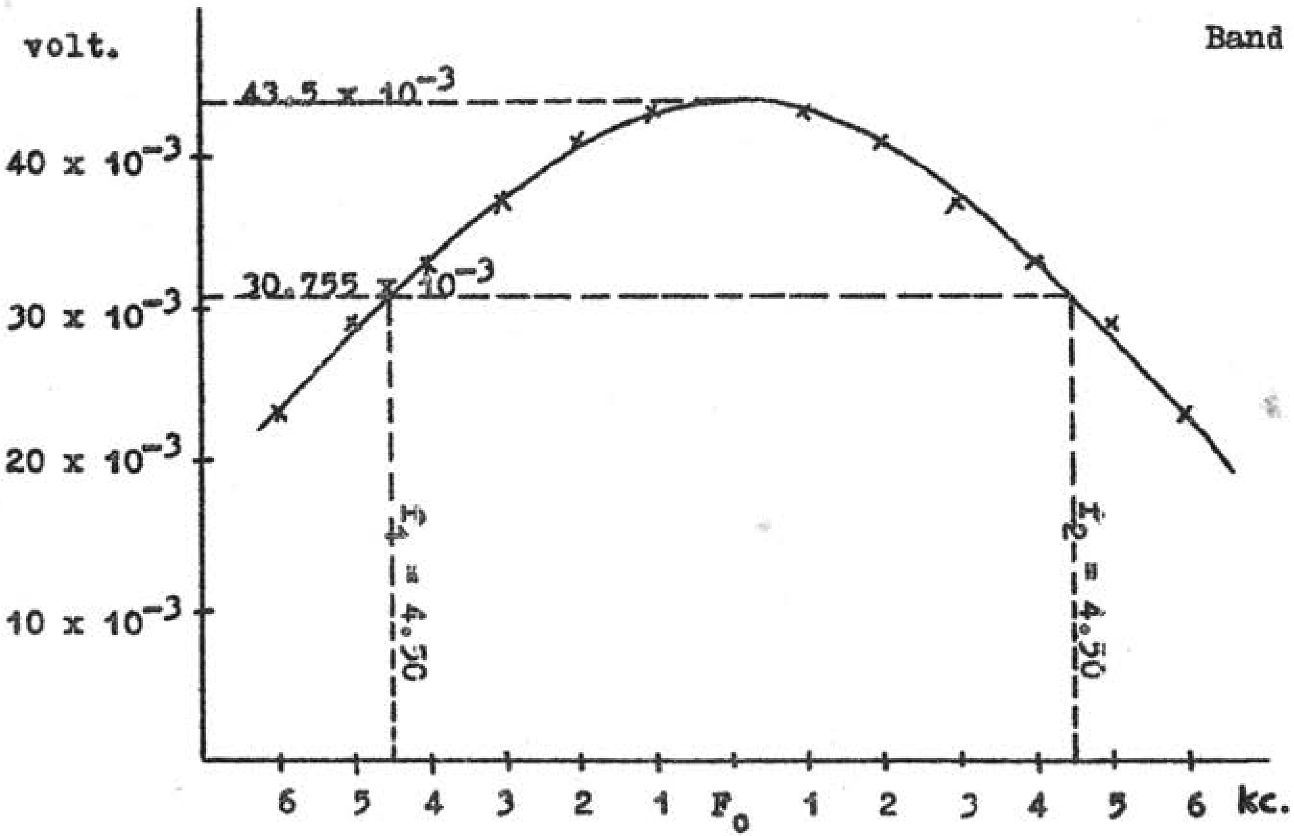


Fig. 28 — Audio frequency spectrum of PUBLIC RELATIONS Dept.

Radio Broadcasting Station.

F_o = 980 kc.
Max. voltage = 119.8×10^{-3} volt.
Half power point = $119.8 \times 10^{-3} \times 0.707$
= 84.7×10^{-3} volt.
Band width = 4.28 + 4.30
= **8.58 kc.**

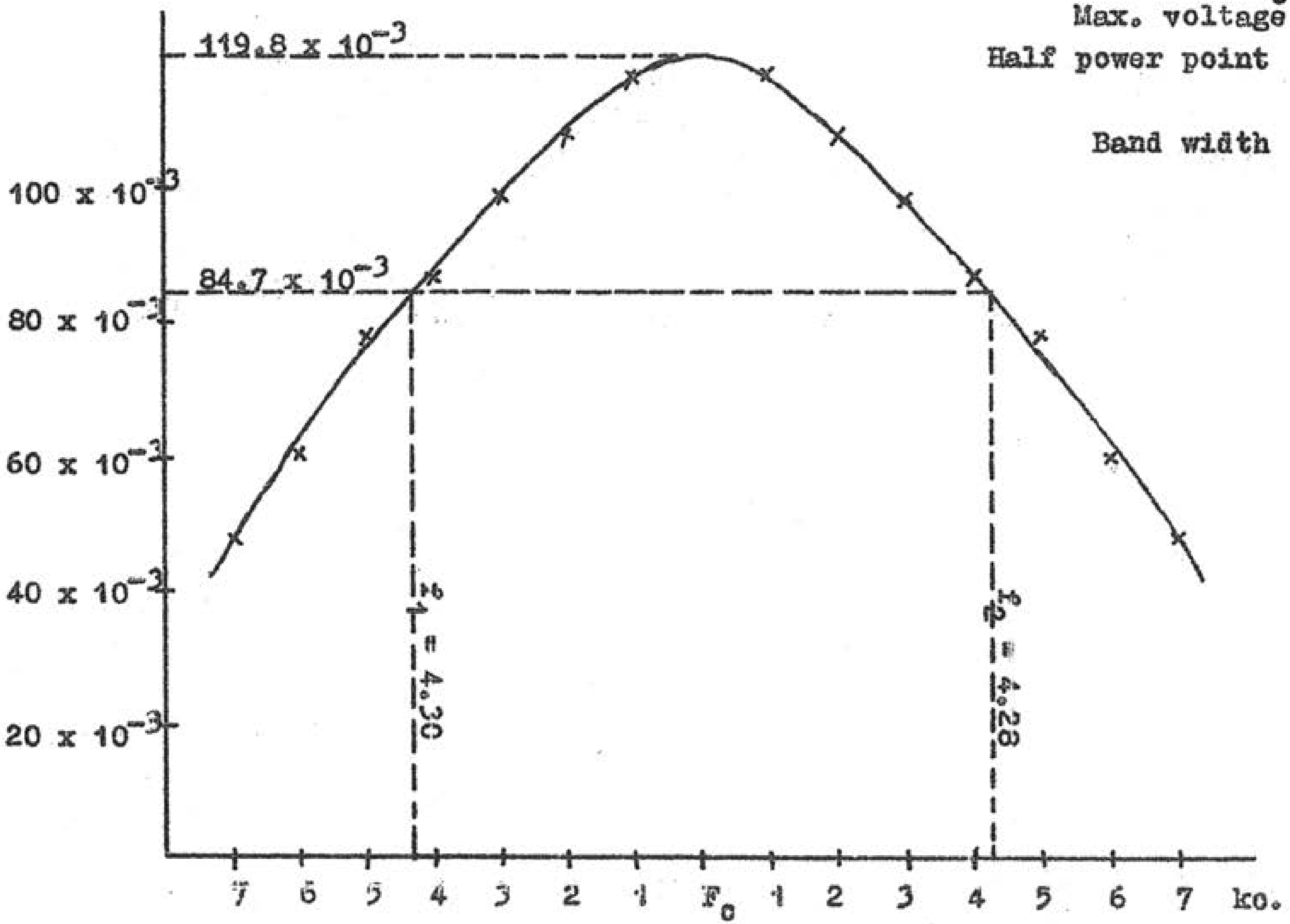


Fig. 29 Audio frequency spectrum of PRD.10 (THAMMASART UNIVERSITY) Radio Broadcasting Station.

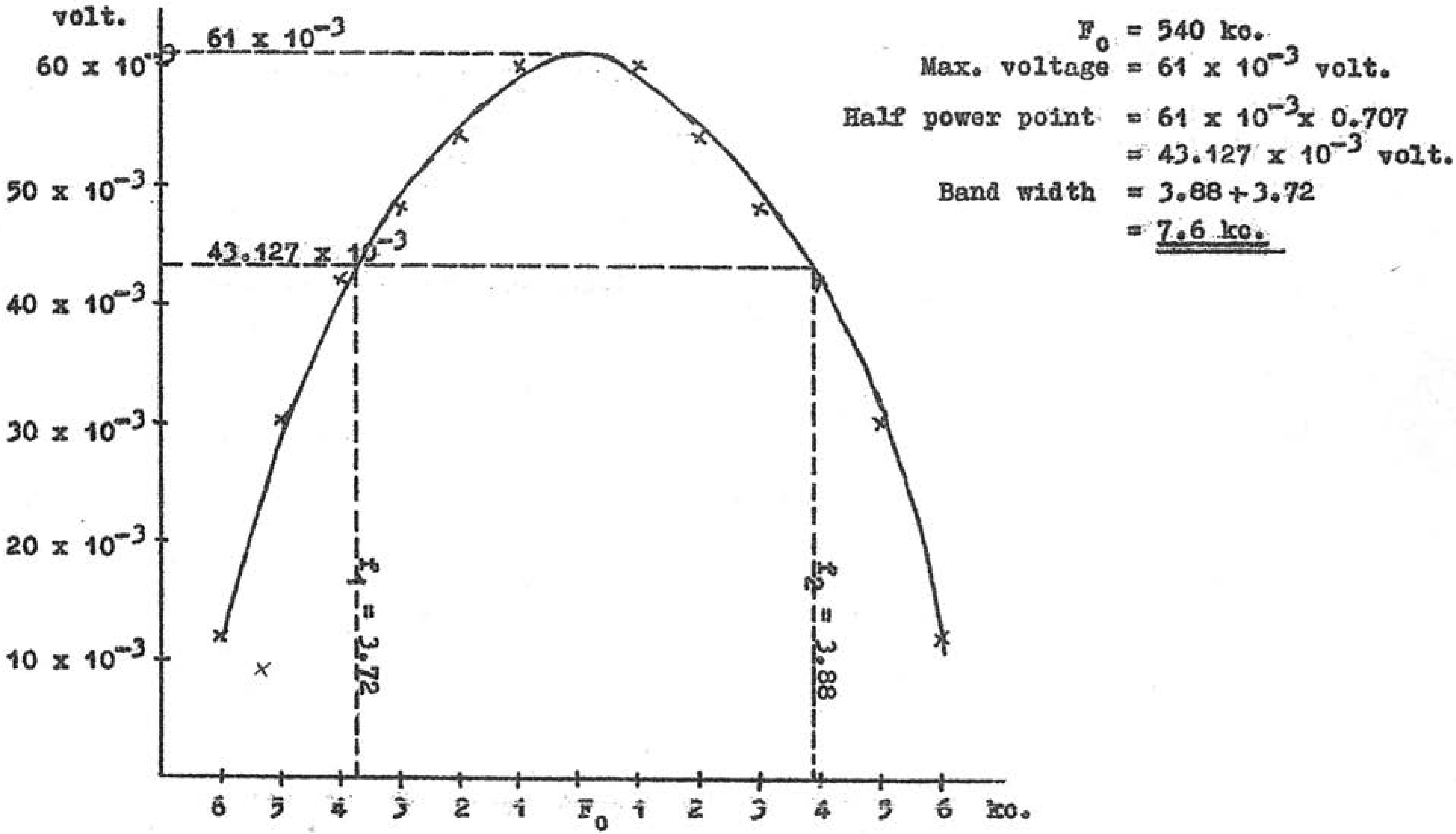


Fig. 30 Audio frequency spectrum of ROYAL THAI AIRFORCE Radio Broadcasting Station.

F_o = 1430 kc.
Max. voltage = 110×10^{-3} volt.
Half power point = $110 \times 10^{-3} \times 0.707$
= 77.77×10^{-3} volt.
Band width = 4.62 + 4.68
= 9.3 kc.

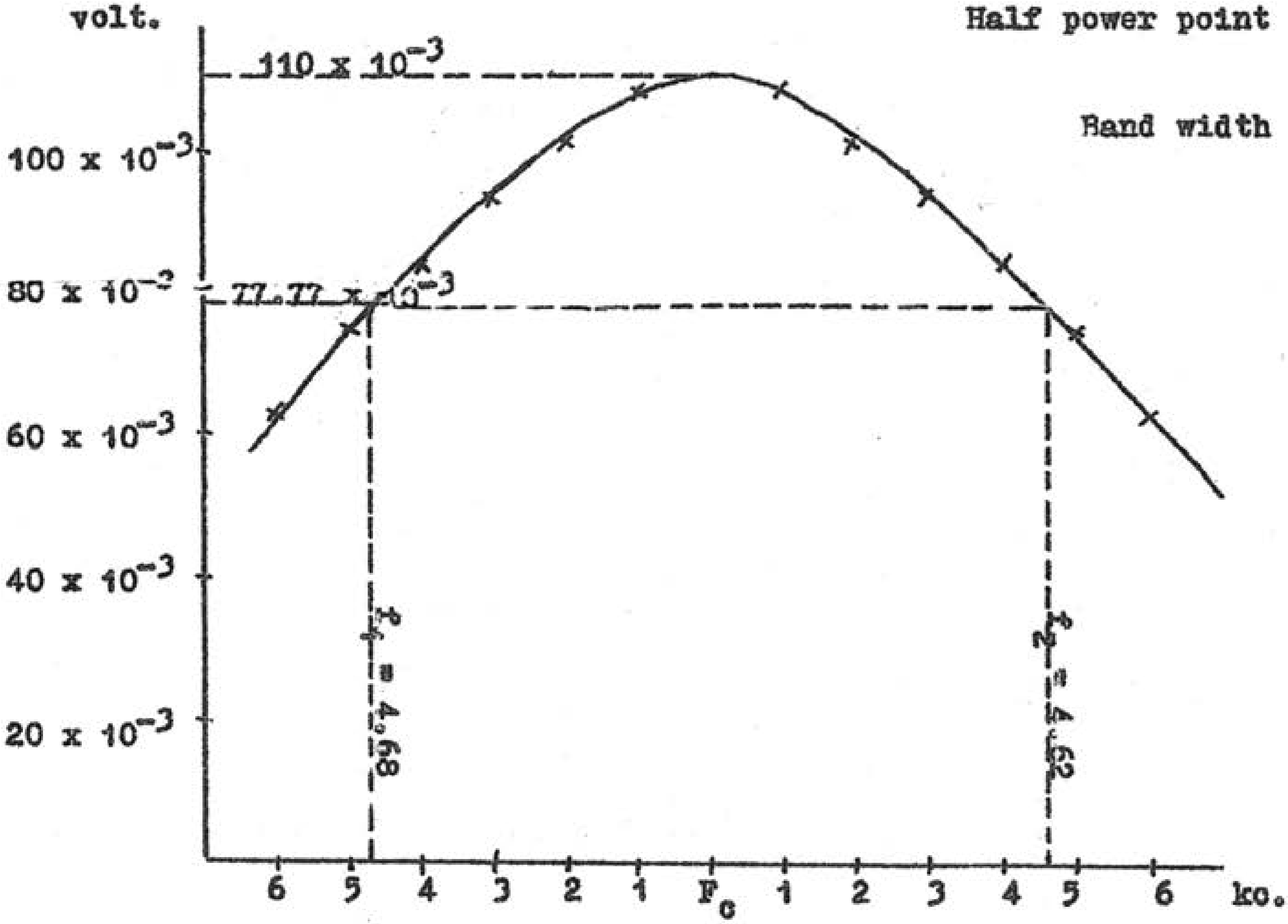
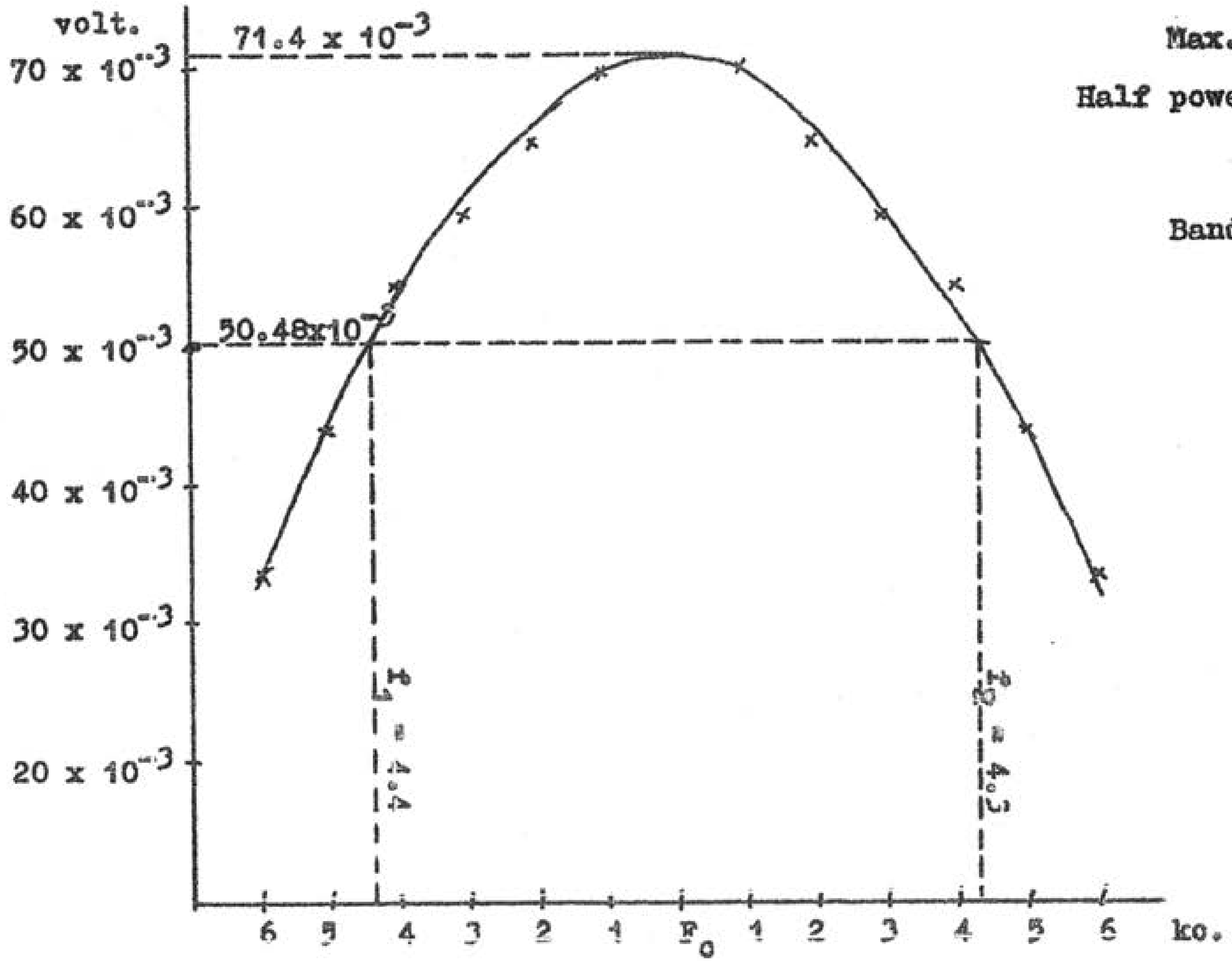


Fig. 31 Audio frequency spectrum of POLICE Dept.
Radio Broadcasting Station.



F_o = 665 kc.

Max. voltage = 71.4×10^{-3} volt.

Half power point = $71.4 \times 0.707 \times 10^{-3}$

= 50.48×10^{-3} volt.

Band width = 4.3 + 4.4

= 8.7 kc.

Fig. 32 Audio frequency spectrum of AGRICULTURAL UNIVERSITY Radio Broadcasting Station.

emission at the frequencies far from the unmodulated carrier at 15 KC, 30 KC, 75 KC, $2F_c$, $3F_c$, $4F_c$, and $5F_c$ respectively.

Harmonic Distortion. Find the value of the second, third, fourth, and fifth harmonics in per cent from :-

$$\text{per cent harmonic} = \frac{E_{\text{that harmonic}}}{E_c} \times 100 \quad \%$$

The value of total rms harmonic distortion is found from :-

$$\text{Total rms harmonic distortion} = \sqrt{(\%\text{2nd harmonic}) + (\%\text{ 3rd harmonic}) + \ldots}$$

Public Relations Dept. 8 Radio Broadcast Station. F_c = 674.15 KC.

From Fig. 26, Bandwidth= 9.63 KC.

Carrier frequency shift = + 16 cycles and - 12 cycles from F_c.

Per cent modulation = 0.31 x 2 x 100 = 62 %

For spurious emission, at F_c + 15 KC has 33.98-db down and zero at the other frequencies.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

Public Relations Dept. Radio Broadcast Station. F_c = 927 KC.

From Fig. 27, Bandwidth= 8.90 KC.

Carrier frequency shift = + 8 cycles and - 6 cycles from F_c.

Per cent modulation = 0.28 x 2 x 100 = 56 %

For spurious emission, the amplitudes are zero at every point.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

<u>Public Relations Dept. Radio Broadcast Station.</u> F_c = 830 KC.

From Fig. 28, Bandwidth= 9.00 KC.

Carrier frequency shift = + 12 cycles and - 8 cycles from F_c.

Per cent modulation = 0.43 x 2 x 100 = 86 %

For spurious emission, at F_c + 15 KC has 30.46-db down and zero at the other frequencies.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

<u>PRD 10 (Thammasart University) Radio Broadcast Station.</u> F_c = 980 KC.

From Fig. 29, Bandwidth= 8.58 KC.

Carrier frequency shift = + 14 cycles from F_c.

Per cent modulation = 0.39 x 2 x 100 = 78 %

For spurious emission, the amplitudes are zero at the other frequencies.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

<u>Royal Thai Airforce Radio Broadcast Station.</u> F_c = 540 KC.

From Fig. 30, Bandwidth= 7.6 KC.

Carrier frequency shift = + 2 cycles and - 15 cycles from F_c.

Per cent modulation = 0.20 x 2 x 100 = 40 %

For spurious emission, at F_c + 30 KC has 33.98-db down and zero at the other frequencies.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

Police Dept. Radio Broadcast Station. F_c = 1430 KC.

From Fig. 31, Bandwidth= 9.3 KC.

Carrier frequency shift = + 11 cycles and - 6 cycles from F_c.

Per cent modulation = 0.45 x 2 x 100 = 90 %

For spurious emission, the amplitudes are zero at every point except at F_c + 30 KC has 33.98-db down.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

Agricultural University Radio Broadcast Station. F_c = 665 KC.

From Fig. 32, Bandwidth= 8.7 KC.

Carrier frequency shift = - 11 cycles from F_c

Per cent modulation = 0.27 x 2 x 100 = 54 %

For spurious emission, at F_c + 15 KC has 28-db down and zero at the other frequencies.

The result of this investigation is in the limit of the Rules and Regulations of ITU and FCC.

Error in Measurements

There are some errors in measuring and summing up the datas from the PANALYZOR SB-12b. The errors in each measurement will be described individually.

Error in measuring Bandwidth.

1. The spectrum is not a sharp trace on the screen of the PANALYZOR SB-12b, thus the value of the amplitude in the data is an approximate value. The vertical amplitude scale on the screen of the PANALYZOR SB-12b is 1 unit and divided into 10 divisions or 0.1 unit per division. From the experiment, the maximum amplitude of the carrier voltage in full scale or 1 unit is equal to 300×10^{-3} volt or 30×10^{-3} volt per division, for 0.01 unit is equal to 3×10^{-3} volt. In measurement, if there is an error of 0.01 unit, the amplitude of the spectrum in voltage will have the 3×10^{-3} volt error. This is an error in finding the bandwidth from an audio frequency spectrum curve.

2. The maximum voltage of the side band spectrum from the curve of an audio frequency spectrum is the approximate point, thus there is a mistake in finding the 3-db down point, this causes an error.

3. If the per cent modulation of the transmitter is not the same at all audio modulating frequencies, the side bands amplitudes at various audio frequencies are not related and this causes a mistake in noting the amplitudes of the side bands.

4. The horizontal scale on the screen of the PANALYZOR SB-12b is divided by calibration in 2 KC per division. Thus, if the vertical scale changes a little in the value of voltage, then the horizontal scale will change in a values of KC too. This effect causes an error in finding the bandwidth if the curve is drawn in an approximate method.

Error in Measuring Frequency Stability.

If the Electronic Counter which is used for this measurement is an accurate equipment, there is a slight error not more than ± 1 count for 5243L Electronic Counter. Thus, the error in measuring the frequency of this experiment is the error in tuning the receiver and the signal generator not exactly on the frequency that the radio broadcast transmitter transmits.

Error in Measuring Per cent Modulation.

From the experiment in measuring per cent modulation by using an oscilloscope, it is found that the RF signal from the transmitter is a weak signal. In using the trapezoid pattern there are two difficult problems: (1) the frequency of the oscillator for external sweep in and, (2) the weak signal of the RF. In this experiment, this method proved to be a failure. However, it is appropriate to be used in connecting directly with the transmitter.

As a result, the appropriate value of per cent modulation is found from the amplitude of the side band at 1 KC audio modulating frequency.

Whereas this is the approximate value, there is an error in measuring the amplitude of the sideband which will also cause an error in per cent modulation. The 0.01 unit error in amplitude will cause a 2% error in per cent modulation.

DISCUSSION

According to the statement afore-mentioned in measuring bandwidth of the transmitter, the audio modulating frequency varies from 1 KC, 2 KC, ... up to 10 KC should be fed through the modulator. But in the actual experiment, only two radio broadcast transmitters which audio modulating signal were fed until 10 KC, the others radio broadcast transmitters were fed until 6- or 7-KC only, because all of these radio broadcast transmitters are very old, if the audio modulating frequency were fed more than 6- or 7-KC, it will cause an excessive current in the plate-circuit and will destroy the plate-circuit of the transmitters, so it is dangerous to perform the experiment with audio modulating frequency higher than 7 KC. Thus, the audio modulating frequency must be avoided not to be higher than 7 KC with the old transmitters. From the result obtained when the audio modulating signal varies from 1 KC to 6- or 7-KC, it can be predicted that when the audio modulating frequency is varied more than 6- or 7-KC the amplitudes of the spectrum will be decreased and the value of audio modulating frequency up to 6- or 7-KC are sufficient to evaluate its bandwidth.

In measuring frequency stability of the transmitters it can be stated that the accurate results were obtained, because the accuracy of the measurement mostly based on the accuracy of the Electronic Counter which in this experiment has an error ± 1 count.

In measuring the spurious emission, it was found that at some frequencies the amplitude of the unmodulated carrier could not be measured due to the interferences from the adjacent channels. This problem can be solved if specific authority provide the experiment at the time when the others stations are out of program.