DATE 8/18/61 SHEET 1 OF 18	TMC SPECIFICATION NO. S -608	A
TF COMPILED / 16 CHECKED	TITLE: FFR-3S TEST PROCEDURE	
APPROVED		

MODEL FFR-3S

TEST PROCEDURE

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 439M

DATE 9/18/61 SHEET 2 OF 18	TMC SPECIFICATION NO. S-608	A
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I. Purpose:

To provide the procedure for aligning and testing the Model FFR so as to obtain the best possible performance for a communication receiver.

II. Test Equipment Required:

A. Standard Signal Generator, Measurements Model 82 or 65-B.
B. Distortion Analyzer, Barker & Williamson.
C. VTVM (audio type), Daven 170 or Heathkit AV2.
D. VTVM (dc type), RCA Voltohmyst or Heathkit V6.
E. Electronic Counter H.P. model 524C or Berkeley model 7160.
F. 455 Kc crystal
G. 600 ohm 5 watt resistor
H. Variable DC voltage source, 0 to $\pm 4\frac{1}{2}$ volts.
I. Headset
J. 15,000 ohm resistor, 10 watt
K. 2,500 ohm 75 watt resistor
L. Line cord with insulated alligator clips at one end.

III. Procedure, FFR Main Chassis.

A. Preassembly Test

1. Power Supply: DANGER HIGH VOLTAGE

Insert tubes, 5Y3 GT and 0A2 into V-108 and V-109 sockets. Place power unit upside down on a nonconducting work bench. Short out the two white leads and insulate from chassis. (Locate these leads coming out of grommet hole behind power transformer.) Check that all exposed ends of cable leads are not shorting with each other.

2. Test A-Resistance Test.

Using V.T. Ohmeter check resistances at following points and compare with nominal values.

	TEST POINT	NOMINAL VALUE
a.	transformer primary, white & grey leads near rectifier tube V-108.	2 ohms
b.	R-149 between chassis & terminal 12 of transformer.	540 to 660 ohms
c.	junction of L-101 and C-150 to gnd.	70,000 ohms
d.	pin no. 1 of V-107 to gnd.	70,000 ohms

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3. Test B- DC and AC Voltages

Connect the line cord clips to the white & grey transformer primary leads near Rectifier socket V-108, and pull rubber insulation over connection to prevent possible short. Next connect 15,000 ohm resistor between pin 1 of V-109 to gnd and the 2,500 ohm 75 Watt resistor from junction of L-101 and R-128 (6,000 ohms) to gnd. These two resistors will provide sufficient load to simulate receiver loading.

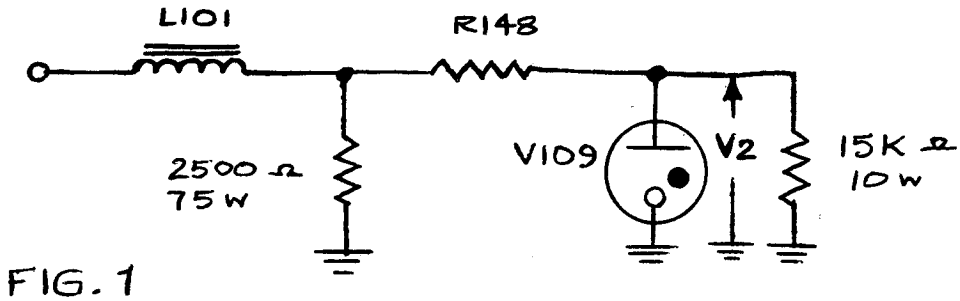

FIG. 1

Plug line cord into power socket and measure DC & AC voltages at following test points.

Test B- DC Voltages

Test Point	Nominal Value
1. Junction of L101 & R148 to ground	+225 to 240 Volts
2. Pin 1 or 7 of V109 to ground	+150 Volts
3. across R149 or terminal 12 of power transformer,	-50 to -65 Volts
4. 4 brown leads in cable to gnd	+6.3 to +6.8 V for each lead to gnd.

Test B- AC Voltages

5. filament voltage across short pair brown leads,	6.1 to 6.5 V. RMS
6. filament voltage across long pair brown leads,	6.1 to 6.5 V. RMS
7. pin no 4 of V-108 to gnd,	360 to 380 V. RMS
8. pin no 6 of V-108 to gnd,	360 to 380 V. RMS

B. Post assembly Test

1. Set controls as follows:

Audio Gain----------fully clockwise
AVC Manual Switch----------AVC
Noise Limiter Switch----------On
BFO Switch----------On
BFO Slave Master Switch--------BFO
Squelch Adjust----------fully clockwise
Line cord disconnected

2. AVC line check. On terminal board E-101 with terminals 7 and 8 shorted, measure resistance from 7 to ground. Compare with following approximate values:

R.F. Gain counterclockwise Resistance 600 ohms
A.V.C. Switch in AVC position, Resistance 1.4 meg.

3. Resistance check (USE CH-208)
4. Voltage check:
   (a). Connect line cord
   (b). Measure filament voltage:
   A.C.-6.1 to 6.5 V.R.M.S. across filaments
   D.C.+6.3 to +6.8 V.D.C. from each filament to ground.
   (c). Measure B+ voltages.

(USE CH-209 ALSO)

Tube Sockets	Socket Pin Numbers				
	1	2	5	6	9
V-100			215	70	
V-101			215	70	
V-102			215	70	
V-104					125
V-105		16	250	250	
V-106	50	50			
V-107			150		

Multiple Connection Socket (J-107)

Pin	Volt
1	+270 V.D.C.
4	+150 V.D.C.
2	+6.3 V.D.C.
5	+6.3 V.D.C.
2-5	6.3 V.A.C.

C. I.F. Alignment

1. Alignment of the I.F. channel requires an accurate 455 Kc. signal source. Plug the 455 Kc. crystal in the BFO circuit (Y-100 on the schematic) and set the BFO Master-Slave switch to the Xtal position. Connect the equipment as follows:
   (a). Connect 600 ohm load across Audio Output Terminals;
   (b). Plug headset into phones jack;
   (c). Connect the AC- VTVM across Detector terminal and ground at rear of receiver;
   (d). Connect the standard signal generator to pin A2 of Multiple Connection Socket.

2. Set Receiver Controls:
   (a). R.F. Gain fully on;
   (b). Noise Limiter Switch Off
   (c). Audio Gain fully on;
   (d). B.F.O. Switch Off.
   (e). Squelch Adjust fully clockwise

3. Set signal generator to 455 Kc. modulated with 1000 cycles at 30% and inject enough voltage into receiver to produce audible signal.

4. Tune I.F. transformers T101, T102, T103 for maximum output.

5. Turn B.F.O. switch to ON.

6. Remove modulation from 455 Kc. output of signal generator.

7. Tune signal generator until zero beat is obtained in FFR and leave generator frequency set.

8. Turn B.F.O. Switch to OFF position.

9. Re-establish 1000 cycle 30% modulation of signal generator.

10. Retune I.F. transformers for maximum meter deflection. Keep generator input low so as to produce 1 volt. A.C. on meter.

11. Adjust C-100 so a signal of 115 microvolts produces 1 volt A.C. on meter.

D. Audio Amplifier

1. With Audio Gain set to Maximum measure voltage across 600 ohm load with AC - VTVM.

2. It should be above 36.4 volts or 2 watts.

3. Check operation of Audio Gain control observing change of output.

NOTE: Input for 2 watts output approximately 1.4 Volts across det. load.

4. Distortion check:

   (a). Connect distortion meter across 600 ohm output resistor;
   (b). With 2 watts output of FFR the distortion should be less than 10%.

5. Hum level with R.F. Gain counterclockwise and audio gain at maximum read AC - VTVM across 600 ohms. Voltage should be lower than .016V R.M.S. or 34 db below 0 dbm.

E. Squelch

1. Set Receiver Controls:
   AVC switch ON
   BFO switch OFF
   Noise limiter OFF
   RF Gain control Maximum
   AF Gain control As detailed in paragraph 3 (b) following

2. DC Check

With receiver "ON", RF Gain at maximum, V110 and V104 removed, measure voltages between points specified below and ground using the vacuum tube voltmeter.

(a). pin 1, V110 voltage to be 11.5 V DC ±20%
(b). pin 1, V104 voltage to be 11.5 V DC ±20%
(c). pin 7, V104 voltage to be 6.0 V DC ±20%

Insert V104 in socket and recheck voltages at
(d). pin 1, V104 voltage to be 7.5 V DC ±20%
(e). pin 7, V104 voltage to be 8.2 V DC ±20%

NOTE

Under no circumstance should voltage in (d). be more positive than that in (e).

(f). Junction of R155, R156 } negative voltage to be not less than -27 V DC

3. (a). Set signal generator to suitable frequency, output level to 6 UV modulated 30% at 1000 cps. (Allowance is to be made for the 6 db pad.)
   (b). Turn squelch control fully counter clockwise and tune receiver. Adjust audio gain control to give 1.8 watts output (+52.6 dbm)
   (c). Turn squelch control until AF audio output falls not more than 1 db.
   (d). Set signal generator to output level 3 db lower than in (a). above.
   (e). Audio output to be not more than -30 dbm. Record this value in Test Sheet.

4. Reset Squelch Adjust control fully clockwise and leave there for remainder of test.

F. B.F.O.

1. Turn B.F.O. switch ON;
2. Zero beat generator against 455 Kc. crystal in FFR;
3. Switch B.F.O. SLAVE-MASTER switch to B.F.O. position.
4. Set B.F.O. pitch control to zero position, capacitor C137 plates in mid-position.
5. Tune B.F.O. coil L103 to obtain zero beat.
6. Tune B.F.O. pitch control for balance.
7. Measure B.F.O. pitch with audio frequency meter connected across 600 ohms output load.
8. Pitch should vary ±2 Kc. or greater.

G. B.F.O. Reactance

1. Connect an Audio frequency counter across 600 ohms output resistor.
2. Connect to pins 7 and 8 of E102 a D.C. voltage source which is variable from zero to ±4.5 volts.
3. Leave B.F.O. control voltage set to zero.
4. Tune signal generator to obtain zero beat.
5. Set D.C. control voltage to +4.5 V. and observe reading on counter.
6. Set D.C. control voltage to -4.5 V. and observe reading on counter.
7. Adjust Reactance tube balance control R136 to obtain balanced frequency shifts.

H. B.F.O. Output

1. Using RF - VTVM measure R.F. voltage from B.F.O. output jack (J104) on rear of receiver.
   (Should be approximately ½ volt)

I. Noise Limiter

1. Operation of Noise Limiter switch should reduce pulse noises.

J. A.V.C.

1. Plate DC-VTVM on A.V.C. terminal of E101 pin No. 4.
2. Place A.V.C.-MANUAL switch to A.V.C.
3. Increase signal generator output and look for a negative deflection of VTVM.

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K. R.F. Gain

1. Operation of R.F. gain control should reduce the output of the receiver with the A.V.C. switch on or off.

L. Fill out FFR Test Sheet.

IV. R.F. Tuning Drawers.

A. Prealignment Check.

1. Insert tuning drawer in FFR receiver chassis and turn power ON.

2. Measure voltages at following points:
(a). Using AC-VTVM measure all filament voltages at tube socket pins. Should be 6.1-6.5 V.R.M.S.
(b). Using DC-VTVM measure voltage from filament to ground. Should be +6.3 to +6.8 V. DC.
(c). Measure DC plate and screen voltages to ground.

Drawers 5, 6, 7, 8.

TUBE	PIN No.	APPROX. DC VOLTAGE
V(5)00	5	+150
	6	+ 60
V(5)01	5	+150
	6	+ 60
V(5)02	5	+112
	6	+112
V(5)03	5	+ 95
	6	+125
V(5)04	5	+ 60
	6	+ 90

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Drawers 1, 2, 3.

TUBE	PIN No.	APPROX. DC VOLTAGE
V(1)00	5	+130
	6	+ 50
V(1)01	5	+130
	6	+ 50
V(1)02	5	+240
	6	+240
V(1)03	5	+100
	6	+130
V(1)04	5	+ 85
	6	+ 75

B. Align I.F. Transformer

1. Connect signal generator to J101 HFO IN jack on rear chassis.

2. Place H.F.O. MASTER-SLAVE switch in EXT. position.

3. Tune signal generator to 455 Kcs. and align the I.F. transformer in tuning drawer according to section IIIC-I.F. Alignment, neglecting Part 11.

C. Align Crystal Filter Tuning Drawer 1, 2, 3.

1. Equipment required:

   a. Sweep signal generator
   b. Oscilloscope

2. Equipment Set-Up:- :

   a. Connect scope Vertical plate input to FFR Detector terminals.
   b. Connect sweep generator sweep output to scope Horizontal plates.
   c. Connect sweep R.F. output to mixer Grid, pin 1 of V(1)02.

3. Receiver Controls.

   a. R.F. Gain fully ON
   b. Noise Limiter Switch OFF
   c. Audio Gain- as desired
   d. B.F.O. Switch OFF
   e. Master-Slave Switch on tuning drawer to EXT.
   f. Bandwith control to normal

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4. Alignment.

   a. Set scope horizontal gain fully clockwise with amplifier switch in 1st. amplifier position.
   b. Set Sweep Generator Deviation control to give two or three inch scope trace width.
   c. Center sweep generator frequency on 455 Kc.
   d. Set sweep generator output voltage to give a vertical trace of approximately four inches with scope amplifier in its most sensitive position. Adjust sweep output to prevent receiver overload.
   e. Tune primary and secondary of T(1)03, top and bottom slugs, for an increase of 455 Kc. peak display.
   f. Set Bandwidth control to 1.3 Kc. position.
   g. Tune slug of L(1)01, filter output tank, for a maximum peak. Retune primary and secondary slugs of T(1)03.
   h. Adjust C(1)23 for symmetrical wave form. Approximate setting is at mid position. As this trimmer is varied from maximum to minimum capacity using an insulated screw driver, a notch should appear first on one side slope, disappear and appear on the other side. If the peak increases or decreases with no apparent notch, the tuned circuits are not on the crystal frequency. Repeaking of T(1)03 and L(1)01 is necessary.
   i. As the Bandwidth Control is reset to its other positions the peak should become narrower with a decrease in amplitude.
   j. Check Bandwidths using standard signal generator method.

D. Equipment Set-Up

1. Connect appropriate dummy antenna to FFR to match signal generator to receiver.

2. Receiver set-up

   a. B.F.O. switch to OFF.
   b. A.V.C. switch to manual.
   c. R.F. Gain fully on
   d. Audio Gain as desired.
   e. Noise limiter OFF.
   f. HFO-MASTER-SLAVE switch to H.F.O.

E. H.F.O. Oscillator

1. Tune signal generator and FFR tuning dial to high frequency end of band. Check R.F. and H.F.O. Alignment Chart (Fig. 2) for correct alignment frequency.

2. Adjust H.F.O. trimmer for correct signal. Check for proper placement of image which should be found by tuning signal generator 910 Kc. above receiver frequency.

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3. At low frequency band in use, adjust H.F.O. coil tuning slug.

4. Check for proper placement of image.

5. Again recheck oscillator at high end.

F. R.F. Alignment

1. With receiver dial tuned to high end of band adjust the three R.F. coil trimmer capacitors for maximum signal on output meter. As each tank is tuned reduce signal voltage to keep output below 1 volt.

NOTE: When tuning mixer, two peaks may be obtained. Correct peaks found at maximum trimmer capacity setting.

2. Tune receiver and generator to low end and tune the three R.F. coil tuning slugs for maximum output.

3. Retune both ends, adjusting also the R.F. oscillator, as the tuning of the mixer section may introduce some pulling on the oscillator frequency.

G. I.F. Rejection

1. With receiver tuned to high end of band, check receiver for sensitivity at 455 Kc. Rejection should be 60 db. or better. Band 3 tuning drawer (200-400 Kc) must be checked at 400 Kc. with the bottom COVER in place. If rejection is under 60 db. the antenna filter choke coils can be moved closer or further away from the chassis to tune filter.

H. Signal to Noise Ratio.

1. With no signal, measure the noise voltage developed across the detector load.

2. Multiply this voltage by 3.16.

3. Tune in a signal and adjust the signal level to obtain an output equal to 3.16 times the noise voltage. The strength of signal is the sensitivity to produce a 10 db signal to noise power ratio.

4. Enter this figure on the tuning drawer test sheet.

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I. Sensitivity.

1. At 3 points on the band, check the signal strength required to produce 1 volt A.C. at the Detector. This is the sensitivity of the receiver.

2. Enter this figure on the tuning drawer test sheet.

J. Image Ratio.

1. Tune the generator to the image frequency and note the sensitivity to produce 1 volt at the Detector.

2. Divide this image sensitivity by the basic sensitivity to obtain the image ratio.

3. Enter this ratio on the test sheet.

K. Reactance Tube Shift.

1. Connect a variable D.C. voltage source ±4.5 volts to pin 1 and 2 of E102 terminal board on rear of Receiver.

2. Use the TMC VOX or other accurate signal generator as signal source where small changes in frequency can be read.

3. Turn B.F.O. ON

4. Set H.F.O. reactance control voltage to zero.

5. Tune signal generator and FFR to midband test frequency.

6. Tune for zero beat.

7. Set H.F.O. control voltage to +4.5 V.

8. Retune signal generator to obtain zero beat and note frequency shift.

9. Set H.F.O. Control voltage to -4.5 V.

10. Retune signal generator to obtain zero beat and note frequency shift.

11. Compare total shift obtained with Fig. 3. If inadequate, adjust H.F.O. reactance tube balance located in tuning drawer.

12. Check H.F.O. shift at both ends of band and adjust as required.

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13. Enter shift obtained in test sheet.

14. Retune Oscillator at both ends of band with reactance voltage zero.

L. H.F.O. Output.

1. With a R.F.-VTVM measure the voltage available at the H.F.O. output jack on the rear of the FFR-3S chassis.

2. Enter this data on the test sheet.

3. Turn H.F.O. MASTER-SLAVE switch to Xtal position.

4. Place appropriate crystal in socket on front of tuning drawer.

5. Note output voltage on H.F.O. jack.

M. A.V.C. Check

1. Turn A.V.C. manual switch to A.V.C.

2. With receiver tuned to signal generator increase signal level.

3. Place DC-VTVM on grid of R.F. tube and note bias change.

N. A test sheet is to be filled out for each tuning drawer and signed by the tester.

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ALIGNMENT CHART

FIG. 2

BAND	OSC.	MIX.	R.F.	ANT.
1	50 Kc 100 Kc	50 Kc 100 Kc	50 Kc 100 Kc	50 Kc 100 Kc
2	100 Kc 200 Kc	100 Kc 200 Kc	100 Kc 200 Kc	100 Kc 200 Kc
3	200 Kc 400 Kc	200 Kc 400 Kc	200 Kc 400 Kc	200 Kc 400 Kc
3M	485 Kc 515 Kc	485 Kc 515 Kc	485 Kc 515 Kc	485 Kc 515 Kc
5	2.0 Mc 4.0 Mc	2.1 Mc 4.0 Mc	2.1 Mc 4.0 Mc	2.1 Mc 4.0 Mc
6	4.0 Mc 8.0 Mc	4.25 Mc 8.0 Mc	4.25 Mc 8.0 Mc	4.25 Mc 8.0 Mc
7	8.0 Mc 16.0 Mc	8.5 Mc 16.0 Mc	8.5 Mc 16.0 Mc	8.5 Mc 16.0 Mc
8	16.0 Mc 31.0 Mc	16.0 Mc 31.0 Mc	16.0 Mc 31.0 Mc	16.0 Mc 31.0 Mc

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TMC SPECIFICATION NO. S-608

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FIG. 3
H.F.O. REACTANCE TUBE SHIFT

BAND	TOTAL FREQ. SHIFT/Mc.	FREQ.	TOTAL SHIFT
1	Min shift of 4 Kc throughout the band	50 Kc 75 Kc 100 Kc	4.0 Kc 4.0 Kc 4.0 Kc
2	Min shift of 4 Kc throughout the band	100 Kc 150 Kc 200 Kc	4.0 Kc 4.0 Kc 4.0 Kc
3	Min shift of 4 Kc throughout the band	200 Kc 300 Kc 400 Kc	4.0 Kc 4.0 Kc 4.0 Kc
3M	Min shift of 6 Kc throughout the band	485 Kc 515 Kc	6.0 Kc 6.0 Kc
5A	4 Kc/Mc	2 Mc 3 Mc 4 Mc	8 Kc 12 Kc 16 Kc
6A	4 Kc/Mc	4 Mc 6 Mc 8 Mc	16 Kc 24 Kc 32 Kc
7A	3 Kc/Mc	8 Mc 12 Mc 16 Mc	24 Kc 36 Kc 48 Kc
8A	Min shift of 32 Kc throughout the band	16 Mc 24 Mc 31 Mc	32 Kc 32 Kc 32 Kc
7B	Min. shift of 8 Kc through the band.	8 Mc 12 Mc 16 Mc	11.2 Kc 16.7 Kc 22.4 Kc
8B	Min. shift of 8 Kc through the band.	16 Mc 24 Mc 31 Mc	16.Kc 24 Kc 32 Kc

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COMPILED / CHECKED	TITLE: MODEL FFR-3S TEST SHEET	
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SERIAL NO. _____

I.F. SENSITIVITY: INPUT _____ uv.

ADJUST FOR 115 uv _____.

I.F. OUTPUT (J-100) _____.

AUDIO GAIN _____.

AUDIO OUTPUTS: 600 OHMS _____.

8 OHMS _____.

PHONES _____.

HUM LEVEL _____ V.

DISTORTION _____ %

SQUELCH - _____ dbm

B.F.O.: XTAL _____.

VARIABLE _____.

B.F.O. REACTANCE TUBE SHIFT ± 3.5 V. _____ Kcs.

B.F.O. OUTPUT (J104): XTAL _____ V.

VARIABLE _____ V.

B.F.O. INPUT _____.

NOISE LIMITER _____.

A.V.C. _____.

R.F. GAIN _____.

TESTED BY _____

DATE _____

TMC FORM 120A

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DATE 9/18/61 SHEET 18 OF 18	TMC SPECIFICATION NO. S-608	A
COMPILED / CHECKED	TITLE: TUNING DRAWER TEST SHEET	
APPROVED		

MODEL FFRD_____

SERIAL NO._____

	LOW FREQ._____Mcs.	MID FREQ._____Mcs.	HIGH FREQ._____Mcs.
SIGNAL TO NOISE RATIO	uv	uv	uv
IMAGE RATIO			
SENSITIVITY FOR 1v. AC AT DET.	uv	uv	uv
REACTANCE TUBE SHIFT	KC	KC	KC
OSC. OUTPUT (J-102)	V.	V.	V.

XTAL OSC. OUTPUT (J-102)_____VOLTS

HFO INPUT

BY_____

DATE_____

TMC FORM 121

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 439M

REVISION SHEET

THE TECHNICAL MATERIEL CORP.
MAMARONECK NEW YORK

S-608
LIST NO.

DATE	REV.	SHEET	EMN #	DESCRIPTION	APP.
7-11-63	A	7	9596	Revised Sh. 7 per EMN	LG