MFA M. Flom Associates, Inc. - Global Compliance Center
3356 North San Marcos Place, Suite 107, Chandler, Arizona 85224-1571
www.goodnet.com/~mflom, (602) 926-3100, FAX: 926-3598

Sub-part
2.983 (f):

EQUIPMENT IDENTIFICATION

FCC ID: K66VX-400V

NAMEPLATE DRAWING

ATTACHED, EXHIBIT 1.

LOCATION

AS PER LABEL DRAWING(S)

DATE OF REPORT

May 8, 1998

MORTON FLOM, P. Eng.

SUPERVISED BY:
MF:glk

THE APPLICANT HAS BEEN CAUTIONED AS TO THE FOLLOWING:

15.21 INFORMATION TO USER.

The users manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) SPECIAL ACCESSORIES.

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

TABLE OF CONTENTS

K66VX-400V

LIST OF GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE

IN ACCORDANCE WITH FCC RULES AND REGULATIONS,
VOLUME II, PART 2 AND TO

22, 74, 90

Sub-part
2.983(a): NAME AND ADDRESS OF APPLICANT:

Yaesu Musen Co., Ltd.
20-2, Shimomaruko 1-chome, Ota-ku
Tokyo Japan 146

VENDOR:

Yaesu U.S.A.
17210 Edwards Rd.
Cerritos, CA 90703

2.983(b):	FCC ID:	K66VX-400V
	MODEL NO:	VERTEX VX-400V
2.983(c):	QUANTITY PRODUCTION PLANNED.	
2.983(d):	TECHNICAL DESCRIPTION:	SEE ATTACHED EXHIBITS
(1):	TYPE OF EMISSION:	11K0F3E, 16K0F3E
(2):	FREQUENCY RANGE, MHz:	146 to 174
(3):	POWER RATING, Watts: SWITCHABLE _x_ ADJUSTABLE ___	1, 5 N/A ___
(4):	MAXIMUM POWER RATING, Watts:	300

2.983(d) (5): VOLTAGES & CURRENTS IN ALL ELEMENTS IN FINAL R. F. STAGE, INCLUDING FINAL TRANSISTOR OR SOLID STATE DEVICE:

COLLECTOR CURRENT, A = per manual
COLLECTOR VOLTAGE, Vdc = per manual
SUPPLY VOLTAGE, Vdc = 7.2

(6): FUNCTION OF ACTIVE CIRCUIT DEVICES:

PLEASE SEE ATTACHED EXHIBITS

(7): CIRCUIT DIAGRAM:

PLEASE SEE ATTACHED EXHIBITS

(8): MANUAL:

PLEASE SEE ATTACHED EXHIBITS

(9): TUNE-UP PROCEDURE:

PLEASE SEE ATTACHED EXHIBITS

(10): DESCRIPTION OF CIRCUITRY & DEVICES PROVIDED FOR DETERMINING AND STABILIZING FREQUENCY:

PLEASE SEE ATTACHED EXHIBITS

(11): DESCRIPTION OF CIRCUITS OR DEVICES EMPLOYED FOR
(a) SUPPRESSION OF SPURIOUS RADIATION,
(b) LIMITING MODULATION,
(c) LIMITING POWER:

PLEASE SEE ATTACHED EXHIBITS

(12): DIGITAL MODULATION DESCRIPTION:

ATTACHED EXHIBITS ____
N/A __x__

2.983(e): TEST AND MEASUREMENT DATA:

FOLLOWS

2.983(f): LABEL INFORMATION:

PLEASE SEE ATTACHED EXHIBITS

2.983(g): PHOTOGRAPHS:

PLEASE SEE ATTACHED EXHIBITS

Sub-part
2.983(e): TEST AND MEASUREMENT DATA

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II; Part 2, Sub-part J, Sections 2.981, 2.983, 2.985, 2.987, 2.989, 2.991, 2.993, 2.995, 2.997, 2.999 and the following individual Parts:

___ 21 - Domestic Public Fixed Radio Services
_x_ 22 - Public Mobile Services
___ 22 Subpart H - Cellular Radiotelephone Service
___ 22.901(d) - Alternative technologies and auxiliary services
___ 23 - International Fixed Public Radiocommunication services
___ 24 - Personal Communications Services
_x_ 74 Subpart H - Low Power Auxiliary Stations
___ 80 - Stations in the Maritime Services
___ 80 Subpart E - General Technical Standards
___ 80 Subpart F - Equipment Authorization for Compulsory Ships
___ 80 Subpart K - Private Coast Stations and Marine Utility Stations
___ 80 Subpart S - Compulsory Radiotelephone Installations for Small Passenger Boats
___ 80 Subpart T - Radiotelephone Installation Required for Vessels on the Great Lakes
___ 80 Subpart U - Radiotelephone Installations Required by the Bridge-to-Bridge Act
___ 80 Subpart V - Emergency Position Indicating Radiobeacons (EPIRB'S)
___ 80 Subpart W - Global Maritime Distress and Safety System (GMDSS)
___ 80 Subpart X - Voluntary Radio Installations
___ 87 - Aviation Services
_x_ 90 - Private Land Mobile Radio Services
___ 94 - Private Operational-Fixed Microwave Service
___ 95 Subpart A - General Mobile Radio Service (GMRS)
___ 95 Subpart C - Radio Control (R/C) Radio Service
___ 95 Subpart D - Citizens Band (CB) Radio Service
___ 95 Subpart E - Family Radio Service
___ 95 Subpart F - Interactive Video and Data Service (IVDS)
___ 101 - Fixed Microwave Services

STANDARD TEST CONDITIONS and ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedures were observed during the testing:

ROOM TEMPERATURE	= 25±5°C
ROOM HUMIDITY	= 20-50%
D.C. SUPPLY VOLTAGE, Vdc	= 7.2
A.C. SUPPLY VOLTAGE, Vac	= N/A
A.C. SUPPLY FREQUENCY, Hz	= N/A

Prior to testing, the EUT was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing.

Measurement results, unless otherwise noted, are worst case measurements.

PAGE NO. 6.

NAME OF TEST: Carrier Output Power (Conducted)

SPECIFICATION: FCC: 47 CFR 2.985(a)
IC: RSS-119, Section 6.2

GUIDE: TIA/EIA-603, Paragraph 2.2.1

TEST CONDITIONS: Standard Temperature and Humidity (S. T. & H.)

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The EUT was connected to a resistive coaxial attenuator of normal load impedance, and the unmodulated output power was measured by means of an R. F. Power Meter.

2. Measurement accuracy is ±3%.

MEASUREMENT RESULTS

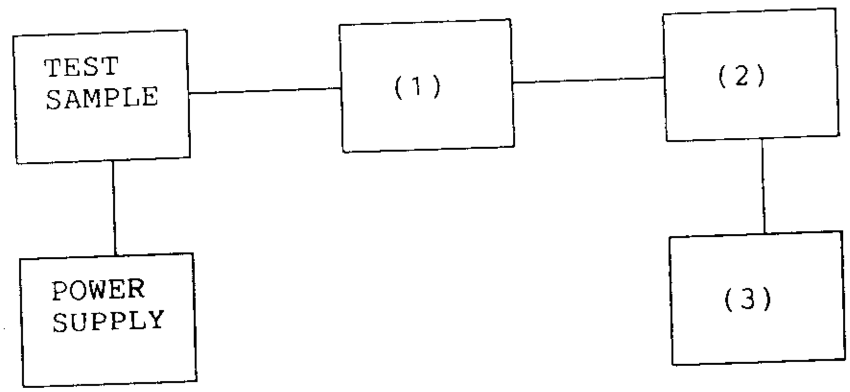
NOMINAL, MHz	R.F. POWER OUTPUT, WATTS
160.025	15
146.025	15
173.975	15

SUPERVISED BY:

MORTON FLOM, P. Eng.

TRANSMITTER POWER CONDUCTED MEASUREMENTS

TEST 1: R. F. POWER OUTPUT
TEST 2: FREQUENCY STABILITY



(1) COAXIAL ATTENUATOR

NARDA 766-10	
SIERRA 661A-30	x
BIRD 8329 (30 dB)	

(2) POWER METERS

HP 435A	
HP 436A	x
HP 8901A POWER MODE	x

(3) FREQUENCY COUNTER

HP 5383A	
HP 5334B	x
HP 8901A FREQUENCY MODE	x

PAGE NO. 8.

NAME OF TEST: Unwanted Emissions (Transmitter Conducted)

SPECIFICATION: FCC: 47 CFR 2.991
IC: RSS-119, Section 6.3

GUIDE: TIA/EIA-603, Paragraph 2.2.13

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The emissions were measured for the worst case as follows:

   (a): within a band of frequencies defined by the carrier frequency plus and minus one channel.

   (b): from the lowest frequency generated in the EUT and to at least the 10th harmonic of the carrier frequency, or 40 GHz, whichever is lower.

2. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

3. MEASUREMENT RESULTS: ATTACHED FOR WORST CASE

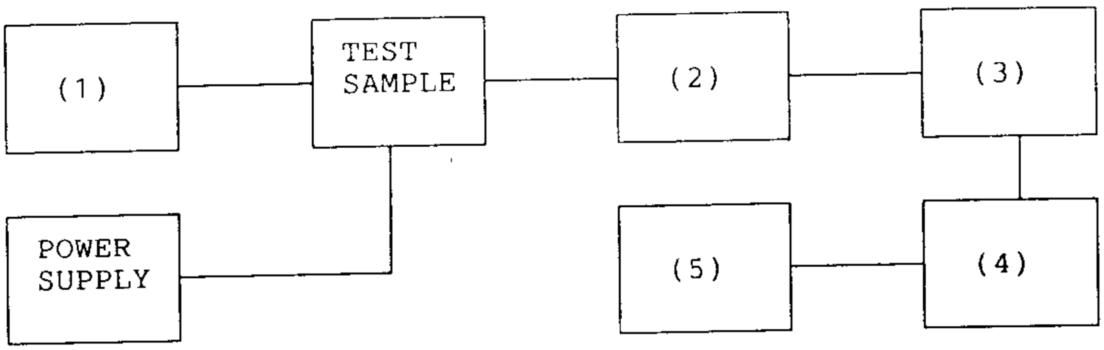
FREQUENCY OF CARRIER, MHz	= 160.025, 146.025, 173.975
SPECTRUM SEARCHED, GHz	= 0 to 10 x F_C
MAXIMUM RESPONSE, Hz	= 2510
ALL OTHER EMISSIONS	= ≥ 20 dB BELOW LIMIT
LIMIT, dBc: $-(43 + 10 \log P_0)$	= -43 (1 Watt) -50 (5 Watts)

SUPERVISED BY:

MORTON FLOM, P. Eng.

TRANSMITTER SPURIOUS EMISSION

TEST A. OCCUPIED BANDWIDTH (IN-BAND SPURIOUS)
TEST B. OUT-OF-BAND SPURIOUS



(1) AUDIO OSCILLATOR/GENERATOR

HP 204D	
HP 8903A	
HP 3312A	x
	x

(2) COAXIAL ATTENUATOR

NARDA 766-10	
SIERRA 661A-30	x
BIRD 8329 (30 dB)	x

(3) FILTERS; NOTCH, HP, LP, BP

CIRQTEL FHT	
EAGLE TNF-1	x
PHELPS DODGE PD-495-8	

(4) SPECTRUM ANALYZER

HP 8566B	x
HP 8563E	

(5) SCOPE

HP 1741A	
HP 181T	
TEK 935	
HP 54502A	

G855001

TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

POWER: HIGH

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	LEVEL, μW
160.025	320.049	-33.8	-70.7	0
160.025	480.083	-34.1	-71.0	0
160.025	640.283	-40.0	-76.9	0
160.025	800.144	-37.4	-74.3	0
160.025	960.358	-39.2	-76.1	0
160.025	1120.178	-39.6	-76.5	0
160.025	1280.017	-39.4	-76.3	0
160.025	1439.754	-38.5	-75.4	0
160.025	1600.228	-39.5	-76.4	0
160.025	1760.032	-38.8	-75.7	0
160.025	1920.004	-39.2	-76.1	0
160.025	2080.425	-39.0	-75.9	0
160.025	2240.022	-38.0	-74.9	0
160.025	2400.552	-38.3	-75.2	0

Conducted Spurious Emission (PARAGRPH 2.2.13) POWER: LOW

	Carrier Freq					
	146.025 MHz		160.025 MHz		173.975 MHz	
	Emission Frequency [MHz]	Spurious Attenuation [dB]	Emission Frequency [MHz]	Spurious Attenuation [dB]	Emission Frequency [MHz]	Spurious Attenuation [dB]
2nd	292.05	-63.00	320.05	-67.00	347.95	-67.00
3rd	438.08	-68.00	480.08	-69.00	521.93	-62.00
4th	584.10	-72.00	640.10		695.90	
5th	730.13		800.13		869.88	
6th	876.15		960.15		1043.85	
7th	1022.18		1120.18		1217.83	
8th	1168.20		1280.20		1391.80	
9th	1314.23		1440.23		1565.78	
10th	1460.25		1600.25		1739.75	

NAME OF TEST: Field Strength of Spurious Radiation

SPECIFICATION: FCC: 47 CFR 2.993(a)
IC: N/A

GUIDE: TIA/EIA-603, Section 2.2.12

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: AS PER ATTACHED PAGE

MEASUREMENT PROCEDURE

1. A description of the measurement facilities was filed with the FCC and was found to be in compliance with the requirements of Section 15.38, by letter from the FCC dated March 3, 1997, FILE 31040/SIT. All pertinent changes will be reported to the Commission by up-date prior to March 2000.

2. At first, in order to locate all spurious frequencies and approximate amplitudes, and to determine proper equipment functioning, the test sample was set up at a distance of three meters from the test instrument. Valid spurious signals were determined by switching the power on and off.

3. In the field, the test sample was placed on a wooden turntable above ground at three (or thirty) meters away from the search antenna. The test sample was connected to an R.F. Wattmeter and a 50 ohm dummy load, and adjusted to its rated output.

   In order to obtain the maximum response at each spurious frequency, the turntable was rotated. Also, the Search Antennas were raised and lowered vertically, and all cables were oriented. Excess power lead was coiled near the power supply.

4. A signal generator, connected with a non-radiating cable to a vertically polarized half-wave antenna (for each frequency involved) was substituted for the transmitter. The Search Antenna was raised and lowered to obtain maximum indicated.

5. The signal generator output was adjusted until a signal level indication equal to that from the transmitter was obtained.

6. Steps 4 and 5 were repeated, using a horizontally polarized half-wave antenna. The higher of the two observations was noted.

NAME OF TEST: Field Strength of Spurious Radiation

SPECIFICATION: FCC: 47 CFR 2.993(a)
IC: N/A

MEASUREMENT PROCEDURE (CONT.)

7. Power into the half-wave antenna was calculated from the characteristic impedance of the line, and the voltage output from the signal generator.

8. The level of each spurious radiation with reference to the transmitter power in dB, was calculated from:

$$\text{SPURIOUS LEVEL, dB} = 10 \text{ LOG } \frac{\text{(Calculated Spurious Power) [from para. 7].}}{\text{Tx Power (Wattmeter)}}$$

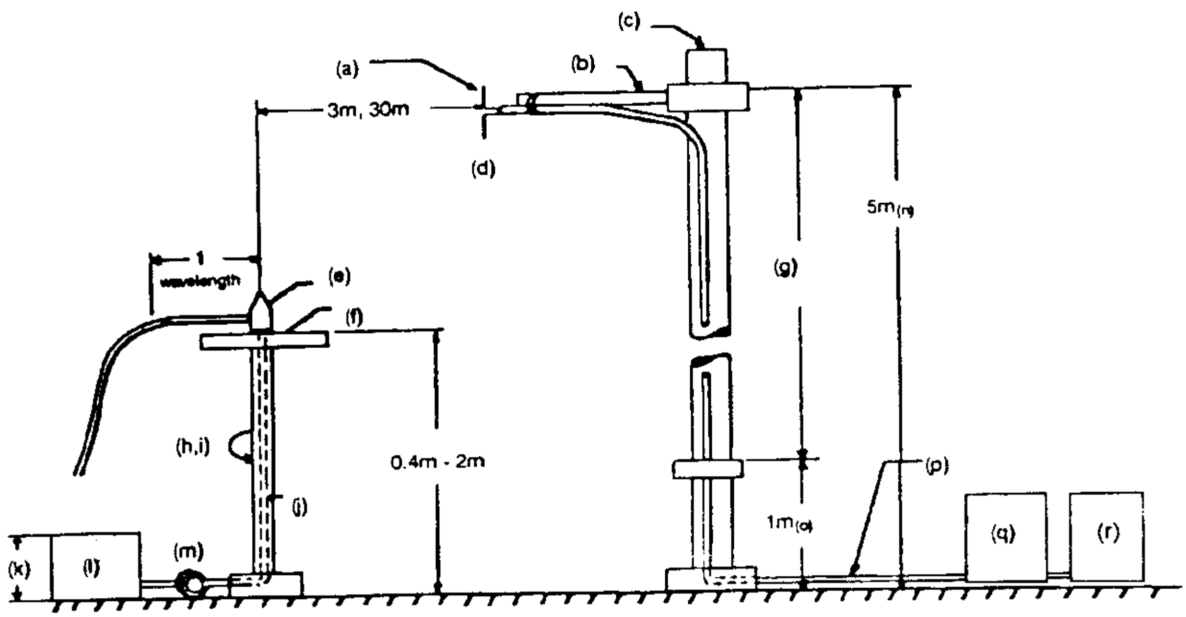
9. The worst case for all channels is shown.

10. Measurement summary:

FREQUENCY OF CARRIER, MHz	= 160.025, 146.025, 173.975
SPECTRUM SEARCHED, GHz	= 0 to 10 x F_C
ALL OTHER EMISSIONS	= ≥ 20 dB BELOW LIMIT
LIMIT, dBc	= -50 (5 Watts) -43 (1 Watt)

11. Measurement results: ATTACHED FOR WORST CASE

RADIATED TEST SETUP



NOTES:

- (a) Search Antenna - Rotatable on boom.
- (b) Non-metallic boom.
- (c) Non-metallic mast.
- (d) Adjustable horizontally.
- (e) Equipment Under Test.
- (f) Turntable.
- (g) Boom adjustable in height.
- (h) External control cables routed horizontally at least one wavelength.
- (i) Rotatable.
- (j) Cables routed through hollow turntable center.
- (k) 30 cm or less.
- (l) External power source.
- (m) 10 cm diameter coil of excess cable.
- (n) 25 cm (V), 1 m-7 m (V, H).
- (o) 25 cm from bottom end of 'V', 1 m normally.
- (p) Calibrated Cable at least 10 m in length.
- (q) Amplifier (optional).
- (r) Spectrum Analyzer.

TRANSMITTER SPURIOUS EMISSIONS (RADIATED FIELD STRENGTH)

ALL OTHER EMISSIONS = ≥ 20 dB BELOW LIMIT

EMISSION, MHz/HARMONIC	SPURIOUS LEVEL BELOW CARRIER, dBc Lo	Hi
2nd to 10th	<-60	<-70

SUPERVISED BY: MORTON FLOM, P. Eng.

NAME OF TEST: Emission Masks (Occupied Bandwidth)

SPECIFICATION: FCC: 47 CFR 2.989(c)(1)
IC: RSS-119, Section 6.4

GUIDE: TIA/EIA-603, Paragraph 2.2.11

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: As per previous page

MEASUREMENT PROCEDURE

1. The EUT and test equipment were set up as shown on the following page, with the Spectrum Analyzer connected.

2. For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for ±2.5 kHz deviation (or 50% modulation). With level constant, the signal level was increased 16 dB.

3. For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.

4. The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.

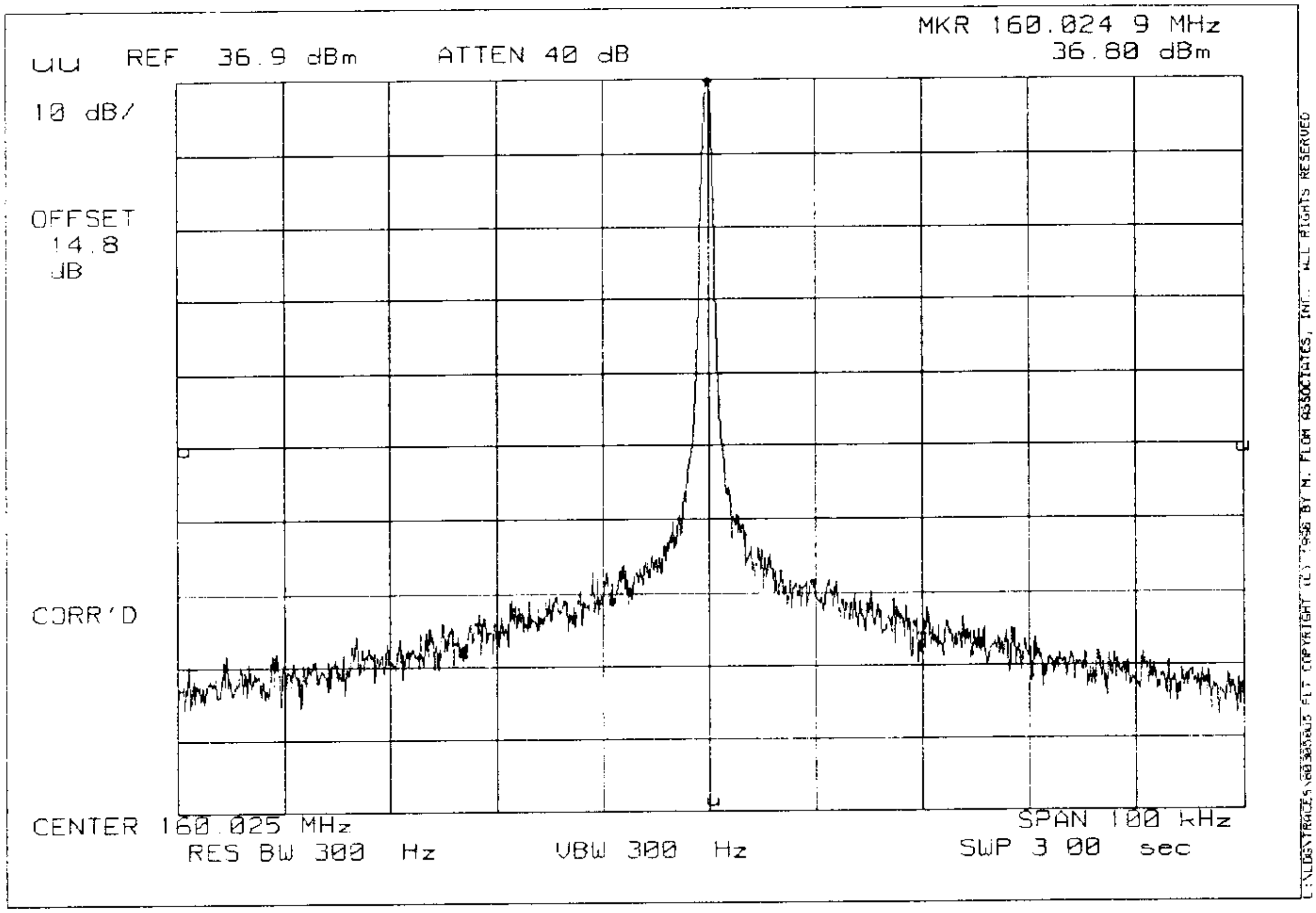
5. MEASUREMENT RESULTS: ATTACHED

PAGE 15.1.

K66VX-400V

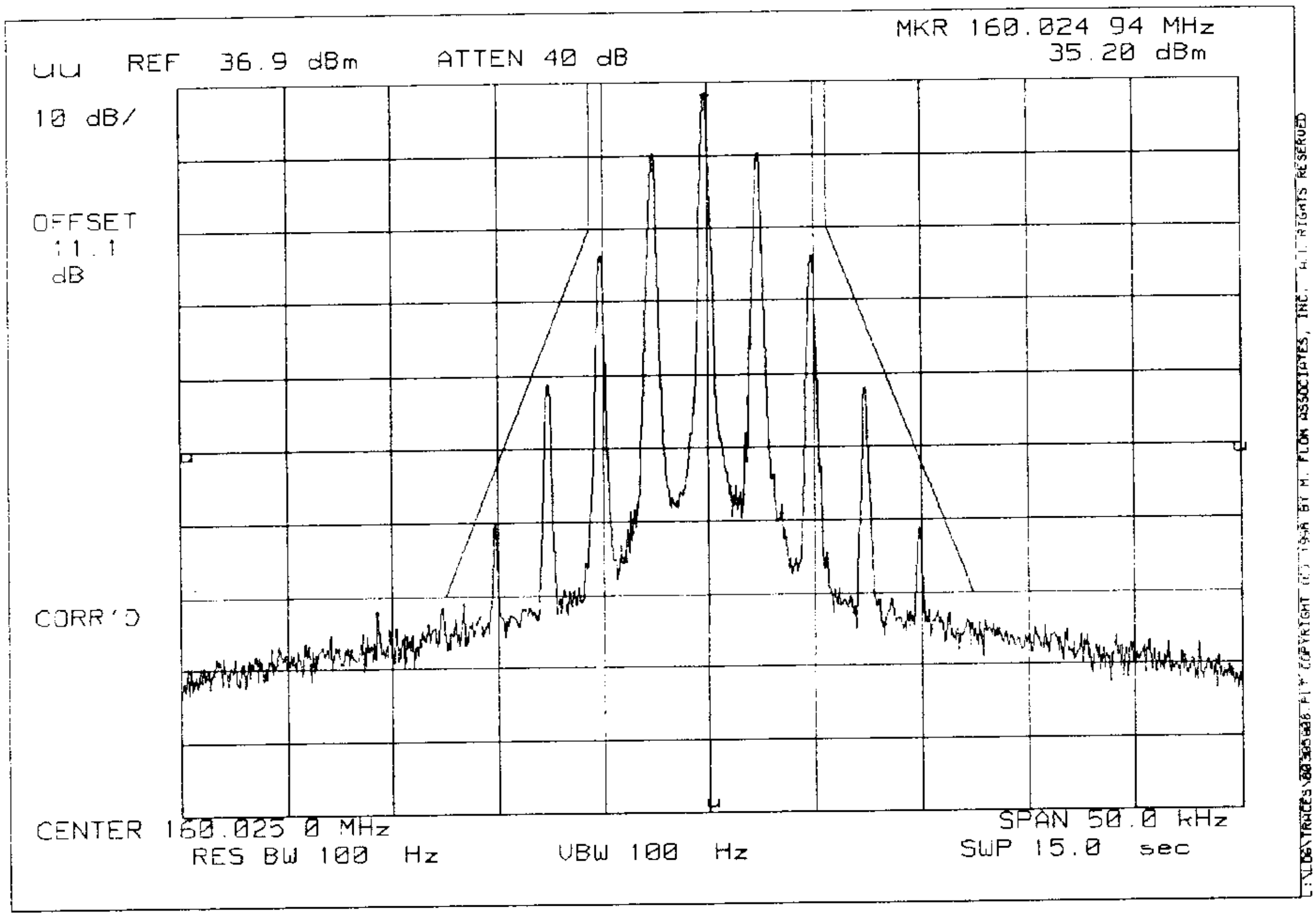
SPECTRUM ANALYZER PRESENTATION
YAESU, VX-400V
1998-MAY-05, 13:08, TUE

POWER: HIGH
MODULATION: NONE



PAGE 15.2.
SPECTRUM ANALYZER PRESENTATION
YAESU, VX-400V
1998-MAY-05, 13:48, TUE

POWER: HIGH
MODULATION: VOICE: 2500 Hz SINE WAVE
MASK: D, VHF/UHF 12.5kHz BW



PAGE 15.3.

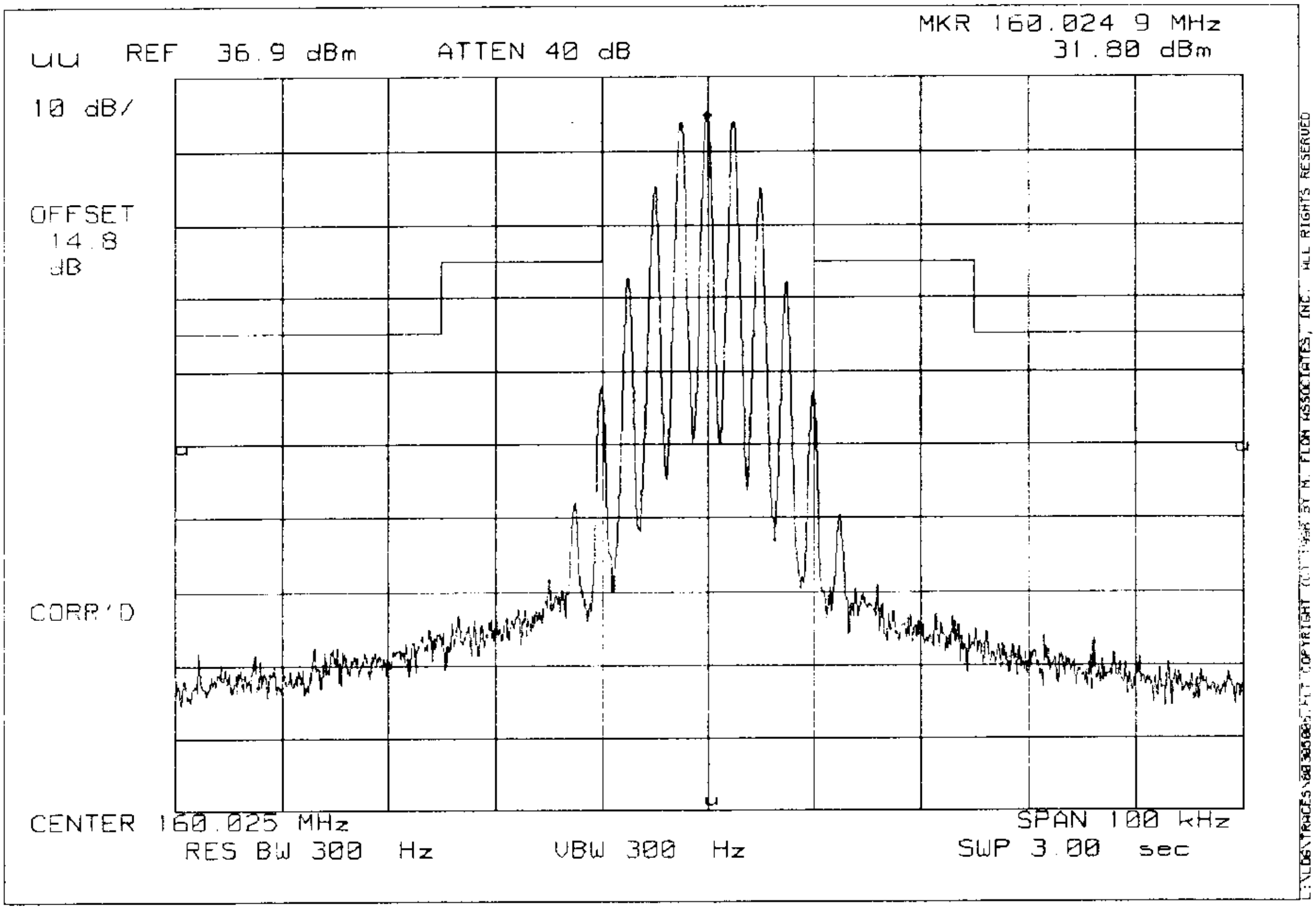
SPECTRUM ANALYZER PRESENTATION

YAESU, VX-400V

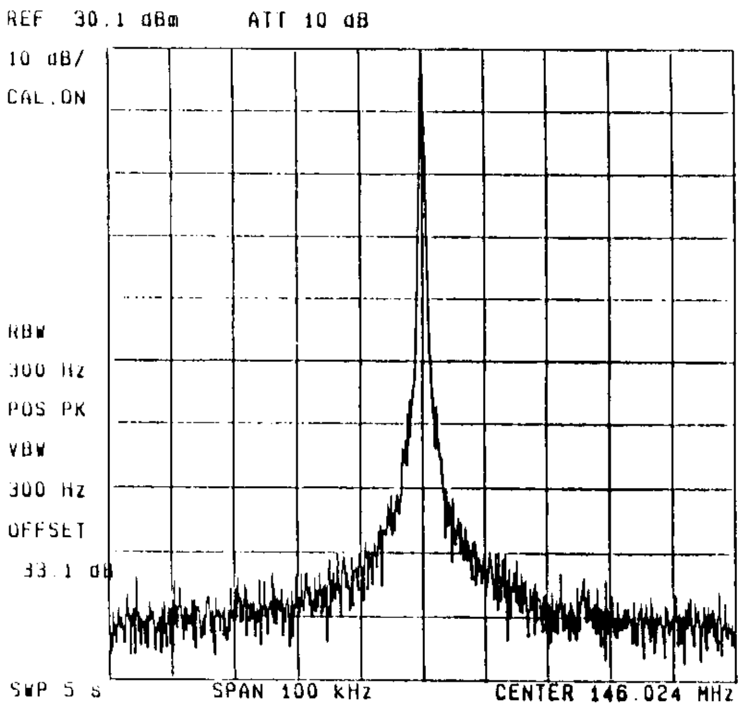
1998-MAY-05, 13:09, TUE

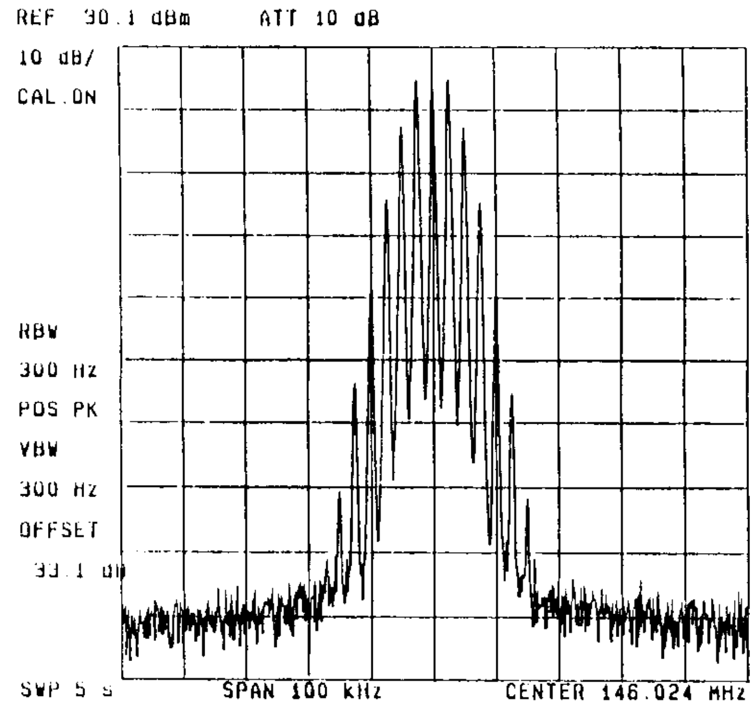
K66VX-400V

POWER: HIGH
MODULATION: VOICE: 2500 Hz SINE WAVE
MASK: B, VHF/UHF 25kHz, w/LPF



OCCUPIED BANDWIDTH (PARAGRAPH 2.2.11)



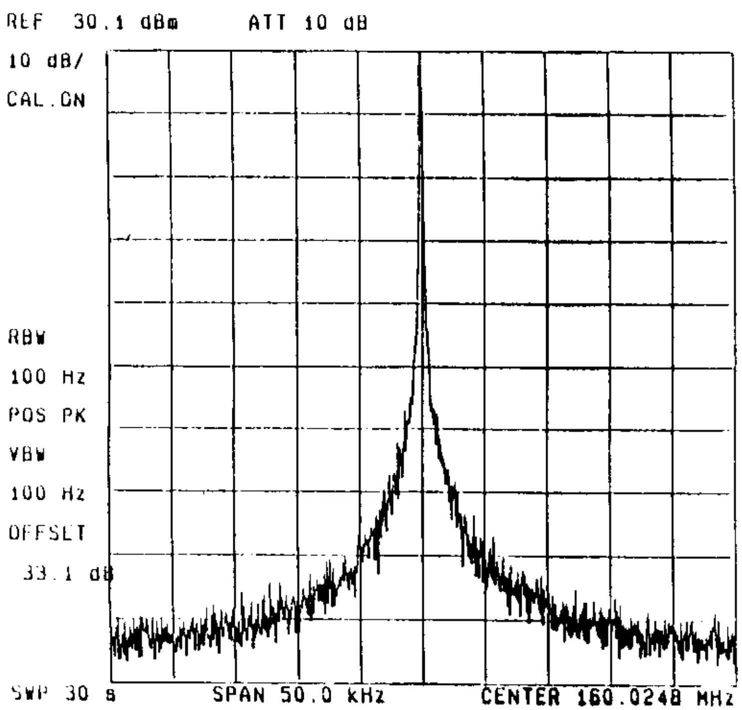


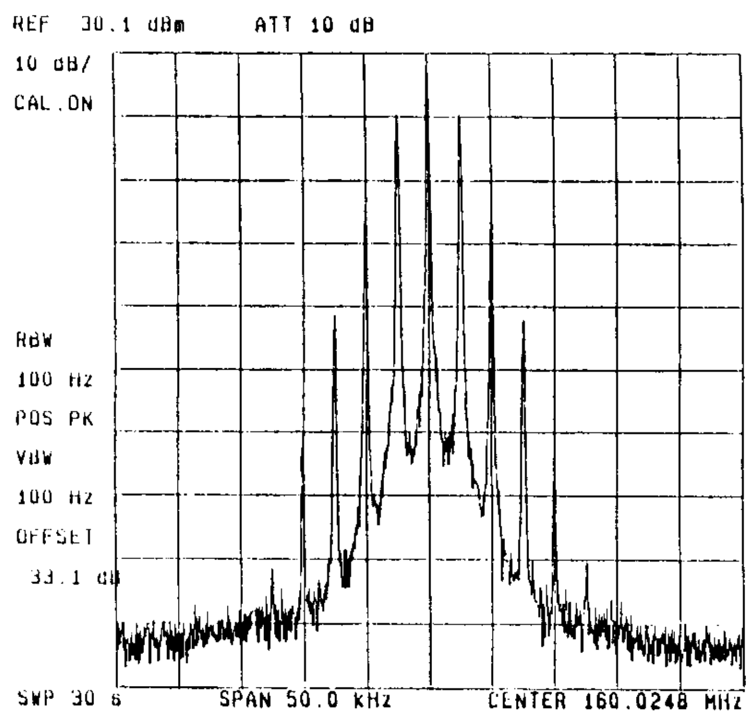
Modulation : NONE
Power : LOW, 1 [W]

Modulation : VOICE
Power : LOW, 1 [W]

Model Name : VX-400V
Serial Number : 8F000017
Channel Spacing : 25 [kHz]
Frequency : 146.025 [MHz]

OCCUPIED BANDWIDTH (PARAGRAPH 2.2.11)





Modulation : NONE
Power : LOW, 1 [W]

Modulation : VOICE
Power : LOW, 1 [W]

Model Name : VX-400V
Serial Number : 8F000017
Channel Spacing : 12.5 [kHz]
Frequency : 160.025 [MHz]

NAME OF TEST: Transient Frequency Behavior

SPECIFICATION: FCC: 47 CFR 90.214
IC: RSS-119, Section 6.5

GUIDE: TIA/EIA-603, Paragraph 2.2.19

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The EUT was setup as shown on the attached page, following TIA/EIA-603 steps a, b, and c as a *guide*.

2. The transmitter was turned on.

3. Sufficient attenuation was provided so that the transmitter carrier level measured at the output of the combiner was 40 dB below the maximum input level of the test receiver. This level was recorded as step f.

4. The transmitter was turned off.

5. An RF signal generator (1) modulated with a 1 kHz tone at either 25, 12.5, or 6.25 kHz deviation, and set to the same frequency as the assigned transmitter frequency, (2) was adjusted to a level -20 dB below the level recorded for step f, as measured at the output of the combiner. This level was then fixed for the remainder of the test and is recorded at step h.

6. The oscilloscope was setup using TIA/EIA-603 steps j and k as a guide, and to either 10 ms/div (UHF) or 5 ms/div (VHF).

7. The 30 dB attenuator was removed, the transmitter was turned on, and the level of the carrier at the output of the combiner was recorded as step l.

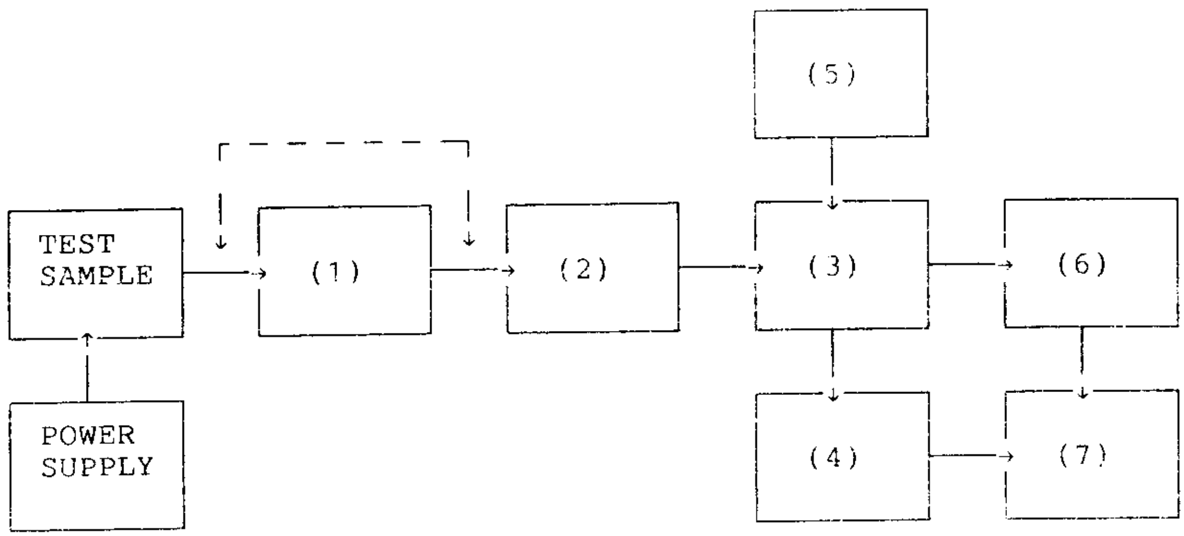
8. The carrier on-time as referenced in TIA/EIA-603 steps m, n, and o was captured and plotted. The carrier off-time as referenced in TIA/EIA-603 steps p, q, r, and s was captured and plotted.

LEVELS MEASURED:

step f, dBm	= -13.8
step h, dBm	= -34.7
step l, dBm	= 15.9

SUPERVISED BY: MORTON FLOM, P. Eng.

TRANSIENT FREQUENCY BEHAVIOR



(1) ATTENUATOR
(NOTE: Removed after 1st step)

30 dB	x

(2) ATTENUATOR

30 dB	
20 dB	x
10 dB	
KAY VARIABLE	

(3) COMBINER

4 x 25 Ω COMBINER	x

(4) CRYSTAL DETECTOR

HP 8470B	x

(5) RF SIGNAL GENERATOR

HP 8656A	
HP 8920A	x

(6) MODULATION ANALYZER

HP 8901A	x

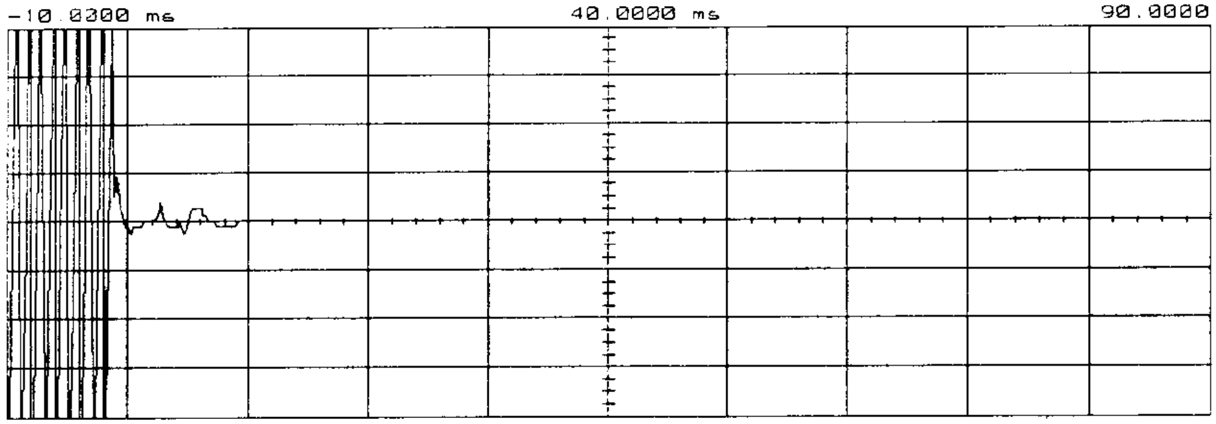
(7) SCOPE

HP 54502A	x

PAGE 18.1. K66VX-400V

OSCILLOSCOPE PRESENTATION
YAESU, VX-400V
1998-MAY-05, 15:01, TUE

MODULATION: Ref Gen=12.5 kHz Deviation
REMARK: CARRIER ON TIME



	Timebase	Delay/Pos	Reference	Mode
Main	10.0 ms/div	40.0000 ms	Center	Repetitive
	Sensitivity	Offset	Probe	Coupling
Channel 1	275 mV/div	0.00000 V	1.000 :1	dc (1M ohm)

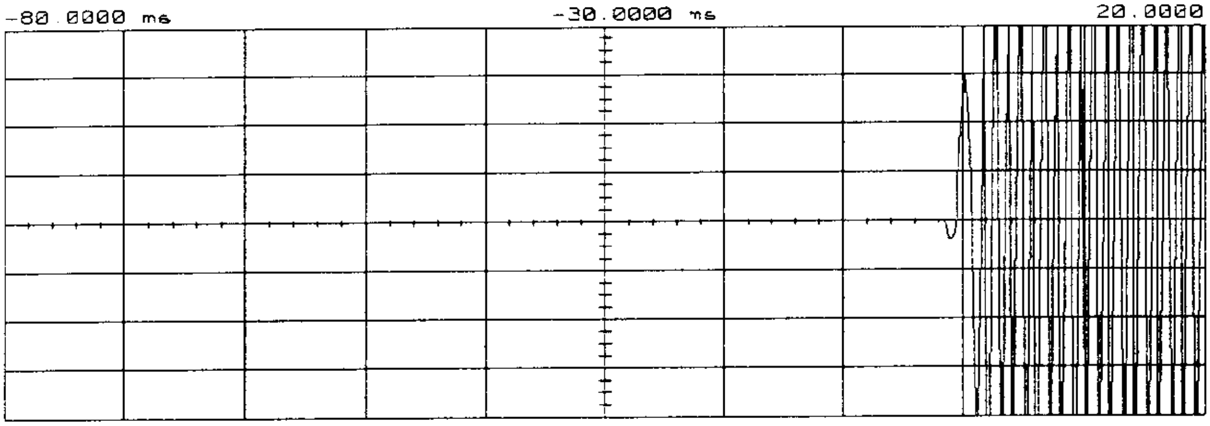
Trigger mode Edge
On Negative Edge Of Chan2
Trigger Level
Chan2 = -25.000 mV (noise reject ON)
Holdoff = 40.000 ns

PAGE 18.2. K66VX-400V

OSCILLOSCOPE PRESENTATION
YAESU, VX-400V
1998-MAY-05, 15:03, TUE

MODULATION: Ref Gen=12.5 kHz Deviation
REMARK: CARRIER OFF TIME

-80.0000 ms -30.0000 ms 20.0000 ms

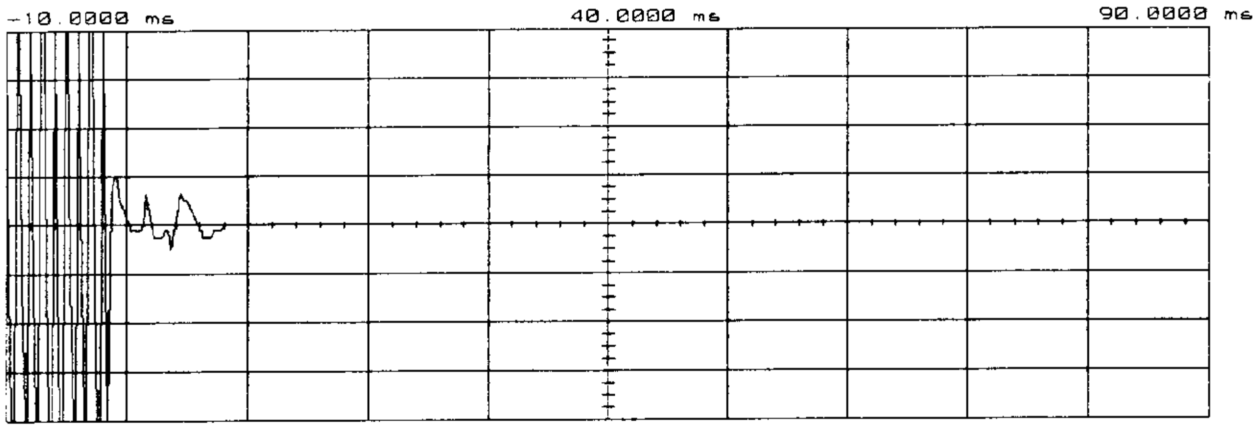


	Timebase	Delay/Pos	Reference	Mode	
Main	10.0 ms/div	-30.0000 ms	Center	Repetitive	
	Sensitivity	Offset	Probe	Coupling	
Channel 1	275 mV/div	0.00000 V	1.000 : 1	dc (1M ohm)	

Trigger mode : Edge
On Positive Edge Of Chan2
Trigger Level
Chan2 = -587.500 mV (noise reject ON)
Holdoff = 40.000 ns

OSCILLOSCOPE PRESENTATION
YAESU, VX-400V
1998-MAY-05, 14:58, TUE

MODULATION: Ref Gen=25 kHz Deviation
REMARK: CARRIER ON TIME

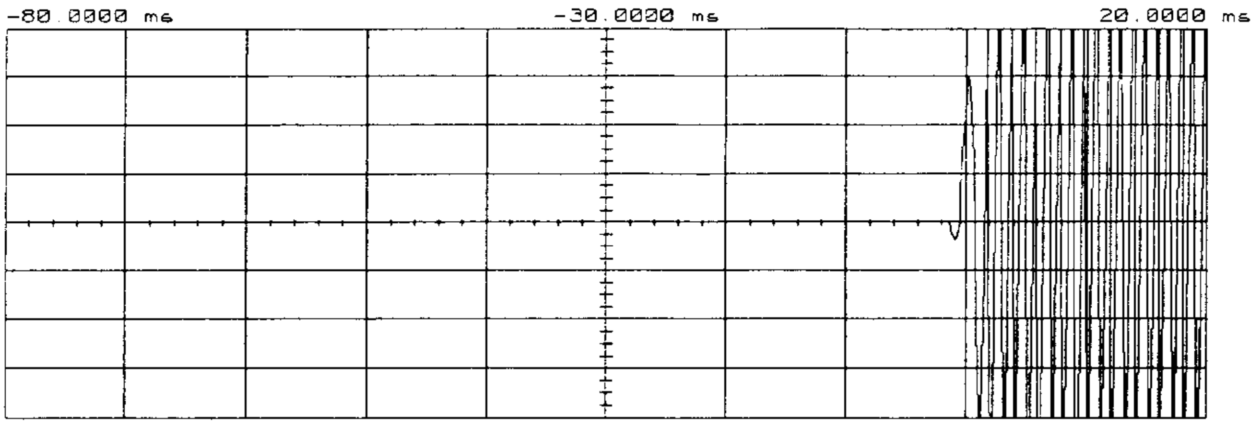


	Timebase	Delay/Pos	Reference	Mode
Main	10.0 ms/div	40.0000 ms	Center	Repetitive
	Sensitivity	**Offset**	**Probe**	**Coupling**
Channel 1	275 mV/div	0.00000 V	1.000 :1	dc (1M ohm)

Trigger mode Edge
On Negative Edge Of Chan2
Trigger Level
Chan2 = -25.000 mV (noise reject ON)
Holdoff = 40.000 ns

PAGE 18.4.
OSCILLOSCOPE PRESENTATION
YAESU, VX-400V
1998-MAY-05, 14:59, TUE

MODULATION: Ref Gen=25 kHz Deviation
REMARK: CARRIER OFF TIME



	Timebase	Delay/Pos	Referance	Mode
Main	10.0 ms/div	-30.0000 ms	Center	Repetitive
	Sensitivity	Offset	Probe	Coupling
Channel 1	275 mV/div	0.00000 V	1.000 :1	dc (1M ohm)

Trigger mode : Edge
On Positive Edge Of Chan2
Trigger Level
Chan2 = -587.500 mV (noise reject ON)
Holdoff = 40.000 ns

NAME OF TEST: Audio Low Pass Filter (Voice Input)

SPECIFICATION: FCC: 47 CFR 2.987(a)
IC: RSS-119, Section 6.6

GUIDE: TIA/EIA-603, Paragraph 2.2.15

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

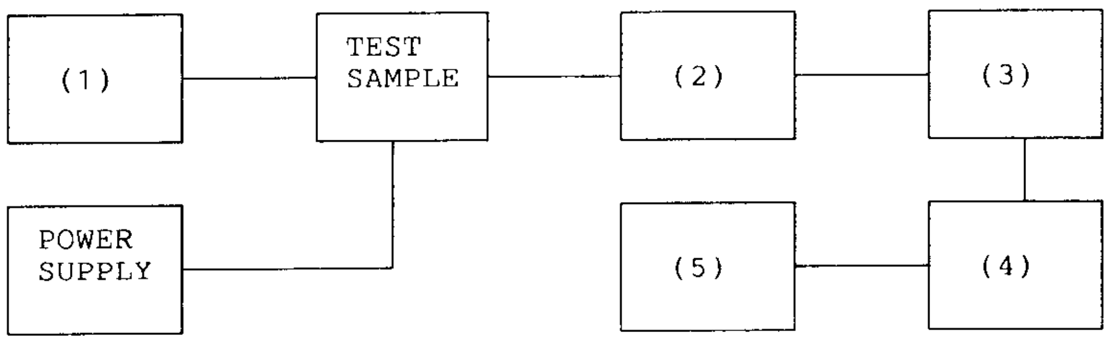
1. The EUT and test equipment were set up such that the audio input was connected at the input to the modulation limiter, and the modulated stage.

2. The audio output was connected at the output to the modulated stage.

3. MEASUREMENT RESULTS: ATTACHED

TRANSMITTER TEST SET-UP

TEST A. MODULATION CAPABILITY/DISTORTION
TEST B. AUDIO FREQUENCY RESPONSE
TEST C. HUM AND NOISE LEVEL
TEST D. RESPONSE OF LOW PASS FILTER
TEST E. MODULATION LIMITING



(1) AUDIO OSCILLATOR/GENERATOR

HP 204D	
HP 8903A	
HP 3312A	x
	x

(2) COAXIAL ATTENUATOR

NARDA 766-10	
SIERRA 661A-30	x
BIRD 8329 (30 dB)	

(3) MODULATION ANALYZER

HP 8901A	x

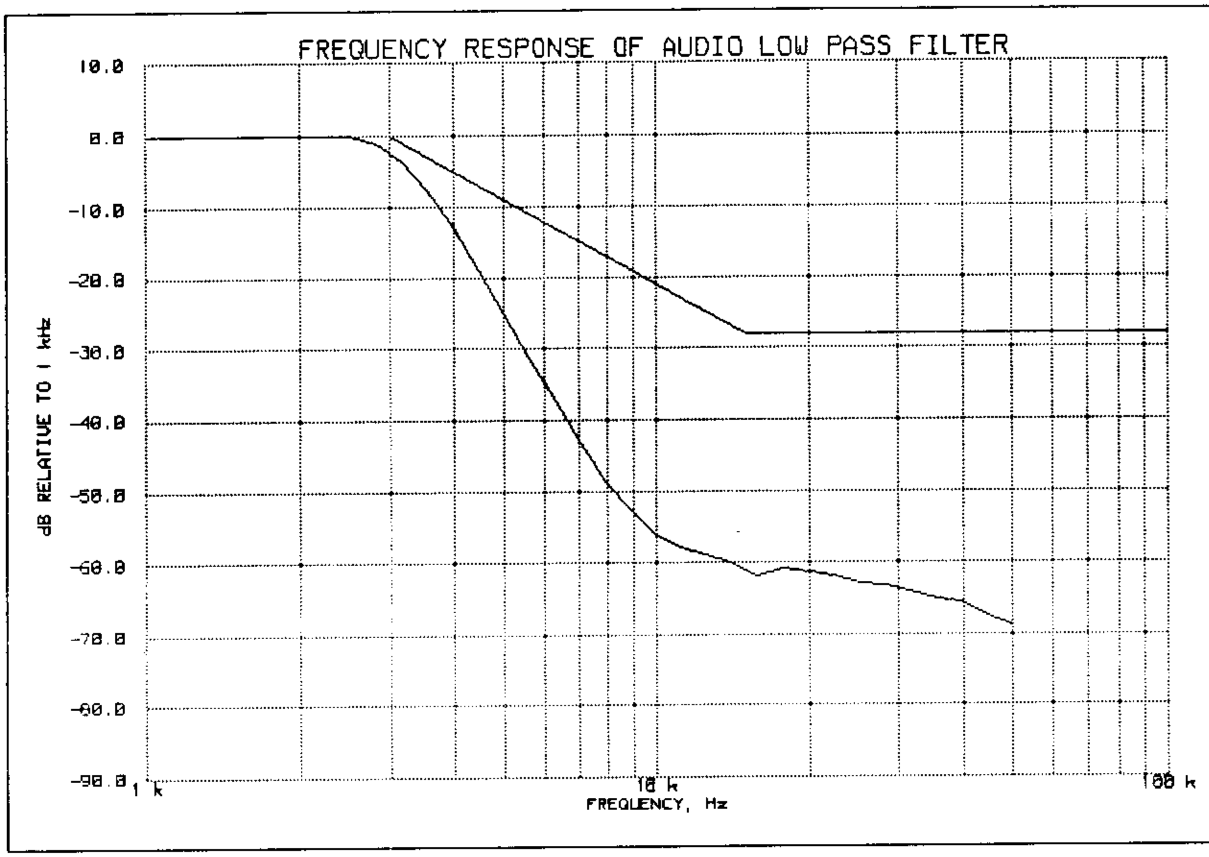
(4) AUDIO ANALYZER

HP 8903A	x

(5) SCOPE

HP 1741A	
HP 181T	
TEK 935	

FREQUENCY RESPONSE OF AUDIO LOW PASS FILTER
YAESU, VX-400V
5 MAY 1998, 11:01



PEAK AUDIO FREQUENCY, Hz: 2510

SUPERVISED BY:

MORTON FLOM, P. Eng.

NAME OF TEST: Audio Frequency Response

SPECIFICATION: FCC: 47 CFR 2.987(a)
IC: N/A

GUIDE: TIA/EIA-603, Section 2.2.6

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: As per previous page

MEASUREMENT PROCEDURE

1. The EUT and test equipment were set up as shown on the following page.

2. The audio signal generator was connected to the audio input circuit/microphone of the EUT.

3. The audio signal input was adjusted to obtain 20% modulation at 1 kHz, and this point was taken as the 0 dB reference level.

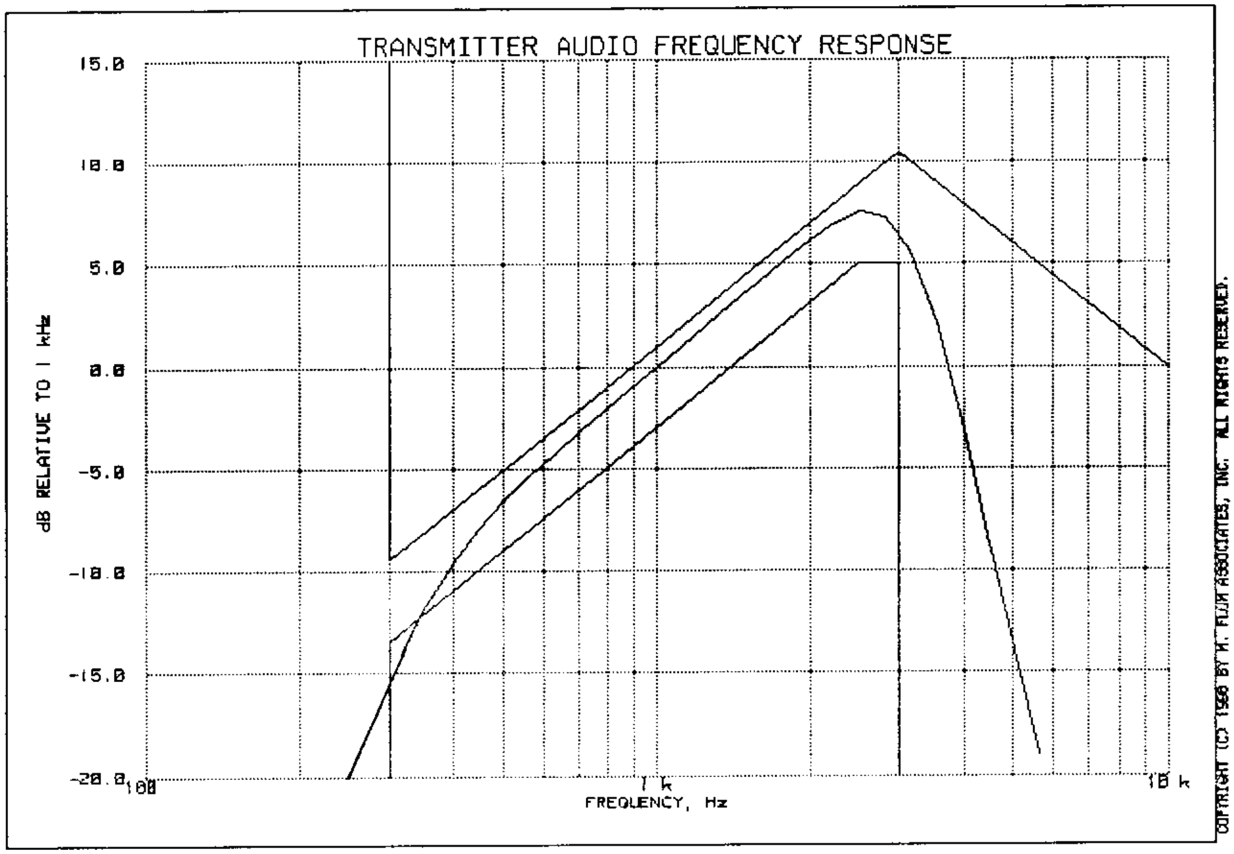
4. With input levels held constant and below limiting at all frequencies, the audio signal generator was varied from 100 Hz to 50 kHz.

5. The response in dB relative to 1 kHz was then measured, using the HP 8901A Modulation Analyzer.

6. MEASUREMENT RESULTS: ATTACHED

PAGE 23. K66VX-400V

TRANSMITTER AUDIO FREQUENCY RESPONSE
YAESU, VX-400V
5 MAY 1998, 10:58



PEAK AUDIO FREQUENCY, Hz: 2510

TABLE VALUES:

FREQUENCY, Hz	LEVEL, dB	FREQUENCY, Hz	LEVEL, dB	FREQUENCY, Hz	LEVEL, dB
300	-15.3	30000	-24.4		
20000	-24.8	50000	-24.5		

SUPERVISED BY: MORTON FLOM, P. Eng.

NAME OF TEST: Modulation Limiting

SPECIFICATION: IC: RSS-119, Section 6.6
FCC: 47 CFR 2.987(b)

GUIDE: TIA/EIA-603, Paragraph 2.2.3

TEST CONDITIONS: S. T. & H.

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The signal generator was connected to the input of the EUT as for "Frequency Response of the Modulating Circuit."

2. The modulation response was measured for each of three frequencies (one of which was the frequency of maximum response), and the input voltage was varied and was observed on an HP 8901A Modulation Analyzer.

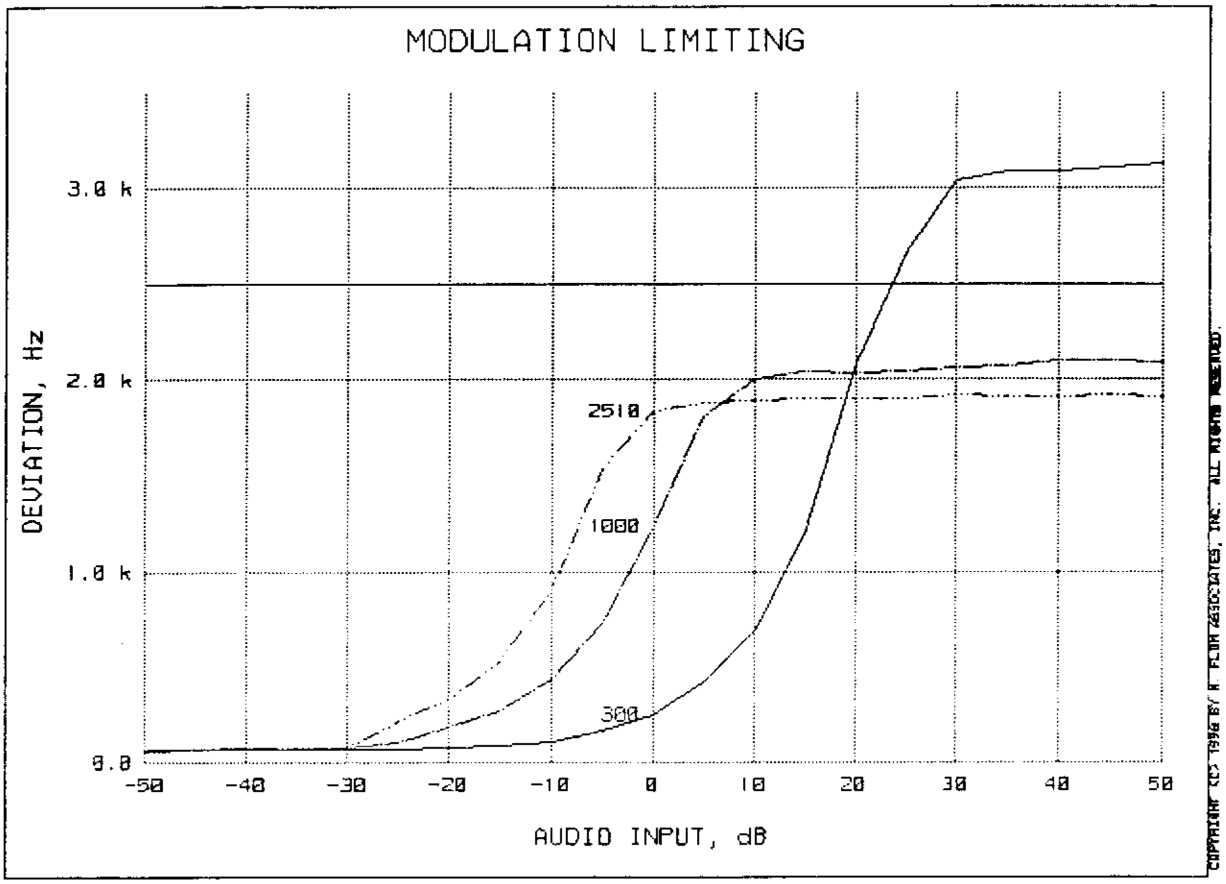
3. The input level was varied from 30% modulation (±1.5 kHz deviation) to at least 20 dB higher than the saturation point.

4. Measurements were performed for both negative and positive modulation and the respective results were recorded.

5. MEASUREMENT RESULTS: ATTACHED

PAGE 25.1.
MODULATION LIMITING
YAESU, VX-400V
1998-MAY-05, 11:11

K66VX-400V

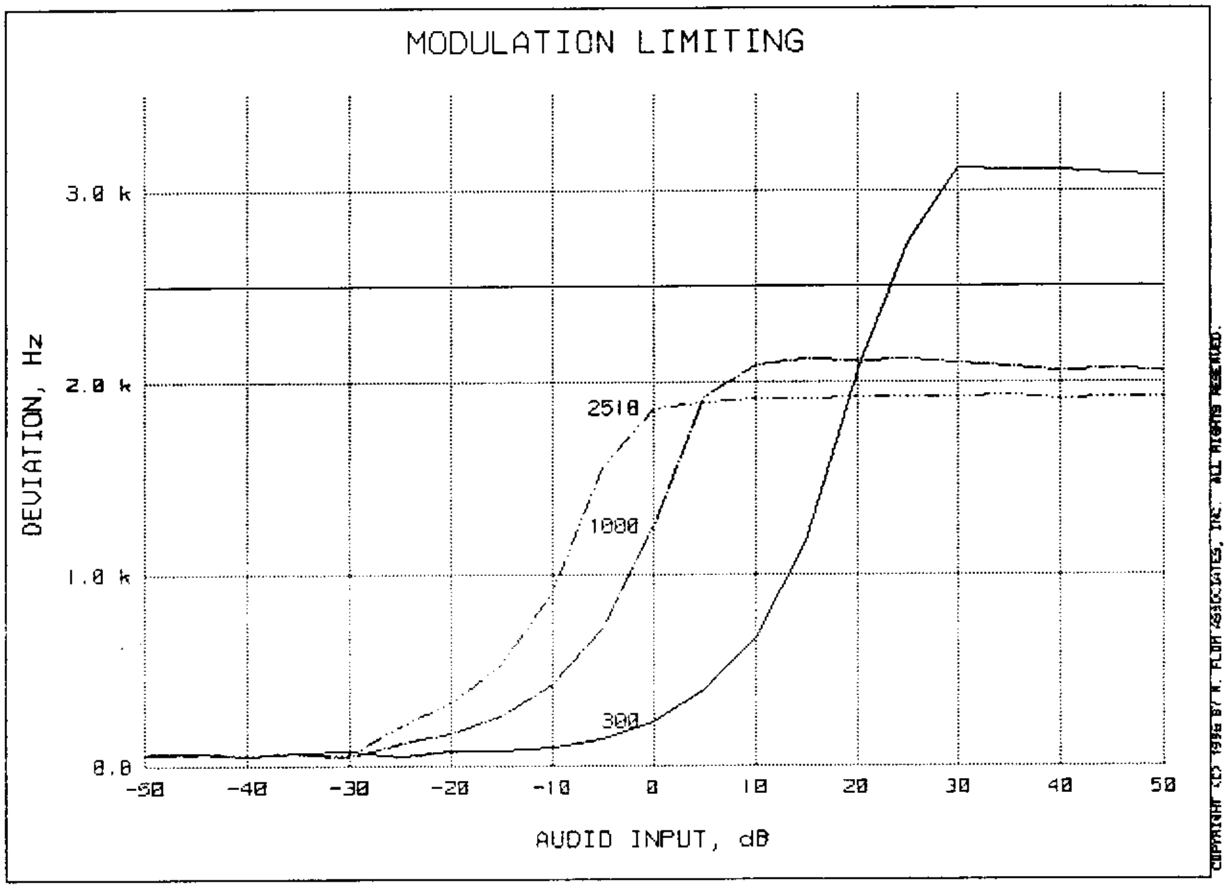


REFERENCE DEVIATION, kHz	=	1.25
REFERENCE MODULATION, Hz	=	1000
PEAKS	=	POSITIVE
AUDIO AMPLITUDE, mV	=	18.37

SUPERVISED BY: MORTON FLOM, P. Eng.

PAGE 25.2.
MODULATION LIMITING
YAESU, VX-400V
1998-MAY-05, 11:11

K66VX-400V



REFERENCE DEVIATION, kHz = 1.25

REFERENCE MODULATION, Hz = 1000

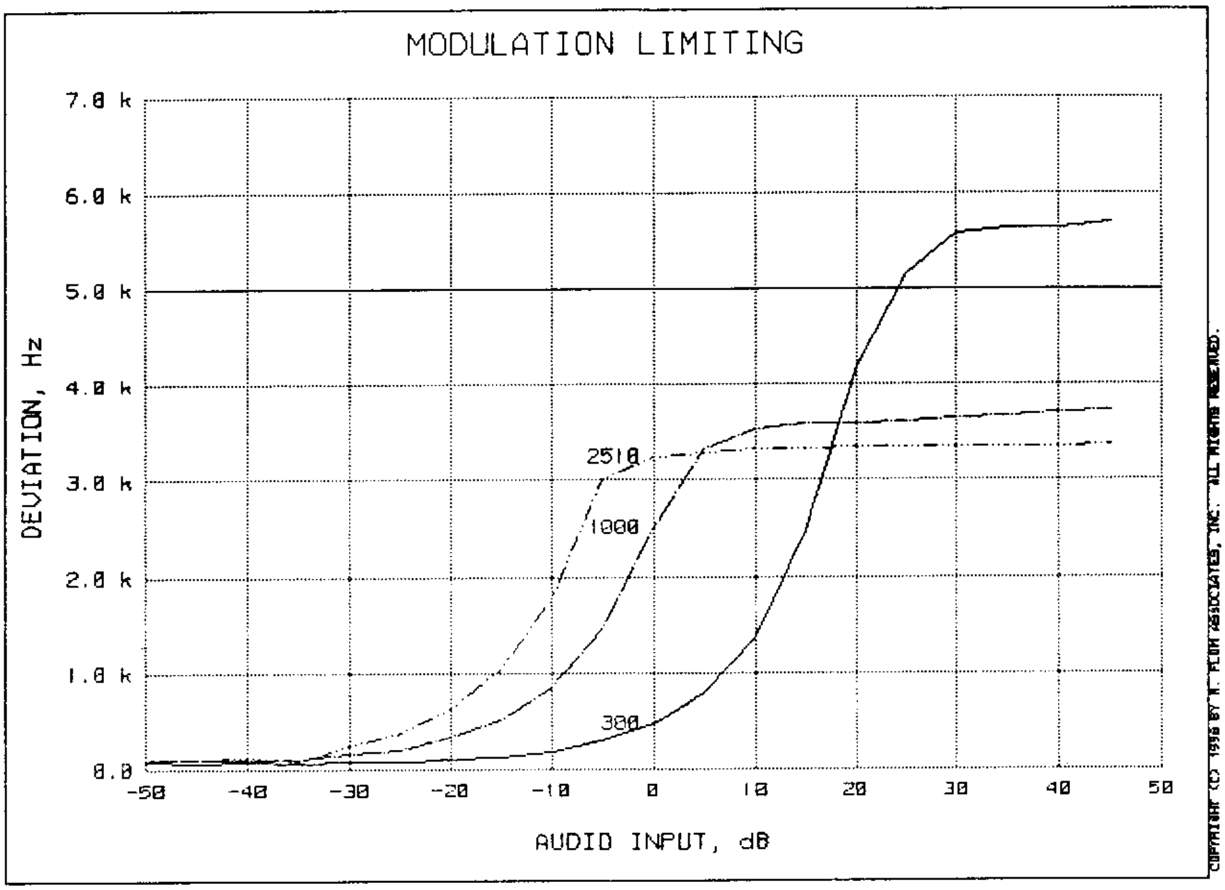
PEAKS = NEGATIVE

AUDIO AMPLITUDE, mV = 18.37

SUPERVISED BY:

MORTON FLOM, P. Eng.

MODULATION LIMITING
YAESU, VX-400V
1998-MAY-05, 11:05



REFERENCE DEVIATION, kHz = 2.5

REFERENCE MODULATION, Hz = 1000

PEAKS = POSITIVE

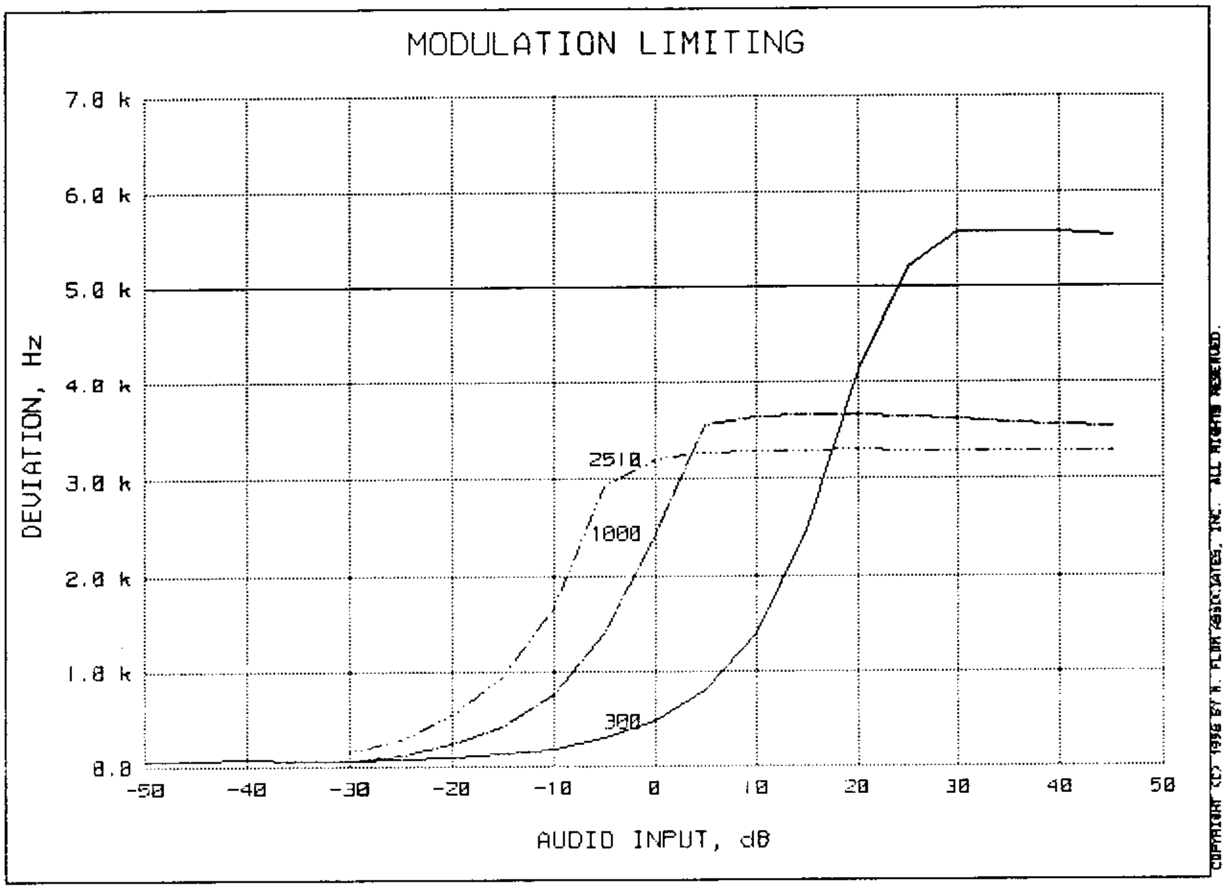
AUDIO AMPLITUDE, mV = 21.09

SUPERVISED BY:

MORTON FLOM, P. Eng.

PAGE 25.4. K66VX-400V

MODULATION LIMITING
YAESU, VX-400V
1998-MAY-05, 11:05



REFERENCE DEVIATION, kHz = 2.5

REFERENCE MODULATION, Hz = 1000

PEAKS = NEGATIVE

AUDIO AMPLITUDE, mV = 21.09

SUPERVISED BY: MORTON FLOM, P. Eng.

NAME OF TEST: Frequency Stability (Temperature Variation)

SPECIFICATION: FCC: 47 CFR 2.995(a)(1)
IC: RSS-119, Section 7.0

GUIDE: TIA/EIA-602, Section 2.2.2

TEST CONDITIONS: As indicated

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The EUT and test equipment were set up as shown on the following page.

2. With all power removed, the temperature was decreased to -30°C and permitted to stabilize for three hours. Power was applied and the maximum change in frequency was noted within one minute.

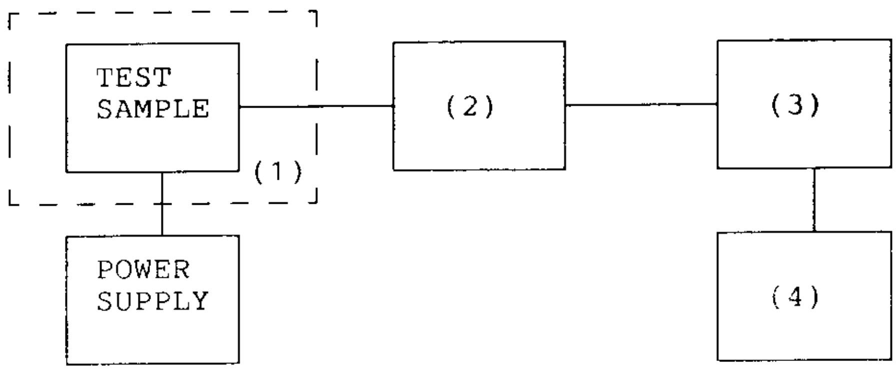
3. With power OFF, the temperature was raised in 10°C steps. The sample was permitted to stabilize at each step for at least one-half hour. Power was applied and the maximum frequency change was noted within one minute.

4. The temperature tests were performed for the worst case.

5. MEASUREMENT RESULTS: ATTACHED

TRANSMITTER TEST SET-UP

TEST A. OPERATIONAL STABILITY
TEST B. CARRIER FREQUENCY STABILITY
TEST C. OPERATIONAL PERFORMANCE STABILITY
TEST D. HUMIDITY
TEST E. VIBRATION
TEST F. ENVIRONMENTAL TEMPERATURE
TEST G. FREQUENCY STABILITY: TEMPERATURE VARIATION
TEST H. FREQUENCY STABILITY: VOLTAGE VARIATION



(1) TEMPERATURE, HUMIDITY, VIBRATION

TENNEY TEMPERATURE CHAMBER	x
WEBER HUMIDITY CHAMBER	
L.A.B. RVH 18-100	

(2) COAXIAL ATTENUATOR

NARDA 766-10	
SIERRA 661A-30	x
BIRD 8329 (30 dB)	x

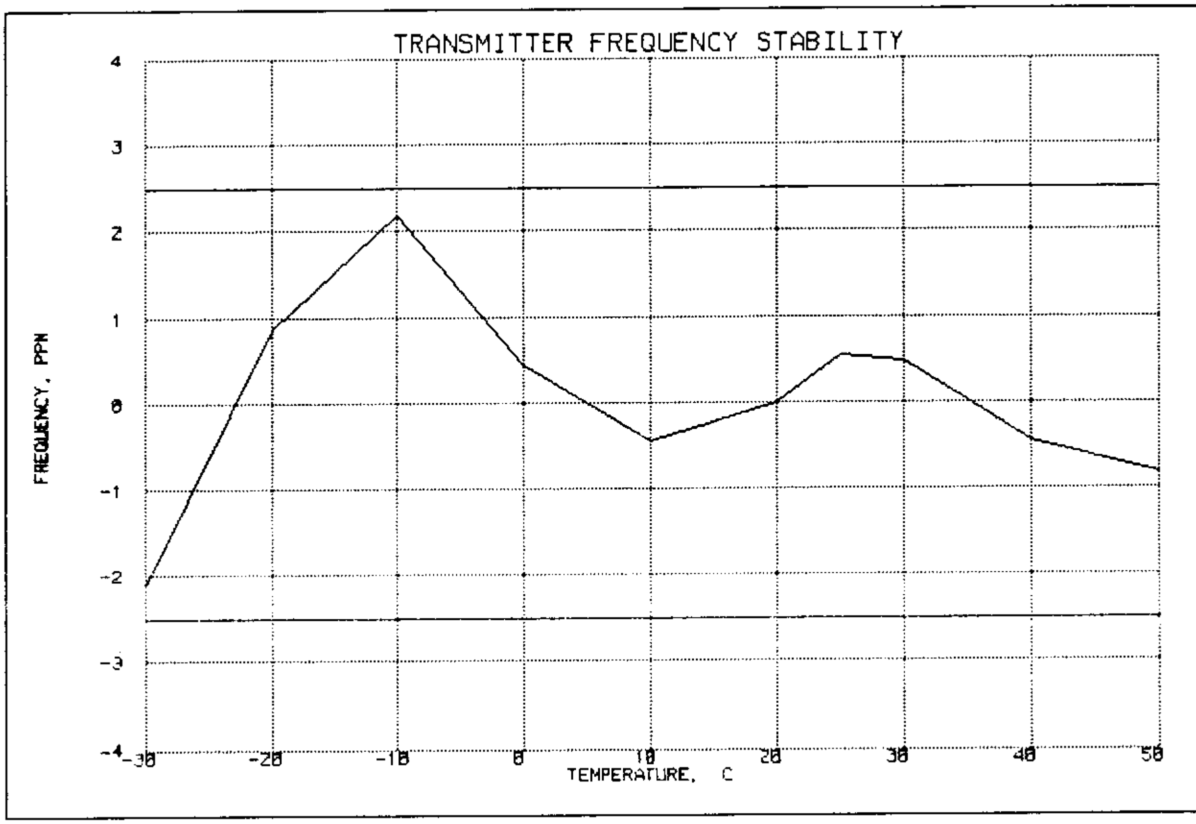
(3) R.F. POWER

HP 435A POWER METER	
HP 436A POWER METER	x
HP 8901A POWER MODE	x

(4) FREQUENCY COUNTER

HP 5383A	
HP 5334B	x
HP 8901A	x

TRANSMITTER FREQUENCY STABILITY
YAESU, VX-400V
7 MAY 1998, 10:03



FREQUENCY OF CARRIER, MHz = 160.02495

LIMIT, ppm = 2.5

LIMIT, Hz = 400

SUPERVISED BY:

MORTON FLOM, P. Eng.

NAME OF TEST: Frequency Stability (Voltage Variation)

SPECIFICATION: FCC: 47 CFR 2.995 (b)(1)
IC: RSS-119, Section 7.0

GUIDE: TIA/EIA-602, Section 2.2.2

TEST CONDITIONS: As indicated

TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The EUT was placed in a temperature chamber at 25±5°C and connected as for "Frequency Stability - Temperature Variation" test.
2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.
3. The variation in frequency was measured for the worst case.

MEASUREMENT RESULTS

LIMIT, ppm = 5
LIMIT, Hz = 800

STV, %	Vdc	CHANGE IN FREQUENCY, Hz	
85	6.1	160024980	-20
100	7.2	160025000	0
115	8.3	160025000	0
BATTERY END POINT:	6.5	160024980	-20

SUPERVISED BY: MORTON FLOM, P. Eng.

NAME OF TEST: Necessary Bandwidth and Emission Bandwidth

PARAGRAPH: 47 CFR 2.202(g)

MODULATION = 16K0F3E

NECESSARY BANDWIDTH CALCULATION:

MAXIMUM MODULATION (M), kHz	= 3
MAXIMUM DEVIATION (D), kHz	= 5
CONSTANT FACTOR (K)	= 1
NECESSARY BANDWIDTH (B_N), kHz	= (2 x M) + (2 x D x K)
	= 16.0

MODULATION = 11K0F3E

NECESSARY BANDWIDTH CALCULATION:

MAXIMUM MODULATION (M), kHz	= 3
MAXIMUM DEVIATION (D), kHz	= 2.5
CONSTANT FACTOR (K)	= 1
NECESSARY BANDWIDTH (B_N), kHz	= (2 x M) + (2 x D x K)
	= 11.0

SUPERVISED BY: M. Flom P.Eng
MORTON FLOM, P. Eng.

TESTIMONIAL
AND
STATEMENTOF CERTIFICATION

K66VX-400V

THIS IS TO CERTIFY:

1. THAT the application was prepared either by, or under the direct supervision of, the undersigned.

2. THAT the technical data supplied with the application was taken under my direction and supervision.

3. THAT the data was obtained on representative units, randomly selected.

4. THAT, to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct.

CERTIFYING ENGINEER: MORTON FLOM, P. Eng.

STATEMENT OF QUALIFICATIONS

EDUCATION:

1. B. ENG. in ENGINEERING PHYSICS, 1949, McGill University, Montreal, Canada.

2. Post Graduate Studies, McGill University & Sir George Williams University, Montreal.

PROFESSIONAL AFFILIATIONS:

1. ARIZONA SOCIETY OF PROFESSIONAL ENGINEERS (NSPE), #026 031 821.

2. ORDER OF ENGINEERS (QUEBEC) 1949. #4534.

3. ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOPHYSICISTS & GEOLOGISTS OF ALBERTA #5916.

4. REGISTERED ENGINEERING CONSULTANT - GOVERNMENT OF CANADA, DEPARTMENT OF COMMUNICATIONS. Radio Equipment Approvals.

5. IEEE, Lifetime Member No. 0417204 (member since 1947).

EXPERIENCE:

1. Research/Development/Senior Project Engineer, R.C.A. LIMITED (4 years).

2. Owner/Chief Engineer of Electronics. Design/Manufacturing & Cable TV Companies (10 years).

3. CONSULTING ENGINEER (over 25 years).

M. Flom P. Eng.

MORTON FLOM, P. Eng.

TEST INSTRUMENTATION LIST

All equipment calibrated within last 90 days

ADAPTER
HP X281 (Coaxial waveguide); HP S281; HP 85659 (Quasi peak)

AMPLIFIER
Pre-amp. HP 10885A (2-1300 MHz); HP 8447D, HP 8447E, HP 8449A

ANTENNA *See end*

ATTENUATOR
Kay 432D; Power, Sierra 661A-30; Narda 76610; Narda 4779-3, -6, -10 dB

AUDIO OSCILLATOR
HP 204D; AIEC DTC-1; Motorola S-1333B; HP 3312A; HP 8903A

BATTERY
Sears Diehard, Stock #4341

CAMERA
Oscilloscope, Tektronix C5A; Polaroid Impulse AF; Kodak DC-50

CAPACITOR
Feed-Thru, 10 μF, Solar 6512-106R; Solar 7525-1

CLOSE FIELD PROBE
HP 11940A, 11941A, HP 11945A

COMPUTER
HP 332; HP Vectra 486/25VL; Various PC COmpatables

CONVERTOR, Down
HP 117 10B

COUPLER
Narda 1080, Waveguide; HP S750E (Cross guide); Waveline 274/40; Solar 7415-3; Solar 7835-891 & -896

CURRENT PROBE
Solar 6741-1

DETECTOR
HP 8470B

DIGITAL MULTIMETER
HP 3476A w/H.F. Probe; Fluke 8030A-01; HP 3478A

DISTORTION ANALYZER
HP 334A; HP 8903A

ELECTRONIC COUNTER
HP 5383A; HP 5334B

FILTER
Cirqtel FHT/7-50-57/ 50-1A/1B (HP); Jerrold TLB-1; THB-1, Piezo 5064; Eagle TNF-I Series, Krohn-Hite 3202; Phelps-Dodge #PD-495-8; Newtone #PD6000 Line Protector; 870-890 MHz (Lab Design); 900 MHz (Lab Design); Solar High-Pass s/n 882029

FREQ. DEV. METER
HP 8901A

FREQ. DOUBLER
HP 11721A

FREQUENCY METER
HP 537A; HP 536A

GENERATOR
Solar 6550-1 (power sweep); HP 8640B, GAW 1012, HP 8656A (signal); Solar 8282-1 (spike)

HUMIDITY CHAMBER
Embem Co FW30; Bowser 0

LIMITER, R.F
HP 11867A; HP 11693A; HP 10509A

LISN
Singer 91221-1; Ailtech 94641-1 (50μH)

LOAD, POWER
Telewave TLW-25; Bird 8329

MILLIAMETER
HP 428B

MIXER
HP 10514A; Mini-Circuits TAK-1H

OPEN FIELD SITE
As filed with FCC & IC and kept up-dated.
TURNTABLES:
Up to 2000# capacity
GROUND SCREEN:
Complies with docket 80-284
ANTENNA MAST:
Complies as above

OSCILLOSCOPE
HP 1741A; HP 181T; Tektronix T935; HP 54502A

PHANTOM
M.F.A. Labs Left and Right human head

PLOTTER
HP 7470; HP7475A

POWER METER
AF GR 1840A; HP 435A with 8481A & 8482H Power Sensors; HP 436A; HP 8901A

POWER SUPPLY
HP 6286A; Heathkit 1P 2711; 1P 5220; Honda EM400 (portable gas gen.); HP 6012

PRINTER
Brother HL-8; Brother HL-10V; HP DeskJet 640C

R. F. PRESELECTOR
HP 85685A

RADIATION METER
Narda 8717 w/8010 Amp, 8021B and 8760 probes

RESISTOR, PRECISION
Solar 7144-1.0, 7144-10.0; Solar 8525-1

SCALE
Weigh-Tronix 3632T-50

SCANNER
HP 9190A Scanjet

SCREEN ROOM
Lindgren 22-2/2-0

SIGNAL LEVEL METER
Jerrold 704B

SIGNAL SAMPLER
R. F. Bird 4273-030, 4275-030

SINAD/VOLTMETER
Helper Sinadder

SPECTRUM ANALYZER
HP 8558B, 8557; HP 8563E; HP 853A; HP 8566B/8568B

TEMPERATURE CHAMBER
Tenney, Jr

TEMPERATURE PROBE
Fluke 80T-150C

TERMINATION
Narda 320B Waveguide. Waveline #281

TEST SET
Semi-Automatic: HP 8953A; HP 8954A Interface: Computer / Controller; P.S. Programmer; HP 59501A; RF Communications: HP 8920A

TRANSFORMERS
Audio Isolation: Solar 6220-1A; Impedance: HP 11694A; Isolation: Solar 7032-1; Matching: Solar 7033-1

TRANSMISSION & NOISE MEASURING SET
HP 3555B

VIBRATION CHAMBER
Unholtz-Dickie T 500; Unholtz-Dickie T 4000

VOLTMETER
HP 410C; HP 3478A

WATTMETER
Bird 43, Sierra 174A-2

ANTENNAS

30 - 50 Hz
Emco 7603 M-Field; Emco 7604 M-Field
20 - 200 MHz
Aprel Biconical Model AAB20200
20 - 300 MHz
Emco Biconical H-Field
25 - 1000 MHz
Singer DM-105A; EMCO 3121C
200 - 1000 MHz
Aprel Log Periodic, Model AALP 2001
10 kHz - 30 MHz
Emco 3107B, E-Field; Emco 3101B/1, Rod E-Field
10 kHz - 32 MHz
Singer 94593-1 (Loop)
150 kHz - 32 MHz
Singer 92197-1 (41")
150 kHz - 32 MHz
Singer 93049-1 (9')
1 - 10 GHz
Singer 90794-A Discone
1 - 18 GHz
Horn: Aprel Model AAH-118
18 - 40 GHz
Emco 3116, Horn
40 - 60 GHz
Horn: HP 11970U, HP 11971U, HP 11975A (Lo Drive Amplifier)
50 - 75 GHz
Mixer, HP 11970V, HP 11971V
75 - 110 GHz
Mixer, HP 11970W

VX-400V Alignment

Introduction

The VX-400 is carefully aligned at the factory for the specified performance across the frequency range specified for each version. Realignment should therefore not be necessary except in the event of a component failure, or altering version type. All component replacement and service should be performed only by an authorized Yaesu representative, or the warranty policy may be void.

The following procedures cover the sometimes critical and tedious adjustments that are not normally required once the transceiver has left the factory. However, if damage occurs and some parts subsequently are placed, realignment may be required. If a sudden problem occurs during normal operation, it is likely due to component failure; realignment should not be done until after the faulty component has been replaced.

We recommend that servicing be performed only by authorized Yaesu service technicians who are experienced with the circuitry and fully equipped for repair and alignment. Therefore, if a fault is suspected, contact the dealer from whom the transceiver was purchased for instructions regarding repair. Authorized Yaesu service technicians realign all circuits and make complete performance checks to ensure compliance with factory specifications after replacing any faulty components.

Those who do undertake any of the following alignments are cautioned to proceed at their own risk. Problems caused by unauthorized attempts at realignment are not covered by the warranty policy. Also, Yaesu reserves the right to change circuits and alignment procedures in the interest of improved performance, without notifying owners.

Under no circumstances should any alignment be attempted unless the normal function and operation of the transceiver are clearly understood, the cause of the malfunction has been clearly pinpointed and any faulty components replaced, and realignment determined to be absolutely necessary.

The following test equipment (and thorough familiarity with its correct use) is necessary for complete realignment. Correction of problems caused by misalignment resulting from use of improper test equipment is not covered under the warranty policy. While most steps do not require all of the equipment listed, the interactions of some adjustments may require that more complex adjustments be performed afterwards.

Do not attempt to perform only a single step unless it is clearly isolated electrically from all other steps. Have all test equipment ready before beginning, and follow all of the steps in a section in the order presented.

Required Test Equipment

- ❐ RF Signal Generator with calibrated output level at 200MHz
- ❐ Deviation Meter (linear detector)
- ❐ In-line Wattmeter with 5% accuracy at 200MHz
- ❐ 50-Ω RF Dummy Load with power rating 10W at 200MHz
- ❐ Regulated DC Power Supply (standard 7.5V DC, 3A)
- ❐ Frequency Counter with 0.2ppm accuracy at 200MHz
- ❐ AC Voltmeter
- ❐ DC Voltmeter
- ❐ VHF Sampling Coupler
- ❐ IBM PC / compatible Computer with Microsoft DOS v3.0 or later operating system
- ❐ Yaesu CT-42 Connection Cable & Alignment program

Alignment Preparation & Precautions

A 50-Ω RF Dummy Load and in-line wattmeter must be connected to the main antenna jack in all procedures that call for transmission, except where specified otherwise. Correct alignment is not possible with an antenna.

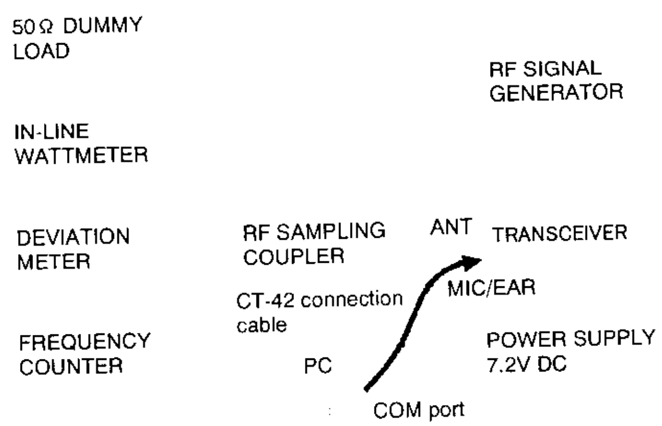
After completing one step, read the following step to determine whether the same test equipment will be required. If not, remove the test equipment (except dummy load and wattmeter, in connected) before proceeding.

Correct alignment requires that the ambient temperature be the same as that of the transceiver and test equipment, and that this temperature be held constant between 20 and 30°C (68 ~ 86 °F). When the transceiver is brought into the shop from hot or cold air, it should be allowed time to come to room temperature before alignment.

Whenever possible, alignments should be made with oscillator shields and circuit boards firmly affixed in place.
Also, the test equipment must be thoroughly warmed up before beginning.

Note: *Signal levels in dB referred to in the alignment procedure are based on 0dBμ EMF = 1μV.*

Setup the test equipment as shown for transceiver alignment, apply 7.5V DC power to the transceiver. Refer to the drawings above for Alignment Points.



The transceiver must be programmed for use in the intended system before alignment is attempted. The RF parameters are loaded from the file during the alignment process.

In order to facilitate alignment over the complete switching range of the equipment it is recommended that the channel data in the transceiver is preset as the chart below.

Channels	Frequency (Simplex)	
	Ver. A	Ver. C
LOW	134.000	146.000
MID	147.000	160.000
HIGH	160.000	174.000

The alignment mode is accessed by “Alignment mode” command from the computer whilst switching on. And it is operated by the alignment tool automatically.

During the alignment mode, normal operation is suspended. Use the alignment tool program running on PC.

Alignment of PLL Reference Frequency

Set up the test equipment as shown above for transmitter alignment. Hold the supply voltage constant 7.5V for all steps.
Select the MID channel and key the transmitter. Adjust TC1001 on the back of the body, if necessary, so the counter frequency is within 100Hz of the channel center frequency for the transceiver version. Also verify that the HIGH and LOW channels are also within tolerance.

Back of the body

This is the trimmer TC1001

The alignment tool outline

Installation the tool

This alignment tool consists, MS-DOS based, only one execute file " align400.exe " . You make a directly as you think fit, and copy this file. That is all of the installation process.

Boot the tool

Change directly and input in command line, " align400 [enter] ", and boot the alignment tool.

Enter to the alignment mode

To enter the alignment mode, turn off the power of the transceiver, and press [F10] to start a countdown 10 sec. You have to power on the transceiver while countdown. If entry succeed, the transceiver generate a beep " p-p-p ".

Action of the switches

When the transceiver is in alignment mode, the action of PTT, MON. Dial is ignored. All of the action is remote controlled by PC.

Basic sequence

The data displayed in screen of this tool is temporary data, and there is fear that the consistence of the displayed data and the data in the transceiver is failure when you do not keep the sequence which is specified below.

basic sequence

1. Enter the alignment mode
2. Data upload
3. Align data
4. Data download

When finish the alignment one parameter, the tool ask you " Update this data? ". If you select "Y", the temporary data is updated.
Next it ask you " Download this result to transceiver? ". If you select "Y", the tool download data to the transceiver.

Menu of the tool

[1] *Fundamentals*

In this section, the parameters are in common with all the channels. " Tx high power ", " max dev. " and " sub audio dev. " can be trimmed at each channel. Each parameter changed up/down by [ ]/[ ], and fixed by input [R] at appropriate value.

Tx :

[T] Tx power

- [0] High

This parameter is to align Tx High power (5W). Select the highest frequency channel in alignment range, and If you input [0], start Tx.

- [1] L1

Align the L1 power (100mW) similar method to " High ".

- [2] L2

Align the L1 power (1W) similar method to " High ".

- [3] L3

Align the L1 power (2.5W) similar method to " High ".

[D] maximum dev.

- [S] Start alignment

This parameter is to align the maximum deviation. Select the middle frequency channel in alignment range, and If you input [s], start Tx and 1kHz modulation.

[C] sub audio dev.

- [S] Start alignment

This parameter is to align the sub audio deviation. Select the middle frequency in alignment range and enabled sub audio signalling channel, and If you input [s], start Tx and sub audio modulation.

Rx :

[U] auto tuning

This parameter is to tune all channels. The tune of the VX-400 RF circuit is depend on its firmware, and execute this alignment, all channel is tuned appropriately.

Set the SG output level to +30dBμ EMF (32μV), and obey the message. The channels must be set to Low, Middle and High each other before execute this alignment.

[N] NSQL

This data is sampled noise level for Noise Squelch.

- [Z] Tight

This parameter is to align the noise level in squelch level 12 (channel parameter).

Set the SG output level to -3dBμ EMF (0.35μV), and obey the message.

- [X] Threshold

This parameter is to align the noise level in squelch level 1.

Set the SG output level to -12dBμ EMF (0.125μV), and obey the message.

[I] RSSI

- [Z] RSSI SQL

This parameter is the RSSI level for RSSI squelch.

Set the SG output level to +3dBμ EMF (0.7μV), and obey the message.

- [X] Tx save

This parameter is the RSSI level for Tx save activity.

Set the SG output level to +15dBμ EMF (2.8μV), and obey the message.

[V] BATT

This parameter is battery level for battery warning (6V) and protect the backup memory (5.5V).

[2] *Channels*

The following parameters are set every channel.

<u>**Tx trim :**</u>

[T] Tx power High

This parameter is to trim Tx High power in displayed channel.

[X] max dev.

This parameter is to trim maximum deviation in displayed channel.

[C] sub audio dev.

This parameter is to trim sub audio deviation in displayed channel.

Rx :

[U] manual tuning

This parameter is to tune displayed channel by manual.

[S] squelch level

This parameter is to set the squelch level. This is equivalent to a squelch volume of the popular transceiver.

Other :

[F] Tx/Rx frequency

This parameter is to set the Tx/Rx frequency.

[A] reboot transceiver

This parameter is to reset and start the transceiver.

VX-400V Circuit Description

1. Receive Signal Path

Incoming RF from the antenna jack is delivered to the RF Unit and passes through a low-pass filter and high-pass filter consisting of coils L1001, L1002, L1003, L1005, L1006 & L1007, capacitors C1006, C1007, C1014, C1022, C1027, C1036, C1054, C1058, C1060 & C1064 and antenna switching diode D1007 (RLS135).

Signals within the frequency range of the transceiver are then amplified by Q1024 (2SC5226-4/5) and enter a varactor-tuned band-pass filter consisting of coils L1010, L1013 & L1015, capacitors C1091, C1104, C1107, C1109, C1112, C1115, C1122, C1123, C1124, C1128, C1133 & C1136 and diodes D1023, D1024 & D1026 (all HVU350) before first mixing by Q1036 (SGM2016).

Buffered output from the VCO is amplified by Q1032 (2SC52264/5) to provide a pure first local signal between 112.3 and 152.3 MHz for injection to the first mixer Q1036 (SGM2016). The 21.7 MHz first mixer product then passes through monolithic crystal filters XF1001, XF1002 (21M12B3, 7.5 kHz BW) to strip away all but the desired signal, which is then amplified by Q1043 (2SC4215Y).

The amplified first IF signal is applied to FM IF subsystem IC Q1040 (TA31136FN), which contains the second mixer, second local oscillator, limiter amplifier, noise amplifier, and S-meter amplifier.

A second local signal is generated by PLL reference / second local oscillator Q1022 (2SC2620QB) from 21.25 MHz crystal X1001 to produce the 450 kHz second IF when mixed with the first IF signal within Q1040.

The second IF then passes through the ceramic filter CF1001 (SFPC450E) ,CF1002 (CFWM450G: only Narrow Channel) to strip away unwanted mixer products, and is applied to the limiter amplifier in Q1040, which removes amplitude variations in the 450kHz IF, before detection of the speech by the ceramic discriminator CD1001(CDBC450CX24).

Detected audio from Q1040 is applied to Q1047 (AK2341) and audio low-pass filter, and then past the volume control to the audio amplifier Q1011 (TDA7233D), providing up to 0.5 Watts to the optional headphone jack or 4-Ω loudspeaker.

2. Squelch Control

The squelch circuitry consists of a noise amplifier & band-pass filter within Q1040, and noise detector D1035 (DA221).

When no carrier received, noise at the output of the detector stage in Q1040 is amplified and band-pass filtered by the noise amplifier section of Q1040 and the network between pins 7 and 8, and then rectified by D1035.

The resulting DC squelch control voltage is passed to pin 75 of the microprocessor Q1033. If no carrier is received, this signal causes pin 15 of Q1033 to go low and pin 32 to go high. Pin 15 signals Q1012 (IMD10A) and Q1015 (UMD2N) to disable the supply voltage to the audio amplifier Q1011, while pin 32 makes Q1021 (UMA2N) hold the green (Busy) half of the LED off, when pin 15 is low and pin 32 is high.

Thus, the microprocessor blocks output from the audio amplifier, and silences the receiver while no signal is being received, and during transmission.

When a carrier appears at the discriminator, noise is removed from the output, causing pin 75 of Q1033 to go low and the microprocessor to blink the busy LED via Q1033.

The microprocessor then checks the DTMF decoder chip on the Optional Unit, the CTCSS and the CDCSS code for DTMF or CTCSS or CDCSS code squelch information, if enabled, respectively. If not transmitting and CTCSS or CDCSS is not activated, or if the received tone or code matches that programmed, the microprocessor stops scanning, if active, and allows audio to pass through the audio amplifier Q1011 (TDA7233D) to the loudspeaker by enabling the supply voltage to it via Q1012 and Q1015.

3. Transmit Signal Path

Speech input from the microphone is amplified in Q1009 (NJM2902V) after there is a filter and is sent to Optional Unit. The audio which returned from Optional Unit passes Q1009 (NJM2902V) to be pre-emphasized.

The processed audio is then mixed with a CTCSS tone generated by Q1047 (AK2341) and delivered to D1027 (1SS314) for frequency modulating the PLL carrier up to ± 5kHz from the unmodulated carrier at the transmitting frequency.

If an external microphone is used, PTT switching is controlled by Q1001 (UMZ2N), which signals the microprocessor when the impedance at the microphone jack drops.

If a CDCSS code is enabled for transmission, the code is generated by microprocessor Q1033 and delivered to D1016 (HVU202A) for CDCSS modulating.

If DTMF is enabled for transmission, the tone is generated by the microprocessor Q1033 and applied to the splutter filter section in place of speech audio. Also, the tone is amplified for monitoring in the loudspeaker.

The modulated signal from the VCO Q1038 (2SC2531C8/C9) is buffered by Q1039 (2SC2531C8/C9) and amplified by Q1032 (2SC5226-4/5). The low-level transmit signal is then applied to the PA module Q1007 for final amplification up to 5 watts output power.

The transmit signal then passes through the antenna switch D1007 (RLS135) and is low-pass filtered to suppress away harmonic spurious radiation before delivery to the antenna.

3-1 Automatic Transmit Power Control

RF power output from the final amplifier is sampled by C1018, C1025 and is rectified by D1010 (1SS321). The resulting DC is fed back through Q1018 (NJM2904V) to the PA module, and thus the power output.

The microprocessor selects either high or one of three low power levels.

3-2 Transmit Inhibit

When the transmit PLL is unlocked, pin 2 of PLL chip Q1025 goes to a logic low. The resulting DC unlock control voltage is passed to pin 78 of the microprocessor Q1033. While the transmit PLL is unlocked, pin 54 of Q1033 remains low, which then turns off the Automatic Power Controller Q1008 and Q1018 (UMC5N,NJM2904V) to disable the supply voltage to the PA module Q1007, disabling the transmitter.

3-3 Spurious Suppression

Generation of spurious products by the transmitter is minimized by the fundamental carrier frequency being equal to final transmitting frequency, modulated directly in the transmit VCO. Additional harmonic suppression is provided by a low-pass filter consisting of L1001, L1002 & L1003 and C1006, C1007, C1014, C1022, C1027 & C1036, resulting in more than 60 dB of harmonic suppression prior to delivery to the antenna.

4. PLL Frequency Synthesizer

PLL circuitry on the Main Unit consists of VCO Q1038 (2SC2531C8/C9) and VCO buffers Q1039 (2SC2531C8/C9), Q1034 (2SC4245) ; PLL subsystem IC Q1025 (MC145192DT), which contains a reference divider, serial-to-parallel data latch, programmable divider, phase comparator, charge pump, and a power saver circuit.

Stability is maintained by a regulated 3 V supply via Q1023 (2SB1132Q) to Q1022, temperature compensating thermistor and capacitors associated with the 21.25 MHz frequency reference crystal X1001.

While receiving, VCO Q1038 oscillates between 112.3 and 152.3 MHz according to the transceiver version and the programmed receiving frequency. The VCO output is buffered by Q1039, Q1034 and applied to the prescaler section of Q1025. There the VCO signal is divided by 64 or 65, according to a control signal from the data latch section of Q1025, before being applied to the programmable divider section of Q1025.

The data latch section of Q1025 also receivers serial dividing data from the microprocessor Q1033, which causes the pre-divided VCO signal to be further divided in the programmable divider section, depending upon the desired receive frequency, so as to produce a 5 kHz or 6.25 kHz derivative of the current VCO frequency.

Meanwhile, the reference divider section of Q1025 dividers the 21.25 MHz crystal reference from the reference oscillator Q1022, by 4250 (or 3400) to produce the 5 kHz (or 6.25 kHz) loop reference (respectively).

The 5 kHz (or 6.25 kHz) signal from the programmable divider (derived from the VCO) and that derived from the reference oscillator are applied to the phase detector section of Q1025, which produces a pulsed output with pulse duration depending on the phase difference between the input signals.

This pulse train is filtered to DC and returned to the varactor D1028 (HVU350). Changes in the level of the DC voltage applied to the varactor, affect the reference in the tank circuit of the VCO according to the phase difference between the signals derived from the VCO and the crystal reference oscillator.

The VCO is thus phase-locked to the crystal reference oscillator. The output of the VCO Q1038, after buffering by Q1039 and amplification by Q1032, is applied to the first mixer as described previously.

For transmission, the VCO Q1038 oscillates between 134 and 174 MHz according to the model version and programmed transmit frequency. The remainder of the PLL circuitry is shared with the receiver. However, the dividing data from the microprocessor is such that the VCO frequency is at the actual transmit frequency (rather than offset for IFs, as in the receiving case). Also, the VCO is modulated by the speech audio applied to D1027 (1SS314), as described previously.

Receive and transmit buses select which VCO is made active by Q1031 (DTC144EE). When the power saving feature is active, the microprocessor periodically signals the PLL IC to conserve power and shortens lock-up time.

5. Miscellaneous Circuits

5-1 Push-To-Talk Transmit Activation

The PTT switch on the microphone is connected to pin 3 of microprocessor Q1033, so that when the PTT switch is closed, pin 54 of Q1033 goes high. This signals the microprocessor to activate the TX / RX controller Q1005 (UMG2N), which then disables the receiver by disabling the 5 V supply bus at Q1050 (DTA143EU) to the front-end, FM IF subsystem IC Q1040 and receiver VCO circuitry.

At the same time, Q1002 (XP1501), Q1003 (2SB1132Q) activates the transmit 5V supply line to enable the transmitter.