DATE 6-28-55 SH. 1 OF 14 COMPILED BY KZ	TMC SPECIFICATION NO. S - 261	
	TITLE: PRODUCTION TESTING OF MODEL FSS	JOB 315
APPROVED KZ A.J.J. (Pgs 1 thru 14)		

PRODUCTION TESTING
OF MODEL FSS, FREQUENCY SHIFT
SIMULATOR

INSTRUCTIONS

DATE 6-28-55 SH. 2 OF 14 COMPILED BY KZ	TMC SPECIFICATION NO. S - 261	
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1. Purpose and Description

The Model FSS, Frequency Shift Simulator is a testinstrument designed primarily to permit accurate and expedient testing of frequency shift convertors, fs exciters and of equipment operating on a similar principle. In addition, the instrument permits a number of other testoperations to be carried out, such as, for instance, the oscilloscopic display of the response curve of a variety of types of audio equipment; i.e. amplifiers, bandpass filters, equalizing networks and the like.

The instrument consists basically of two rf oscillators, operating at 1 Mc. One is crystal controlled, the other variable in frequency over a range of about 16 kcps. The audio output is obtained by heterodyning both signals in a mixer stage. In order to obtain the various modes of operation, the VFO is controlled by a reactance tube which in turn receives its modulating voltages from the various control circuits of the instrument. Dep nding upon the position of the KEYING selector switch, this modulating voltage can be a square wave variable in frequency and time base; it can be a steady DC voltage reversible in polarity by application of a keying voltage; it can also be a sawtooth wave or a fax input waveform.

Frontpanel controls permit complete choice and adjustment of the mode of operation; binding posts p rmit accessability on th frontpanel to input- and output points.

The output center frequency can be read directly on a calibrated dial; its calibration can be checked by adjusting the VFO for zero beat at a given reference point on the dial face; a neon indicator shows when this condition is obtained.

2. Testequipment required

(a) Frequency Counter, Berkeley 5500 or 5558

(b) Distortion Meter, Barker Williamson

(c) Oscilloscope, Dumont 304 or 304A

(d) Audio Generator

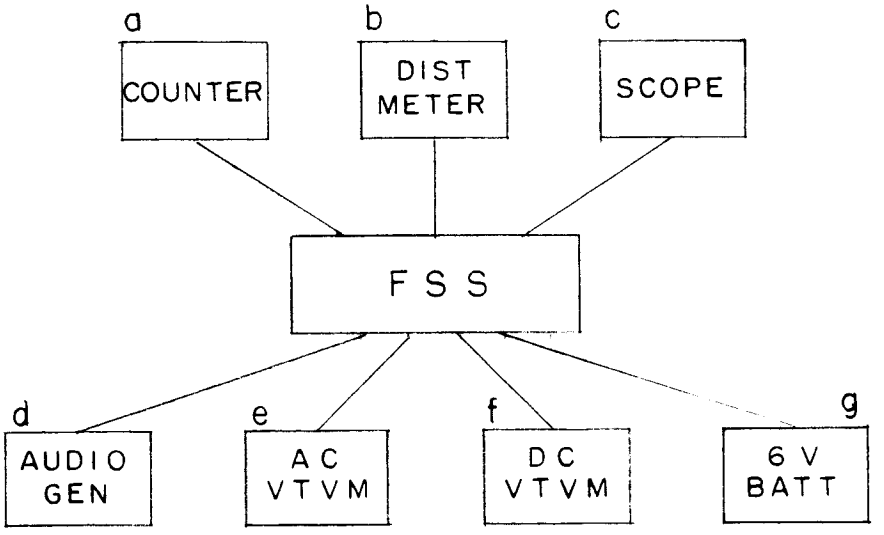
(e) VTVM, AC Type

(f) VTVM, DC Type

(g) 6 V Flashlight battery

(h) Resistor 680 ohms, 1 watt

3. General Instrument Layout



4. Mechanical Inspection and Adjustments

Carefully inspect the instrument for obvious mechanical defects and errors. Check for looseness of mountingscrews. Adjust TUNING dial by loosening the shaft coupling such that the dot-marker on the dial corresponds exactly to full-mesh position of the variable capacitor C 3 a,b. Also check correct alignment of pointer knobs; their degree of travel must accurately correspond to the frontpanel engraving.

5. Initial rapid checks

(a) Set and maintain linevoltage at 110 volts during the entire test. All B+ voltages are to be within ± 10 % of specified values.

(b) Check tube filaments for operation, particularly those of V1 and V2 which are fed by a current regulator. Voltage at pin 9 to ground at V2 has to be within 5.0 - 5.6 volts AC.

(c) Make B+ check at VR tubes; voltages must be - 150 V at pin 7 of V14; + 105 V at pin 5 of V15 and + 150 V at pin 5 of V16.

(d) Make B+ check of the high voltage supply. At pin 1 of V9 must appear 255 V; at pin 6 of V8 must appear 235 V.

(e) During initial operation of the unit observe carefully for obvious defects, shorts, wiring errors, overheating of components etc.

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6. Test Instructions

(a) Proceed as outlined in Testsequence and Procedures (part 7 to follow)

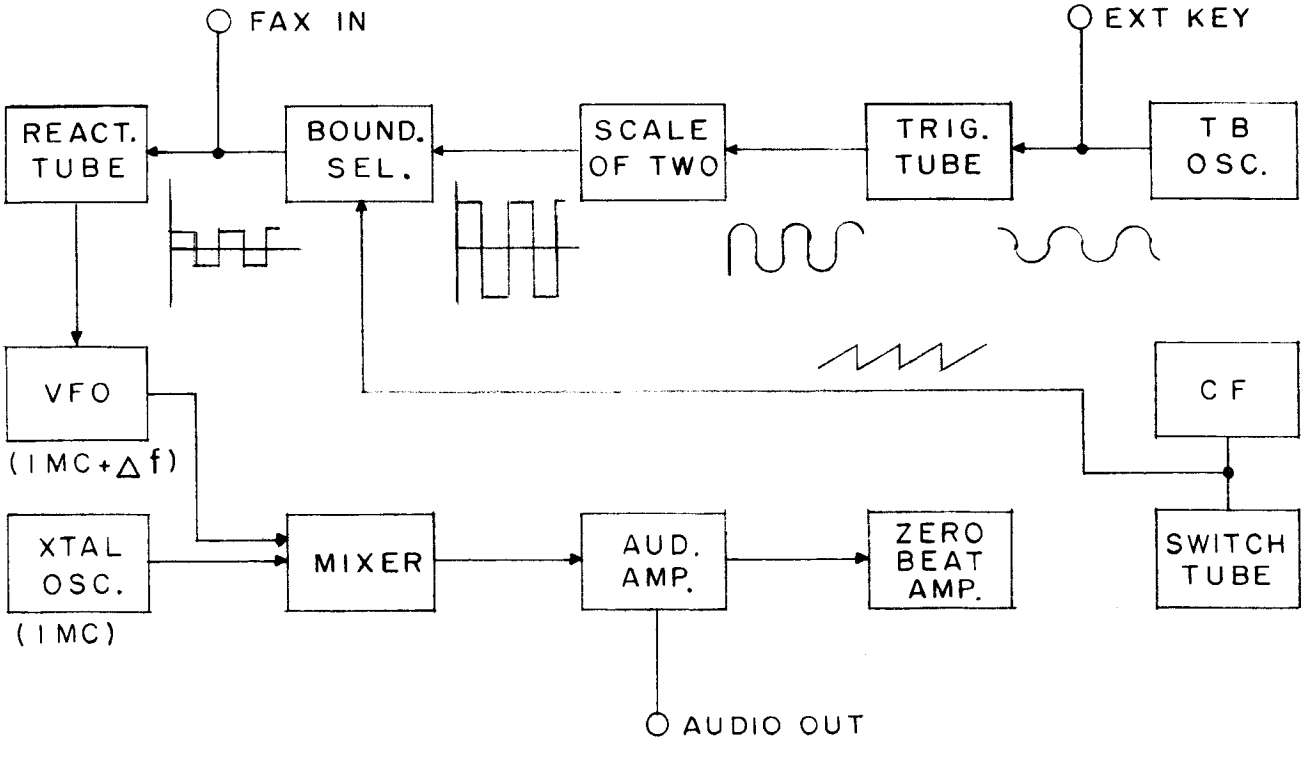
(b) Where testspecifications are not met it should be attempted to locatethe source of trouble before rejecting the unit.

(c) Fill in blanks on TestReport Sheet, rejecting those units that do not meet the specifications stated.

(d) Sign Report Sheet and submit to supervisor.

7. Testsequence and Procedures

NOTES: Testing and alignment should take place in the suggested order; to aid in the understanding of the function of the various control circuits, a block diagram of the Model FSS is shown here.



All voltages to be withing ± 10 %, unless otherwise noted. Tubes V1 and V2 (6J6 and 12AU7) are to be selected for a Gm difference between sections of not more than 10 %; the Gm must furthermore fall withing ± 20 % of manufacturer's specification for that tube. Selected tubes are to be marked with a red paint-dot on the exhaust tip.

(a) Xtal oscillator operation, V3

Check voltages at V3 with DC VTVM and compare with values on tube voltage chart. Check rf output at pin 8 of V3 with rf prob ; rms voltage to be 25 V rms. Check voltage at pin 1 of V5; voltage to be - .7V.

(b) VFO Operation, V1, V2

Check voltages at V1 and V2 and compare with values on tube voltage chart. Check rf output at terminal 1 of oven assembly; voltage to be 9 V rms. (For alignment refer to sect. j)

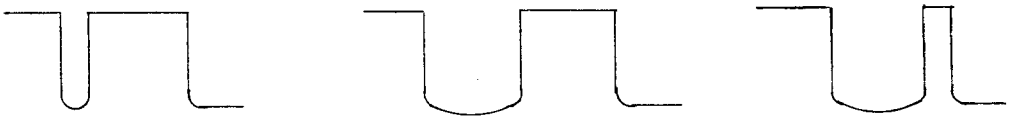
(c) TB. oscillator, V11.

Check voltages at V11 with DC VTVM and compare with values on tube voltage chart. Using audio generator and scope, check waveform and frequency of TB oscillator. Connect scope to pin 8 of V11, observe sinewave while rotating TB FREQUENCY control, first on range 6-60, then on 60-600 cps. No distortion should become noticable on all but the lowest frequencies. Using audio generator as scope horizontal timebase, observe frequency by means of Lissajous figur s and compare with frontpanel engraving dial markers. No adjustment is provided; in cases of severe

discrepancies, investigate the circuitry for errors and for defective components. Accept if frequency corresponds with dial within +20%. AC voltage at Pin 8, V11 to be 30-45 V. rms.

(d) Trigger stage operation, V7

Check voltages at V7 with DC VTVM and compare with values on tube voltage chart. Connect scope to pin 2 of V7 and check for presence of wave form from TB oscillator; with front panel switch S2, KEYING in position INT. Then connect probe of scope to pin 8 of V7; rotate the MARKBIAS control and check whether the wave form at this point corresponds to the following pictorial:



extr. CCW about midpoint extr. CW

Then set KEYING switch to EXT. Connect a 6 volt battery with the negative side to ground; touch the positive side to the terminal marked EXT KEY and note whether the B+ potential at pin 8 of V7 changes from 160V for open circuit to 36V with battery connected. Accept on this test if these conditions are met.

(e) Scale of Two operation, V6

Set KEYING switch to INT., MARKBIAS about Mid Pos., Check voltages at V6 with DC VTVM and compare with values on tube voltage chart. Connect scope to pin 1 of V6. Check whether a squarewave is present at this point; p-p amplitude to be 100V. Also check whether it follows exactly an adjustment of the TB FREQUENCY and MARKBIAS controls, both located on the front panel. Accept if these conditions are met.

(f) Boundary Selector operation, V4

With the scope at DC amplifier, connect probe to pins 5 and 7 of V4. With the scope trace adjusted exactly in the center of the screen note whether the squarewave observed at this point is well centered around the zero axis. Also check whether + 6V DC is present at pin 1 and - 6V DC at pin 2 of V4 (These voltages to be within ± 5 % *). Connect DC scope to pin 2 of V2, set SHIFT RANGE to ± 5000 cps and rotate SHIFT VERNIER; observe a variation of square-wave amplitude down to zero with the control at its extr. CCW position. Set control to extr. CW position, switch SHIFT RANGE to ± 1000 cps and observe a decrease in waveform amplitud ; then switch this control to ± 100 cps and observe a further decrease in amplitude. Accept, if these conditions are met.

(g) Audio sweep, V10 and $\frac{1}{2}$ V9

Check voltages at V9 and V10 with DC VTVM and compare with values on tube voltage chart. Connect scope to pin 3 of V9; note presence of sawtooth at this point. With KEYING control set to AUDIO SWEEP, set SHIFT RANGE to ± 5000 cps and SHIFT VERNIER to its extr. CW position; Note presence of sawtooth at pin 2 of V2.

(h) Mixer and Audio, V5, V8, $\frac{1}{2}$ V9

Check voltages at V5, V8 and $\frac{1}{2}$ V9 with DC VTVM and compare with values on tube voltage chart. Set SHIFT VERNIER control to extr. CCW, set OUTPUT control to extr. CW positions and connect scope to the AUDIO OUT terminals. Check and readjust, if necessary the main tuning capacitor C3 a,b for full-mesh with the dial aligned on the dot-marker. Set the ZERO BEAT capacitor to about midcapacity.

With an alignment tool set the trimmer capacitor C2 mounted on top of the main tuning capacitor as close for zero beat as possible. This can be observed by noting the flashing of the neon indicator marked ZERO BEAT. Rotate the OUTPUT control and observe the resulting change in output level down to zero output with the control at its extr. CCW position. At the same time, check the operation of the power switch which forms part of this control.

(i) Alignment check of TUNING dial

With zero beat check point properly aligned, the dial calibration is to be checked at the 3 kcps, 10 kcps anf 15 kcps points. Calibration must not be off more than 4 % of indicated frequency at any point. Adjustments may be made, if necessary, by resetting the rotor set-screw of C3.

(j) VFO alignment

Note: Before this test is performed, the instrument must hav had at least 2 hour warm-up.

Connect counter and scope to AUDIO OUT terminals. Set SHIFT VERNIER to its extr. CCW position. Turn KEYING switch to EXT. Turn R 53 (top chassis control) to about midrange. Connect a 6 V battery with the negative pole to ground, attach lead to positive pole. By reference to the permissible limits set forth in Table I adjust the VFO

(1.) for balance of shift

(2.) for proper amount of shift

Proceed as follows:

(1) Set SHIFT RANGE to ± 5000 cps, set dial to 10 kcps (± 25 cps) rotate SHIFT VERNIER to extr. CW position and note the amount of cps above center frequency obtained. Connect battery + terminal to EXT.KEY and note again the amount of cps below center fr quency obtained. Adjust balance trimmer C 16 carefully if shift obtained is not symmetrical relative to center frequency within ± 75 cps. After adjusting C 16, check on shift in the same manner as described above. This process may have to be repeated several times until a balance within ± 75 cps is obtained.

(2) Now rotate R 53 while checking the amount of shift until the limits stated in Table I are obtained.

With the preselection of V1 and V2 it should be possible to meet these limits at all times.

TABLE I

	OPEN CIRCUIT	BATTERY CONNECTED
±5000	14850 - 15150	4850 - 5150
±1000	10925 - 11075	8925 - 9075
±100	10075 - 10125	9875 - 9925

WARNING: In the event that it is necessary to change tubes V1 and/or V2, the set must be turned off when these tubes are being removed. Otherwise, the regulated filament supply may be seriously damaged.

Set SHIFT RANGE at ± 1000 cps and check whether the shift obtained without further adjustment falls in the range indicated in Table I.

Set SHIFT RANGE at ± 100 cps and check whether the shift obtained without further adjustment falls in the range indicated in Table I.

(k) Check of output level and distortion

Set SHIFT VERNIER to extr. CCW position. Connect AC VTVM and 680 Ω, 1 W resistor across the OUTPUT terminals. With OUTPUT control fully CW, the output level must be no less than + 7dbm at 10 kcps. Set output to 0dbm and connect distortionmeter across the output terminals; measure distortion at 5 kcps. Distortion must be no greater than 6 %.

(L) SAW TOOTH CHECK

DC Scope at Pin 5-7 of V4, Set to Audio Sweep; P-P Amplifier to be 12V (± 2V)

Repetition Frequency is Approximately 2-8 cps.

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Sample

TEST REPORT SHEET
MODEL FSS

1. Mechanical	ok	not ok
2. B+ Power	ok	not ok
3. Xtal osc. operation	ok	not ok
4. VFO operation	ok	not ok
5. TB osc. operation	ok	not ok
6. Trigger stage operation	ok	not ok
7. Scale of two operation	ok	not ok
8. Boundary selector operation	ok	not ok
9. Audio sweep operation	ok	not ok
10. Mixer and audio operation	ok	not ok
11. Dial calibration check	ok	not ok
12. VFO alignment	ok	not ok
13. Output level and distortion	ok	not ok

Corrective actions taken, if any .....

.....

Serial No ..... Accepted..... Rejected.....

(check one)

Tested by ..... Date .....

Tube Voltage Chart

pins	1	2	3	4	5	6	7	8	9
V1	+120V	+120V	*	5.6VAC	-16V	-16V	+.28V	——	——
V2	+120V	0	+6.5V	*	*	+120V	0	+6.5V	5.6VAC
V3	+42V	-16V	*	5.8VAC	5.8VAC	+100V	+42V	+49V	*
V4	+5.6V	-6.0V	*	5.8VAC	-6.0V	n.c.	-6.0V	——	——
V5	-8.0V	+0.7	*	5.8VAC	+74V	+50V	0	——	——
V6	+30V	+20V	*	5.8VAC	-95V	-95V	-80V	——	——
V7	+165V	0	+5V	5.8VAC	5.8VAC	+250V	+165V	+165V	*
V8	+100V	0	+4.7V	5.8VAC	5.8VAC	+235V	+105V	+110V	*
V9	+255V	+35V#	+50V#	5.8VAC	5.8VAC	+45V	-1V	*	*
V10	0	+1.3V	*	5.8VAC	+1.3V	+35V#	+1.3V	——	——
V11	+255V	0	+50V	5.8VAC	*	+100V	+1.4V	+105V	+100V
V12	-415V	n.c.	5.8VAC	*	n.c.	-415V	340VAC	——	——
V13	n.c.	+360V	n.c.	340VAC	n.c.	340VAC	n.c.	+360V	——
V14	*	-150V	n.c.	n.c.	*	n.c.	-150V	——	——
V15	+105V	*	n.c.	*	+105V	n.c.	*	——	——
V16	+150V	*	n.c.	*	+150V	n.c.	*	——	——

Notes: * denotes ground connection; all voltages are DC except where otherwise noted; line maintained at 110 VAC; all measurements of DC taken with VTVM with 10 megΩ input resistance; all AC measurements taken with VTVM with 1 megΩ input resistance; all voltages measured from ground potential; # denotes average value of DC potential (sawtooth waveform).

MODEL FSS REVISION SHEET S-261

DATE	REV.	PAGE	ITEM	DESCRIPTION	REMARKS	APP.
11/1	A	4	2(h)	Added		
"	A	5	5(b)	Was 5.7-6.0 volts AC		
"	A	7	(a)	.7V was 8V and 25V was 10V.		
"	A	7	(b)	Was "at terminal 3"		
"	A	8	(c)	AC voltage at Pin 8 added		
"	A	8	(e)	Reworded		
"	A	9	(f)(g)	Pin 2 of U2 was pin 7 of U2		
"	A	10	(i)	4% was 3%	AJJ	
"	A	10	(j)	2 Hour warm-up was 30 min.		
"	A	11	(l)	(±25 cps.) was (±10 cps.)		
"	A	11	(2)	Table I was changed		
"	A	12	(L)(M)	Added		
"	A	14	-	Tube voltages changed		