DATE 30 December 1963	TMC SPECIFICATION NO. S-806	
SHEET COVER OF		
RRH COMPILED / CHECKED	TITLE: PRODUCTION TESTING OF THE TMC MODEL SBE-4	
APPROVED		

COMPLETE INSTRUCTIONS

FOR THE

PRODUCTION TESTING

OF THE

TMC MODEL SBE-4

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

806

DATE 30 December 1963 SHEET 1 OF 15	TMC SPECIFICATION NO. S-806	
COMPILED RRH / CHECKED N.P.	TITLE: PRODUCTION TESTING OF MODEL SBE-4	
APPROVED BP		

I. INTRODUCTION:

A. The SBE-4 is a Single Sideband Exciter. For test purposes, it may be divided into 4 sections.

1. The Modulator Section

2. The Harmonic Generator Section

3. The Linear Amplifier Section

4. The Power Supply

B. THE L.F. MODUALTOR SECTION:

This section heterodynes the audio input to the desired output frequency which is then brought to the desired level by the linear amplifier. For example, a 1000 cps audio tone combines with a 250 Kc oscillator to produce upper and lower sidebands (USB, LSB) at 251 Kc and 249 KC. Each sideband is selected by the proper filter (FX-190 or FX-191), which attenuates the undesired sideband. The two sidebands are later passed through a carrier suppression filter, which serves to further attenuate the 250 Kc carrier, so it is at least 50 db below the sideband signal. Further combination with a second oscillator in the 2-4 mc range then produces a frequency in the 1.75-3.75 mc range, which is heterodyned to the final frequency by combination with the output of the harmonic generator. On the 2-4 band, no heterodyning is necessary, but it will be noted that an 18 mc Oscillator is injected. This is merely to prevent the diodes in A-2107 from varying impedance at the 1.75-3.75 mc level, and thus cause distortion.

C. LINEAR AMPLIFIER SECTION:

A four band amplifier operating between 2 and 32 mc to raise the level of the signal from Z107 to the desired output.

D. HARMONIC GENERATOR SECTION:

This section supplies the proper high frequency injection to the final modulator (Z107) at a frequency range from 8 to 34 mcs either fundamental or harmonic.

E. The Power Supply is conventional.

II. TEST EQUIPMENT REQUIRED:

A. Audio Generator (Heathkit #AG8)

B. Counter, (Computor Measurements Corp. Model203BN) or equivalent.

C. R.F. VTVM (Boonton Electronics Corp., Mod. 91-A or equivalent)

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

D. Scope, (Dumont Type 304A or equivalent).

E. R.F. Generator, (Measurements Model 82 or equivalent).

F. Heathkit AC VTVM (Model AV2 or equivalent).

G. 75 Ω non-inductive resistance, 5 watt.

H. Spectrum Analyzer, TMC Model FSA.

I. Two Tone Generator, TMC Model TTG-2.

J. TMC Model VOX-5 Variable Frequency Oscillator.

K. Ballantine (Model 314 Electronic Voltmeter or equivalent).

L. 620 Ω, 5% 1/2 watt resistor, non-inductive.

M. Multimeter, (Simpson Model 260 or equivalent).

N. 47 Ω, 1/2 watt resistor, non-inductive.

III. PRELIMINARY

A. Inspect the unit for mechanical imperfections and for proper placement of filters.

B. Inspect for obvious wiring errors.

C. Check oven heaters by measuring heater resistance pins D and E of 101; this would be approximately 200 Ω.

D. Check for B+ shorts with multimeter.

E. Attach jumper pins 2 & 3 of E101.

F. Connect 75 Ω load to J103.

G. Set bandswitch to 2-4 mc.

H. Attach cable from power supply to exciter. Turn Ac power ON. Oven indicator should light and cycle.

IV. TEST OF 250 KC OSICLLATOR

After a brief warm-up period set meter zero by adjusting R135.

V. A. Check frequency at output of Z103, pin 8. This should be 250 Kc.

B. Check the voltage at pin 8 of Z103. This should be .9-1 volts. If the frequency is not 250 Kc, then adjust C120 until the correct frequency appears on the counter.

TMC SPECIFICATION NO. S-806

COMPILED RRH CHECKED

TITLE: PRODUCTION TESTING OF MODEL SBE-4

APPROVED

VI. ALIGNMENT OF T125

A. Set Audio Generator to 3 Kc with .05 output.

B. Feed this into Channel 1, Terminal 6 and 8 of E101.

C. Place probe of Ballanine Model 314 on Plate (pin 6) of LF Amplifier V124.

D. Tune bottom slug for maximum indication on meter. Repeat for top slug. Touch up bottom slug again.

VII. ALIGNMENT OF T126

A. Same as for T125.

B. Same as for T125.

C. Place probe of Ballantine Model 314 on Plate (pin 6) of LF Amplifier V125.

D. Same as for T125.

VIII. 250 KC CARRIER BALANCE

A. Turn carrier insert to zero.

B. Turn both audio channels to OFF.

C. Place scope lead at junction R256 and R257.

D. Alternately adjust USB and LSB balance pots for minimum output.

E. Trace on scope should virtually dissapear at maximum sensitivity.

F. Lock balance pots.

Set up an audio level to 100 on the meter CH-2. Voltage at pin 1 V124 should be +2.5 volts ±2. If difficulty is encountered in this stage, check the following points:

Junction of R256 - R257	.022 volts
Pin 6 of V125	.27 volts
Pin 6 of V124	.3 volts

With 250 Kc injection shorted, voltages at secondary of T125 and T126 should be .006 volts. Remove short from 250 Kc injection.

IX. RETOUCHING OF T125 AND T126

Repeat procedure #2, peaking these two transformers.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

TMC SPECIFICATION NO. S-806

RRH COMPILED | CHECKED | APPROVED

TITLE: PRODUCTION TESTING OF MODEL SBE-4

X. CHECK FOR BANDWIDTH

A. Connect an audio oscillator across a 620 Ω, 5%, resistor to terminal 6 and 8 of E101.

B. Set the oscillator for an output of .05 volts.

C. Set the USB selector switch to OFF.

D. Set the LSB selector switch to Channel 1.

E. Use Meter in SBE-4 (M101).

F. Connect counter to junction of C163 & C164.

G. Vary the audio generator between 350-6000 cycles to get the peak reading on the meter (full scale). This will appear at approximately 1500 cycles.

H. Vary audio generator towards 350 cps and note and record the frequency when meter indicates a reduction of 1 db, 2 db and 3 db. Now tune the generator towards 6000 cps and again note record second frequency at 1 db, 2 db and 3 db. While tuning generator to 6000 cycles from 350 cps, watch meter for any variation greater than 3 db below the point which has been set as a reference point.

I. Take the difference of the two frequencies at the 3 db points. This should ge greater than 6.0 Kc.

XI. TUNING OF T127

A. Put probe at pin 2, V113A tune top slug for a dip, then peak bottom slug. Dip the top slug again.

B. Put probe at pin 7, V113B tune top slug for a dip, then peak bottom slug. Dip the top slug again.

XII. MICROPHONE INPUT

A. Connect an audio oscillator thru a 470 K resistor to microphone jack J101.

B. Set oscillator to 1000 cycles.

C. Set USB and LSB selector switches to OFF.

D. Check 250 Kc injection at arm of R265 and R266 .8 to 1.2 volts.

E. Alternately set a sensitive meter at the outputs of FX-190 and FX-191 and balance out the 250 Kc carrier by adjusting R265 and R266.

F. Set RF bandsxitch to 2-4 mc.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

G. Adjust level of audio oscillator to .007 volts.

H. Turn LSB selector switch to MIKE, LSB gain control to maximum. Check:

Meter reading on LSB	100
Meter reading on USB	0
Output of FX-191	.09-.01

I. Switch bandswitch thru the other three bands, and note that the output has been transferred to FX-190. Return bandswitch to 2-4 mc band.

If the above results are not obtained, check the following points: (short arm of 250 Kc balance pots to ground until checking output of filters FX-190 and FX-191)

Pin 6, V101	.0035 V
Pin 1, V101	.06 V
Pin 7, V122A or Pin 7, V123A	.034 V
Pin 6, V122A or Pin 6, V123A	.052 V
Pin 4 & 7 of T103-4	.05 V
Pin 2 of V122B or Pin 2 of V123B	.034 V
Pin 1 of V122B or Pin 1 of V123B	.1 V
Across C153 or C158	.21 V
Pin 2 of V112	.21 V

Remove short on 250 Kc injection to obtain output from filters.

XIII. CHECK OF 600 Ω AUDIO INPUTS

CHANNEL 1

A. Connect audio oscillator thru 620 Ω resistor to terminal 6 of E101.

B. Ground terminal 8.

C. Set audio oscillator level to .12 volts.

D. Output condition should be the same as per microphone check.

E. Note that rear terminal nomenclature and front panel marking correlate.

CHANNEL 2

A. Same as per Channel 1 connecting audio oscillator to pins 10 and 12 of E101.

XIV. FINAL CHECK OF LOCATION OF USB AND LSB FILTER

A. Set RF bandswitch 2-4 mc range. Alternately set 1000 cycle note in LSB and USB 1000 level. With lissajous pattern, note frequency:

LSB	251 Kc
USB	249 Kc

XV. M.F. ALIGNMENT

A. MID FREQUENCY ALIGNMENT

It has been explained that at the mixer grid of V113 there may appear two frequencies, a 250 Kc frequency (carrier inserted) and a VMO injection frequency. At the band extremes the following table applies:

XTAL OR VMO	DIAL READING	IF	RESULTING FREQ.
2000 Kc	2.0 mc	250 Kc	1.75 mc
4000 Kc	4.0 mc	250 Kc	3.75 mc

The MID FREQUENCY is aligned so that the proper product is chosen when the dial is set to the VMO or XTAL frequency, that is when a 2000 Kc xtal is injected, the MF dial is set to 2.0 mc but the actual frequency is 1.75 mc which is the difference between the 2000Kc xtal and the 250Kc LF. With this in mind, preliminary alignment may be accomplished by using the 2000 Kc and 4000 Kc xtals (or VMO).

Before aligning the MF, see that the tuning condensers are full mesh when the dial is set to the marker on the MF dial.

Remove P107 from J110 on Z107. Connect RF VTVM to CW terminal of output potentiometer R205. Unbalance injection by R130.

Select xtal position 1 (2000 Kc). Set MF dial to 2.25 mc. Tune T109 and T110 for maximum output.

Select xtal position 2 (4000 Kc). Set MF dial to 4.25 mc. Tune trimmers C140 and C141 for maximum output.

This preliminary alignment will ensure subsequent selection of the proper mixer product from the MF meter.

Insert full carrier. Select xtal position 1 (2000 Kc). Set MF dial to 2.0 mc. Tune T109 and T110 for maximum output. Select xtal position 2 (4000) Kc. Set MF dial to 4.0 mc. Tune C140 and C141 for maximum output in each case reduce the carrier to ensure that proper mixer product has been selected. Repeat until band is tracked. Lock slugs with special tool.

TMC SPECIFICATION NO. S-806

RRH COMPILED | CHECKED

TITLE: PRODUCTION TESTING OF MODEL SBE-4

APPROVED

XVI. MID FREQUENCY CRYSTAL OR VMO INJECTION

A. Connect VOX-5 to VMO input J104 (maintain a 1.5 volt level at all subsequent tests).

B. Install a 2000 Kc xtal in position #1.

C. Install a 4000 Kc xtal in position #2.

D. Install a 2250 Kc xtal in position #3.

E. Set R.F. VTVM at the junction of C163 and C164 and measure the following voltages:

Position 1	(2000 Kc)	2.5 V
Position 2	(4000 Kc)	1.2 V
VMO	(2000 Kc)	2.5 V
VMO	(4000 Kc)	1.4 V

XVII. MID FREQUENCY CARRIER BALANCE

A. Select xtal position 1 (2000 Kc).

B. MF dial to 2.25 mc.

C. Balance out carrier by means of R130. Lock potentiometer.

If the unit has been aligned properly, with the carrier inserted and xtal position 1, a signal will be picked up at 2.0 mc and 2.50 mc.

XVIII. FINAL AMPLIFIER

A. Before alignment, check full mesh capacitor setting against dial marking.

B. Remove HF injection from Z107.

C. Zero carrier insertion.

D. Audio channels OFF.

E. Connect R.F. signal generator to grid side of L116 terminating generator with 47 Ω.

F. Terminate SBE output with 75 Ω, 5 watt load.

G. Monitor output voltage with R.F. VTVM.

H. Monitor input with R.F. VTVM.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

TMC SPECIFICATION NO. S-806

RRH COMPILED | CHECKED

TITLE: PRODUCTION TESTING OF MODEL SBE-4

APPROVED

IXX. 2-4 MC BAND ALIGNMENT

A. Set RF band switch to 2-4 mc band.

B. Set dial and generator to 2 mc.

C. Tune T116 and T120 for maximum output.

D. Repeat steps until band is aligned.

E. Check sensitivity at each end of band for 14 volt output.

	INPUT	METER READING
2.0 mc	.15	plus 2 db
4.0 mc	.05	" 2 db

If difficulty is encountered in this test, the following stage gains should be checked:

	2.0 mc	4.0 mc
Gen. Out	.15	.05
Plate 6AH6	.3	.15
Grid 6CL6	.3	.15
Plate 6CL6	25.0	24.0
Grid 6146	9.0	9.3
Plate 6146	80.0	81.0
Output Tap	14	14

In taking these measurements, meter capacity must be compensated.

XX. 4-8 MC BAND ALIGNMENT

A. Set RF bandswitch to 4-8 mc band.

B. Set dial and generator to 4 mc.

C. Tune T113, T117 and T121 for maximum output.

D. Set dial and generator to 8 mc.

E. Tune C203, C192 and C180 for maximum output.

F. Repeat until ends of band track.

G. Lock slugs.

H. When aligned, check RF sensitivity for 14 volt output.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

	INPUT	METER READING
4.0	.055 V	plus 2 db
8.0	.0065 V	plus 2 db

If difficulty is encountered in this test, the following stage gains should be checked:

	4.0 mc	8.0 mc
Gen. Out	.055	.0065
Plate 6AH6	4.0	2.0
Grid	.86	.52
Plate 6CL6	34	19
Grid 6146	11	10
Plate 6146	70	78
Output Tap	14	14

In taking these measurements, the meter capacity must be compensated.

XXI. 8-16 MC BAND ALIGNMENT

A. Set RF bandswitch to 8-16 mc band.

B. Set dial and generator to 8 mc.

C. Tune T115, T119 and T122 for maximum output.

D. Set dial and generator to 16 mc.

E. Tune C202, C190 and C178 for maximum output.

F. Repeat until ends of band are aligned.

G. Check RF sensitivity.

	INPUT	METER READING
8.0 mc	.05	plus 2 db
16.0 mc	.03	plus 2 db

If difficulty is encountered in this test, the following stage gains should be checked:

	8.0 4.0 mc	16.0
Gen. Out	.05	.03
Plate 6AH6	2.2	2.0
Grid 6CL6	1.2	.92
Plate 6CL6	32	30
Grid 6146	12	15
Plate 6146	75	80
Output Tap	14	14

XXII. 16-32 MC BAND ALIGNMENT

A. Set RF bandswitch to 16-32 mc.

B. Set dial and generator to 15 mc.

C. Tune T114, T118 and T112 for maximum output.

D. Set dial and generator to 32 mc.

E. Tune C201, C189 and C177 for maximum output.

F. Repeat until ends of band are tracked.

G. When aligned, check RF sensitivity.

	INPUT	METER READING
16 mc	.09	plus 2 db
32 mc	.06	plus 2 db

If difficulty is encountered in this test, the following stage gains should be checked:

	16 mc	32 mc
Gen. Out	.09	.06
Plate 6AH6	2.0	1.2
Grid 6CL6	1.25	.73
Plate 6CL6	25.0	13
Grid 6146	14.0	8.6
Plate 6146	72.0	83
Output tap	14.0	14

XXII*B H.F. MODULATOR Z107

A. In the 18 mcs xtal position #9.

B. Place an Ac probe to input of R205.

C. Balance out to .3V R.F.

XXIII. CHECK CARRIER AT FX-159

A. Shut off audio input for both channels.

B. Connect Ballantine Model 314 to output of FX-159

C. The carrier should be 60 db below output voltage of FX-159 with one channel turned on and set to 100% on meter.

D. Carrier re-insertion control should be set fully counter-clockwise during this test.

XXIV. CARRIER RE-INSERTION

Place meter at pin 1 of V124, insert full carrier level. Reading should be 2.5 volts. If 250 Kc oscillator output voltage is high. This reading might increase by 50%.

VOX/SQUELCH

A. Place ohmmeter from terminal 4 E101 to ground.

B. With VOX gain at maximum, turn transmitter switch OFF, and reduce carrier insertion to zero.

C. Connect audio oscillator to MIKE input.

D. Turn EXCITER switch to stand-by.

E. Raise AUDIO gain switch control until exciter light goes on indicating that relay K101 has closed.

F. Check level at pin 2, V110 - .16 volts.

G. When the relay closes, terminal 4 should short to ground. When the transmitter switch is thrown to ON, terminal 4 should again short to ground with no audio input.

If difficulty is encountered in this stage, set audio input to .16 volts at pin 2 of V110, and check the following voltages:

Pin 2 V111	5.5 volts
Pin 5 V111	plus 8.0 volts
Pin 2 V109A	plus 6.2 volts
Pin 3 V109A	plus 5.0 volts (no audio input or carrier)

H. Connect audio oscillator to terminal 13 and ground on E101.

I. Reduce output to zero.

J. Set squelch gain to maximum.

K. Insert carrier until VOX circuit is activated.

L. VOX gain at minimum.

M. Increase output from signal generator until the VOX is disabled as indicated by the exciter light.

N. Check voltage at pin 9, V110 - 6 volts.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

If difficulty is encountered in this stage, check the following voltages. Reduce carrier insert to zero:

Set voltage at pin 9 of V110 to .6 volts.

Pin 1 V111		14 V
Pin 7 V111	minus	17 V
Pin 2 V109A	minus	2.5 V

XXV. PUSH TO TALK

By pushing the mike PTT lever or graounding terminal 1 of E101, relay K101 should be activated.

XXVI. AMPLITUDE MODULATION SIMULATION TEST

A. Connect a scope to pin 2 or 7 of V113.

B. Set a 1000 cycle note at minus 10 db level on both upper and lower sideband.

C. A clean two tone test signal should be observed on the scope.

D. Adjust gain of one sideband until the tones are equal.

E. Insert carrier for 100% modulation. Scope should confirm such a signal. If picture is distorted, modulation envelope looks like a distorted sine wave.

XXVII. FINAL TEST

A. Reconnect HF oscillator injection to Z107.

B. Set audio level to 100.

C. Balance HF carrier.

D. Mc band to 2-4.25 mc (0).

E. Set xtal selector switch to position 9 (250 Kc).

F. Tune Mid-Frequency.

G. Set RF bandswitch to 2-4 mc range. Tune output amplifier to 2 mc.

H. Check for 10 volt output.

TMC SPECIFICATION NO. S-806

RRH
COMPILED | CHECKED

TITLE: PRODUCTION TESTING OF MODEL SBE-5

APPROVED

This procedure will be repeated in two megacycles steps through 32 mc, each time checking that the 14 volt output is obtained.

R.F. BAND	MC BAND	FREQUENCY
4-8	4	6
8-16	5	8
8-16	6	10
8-16	7	12
8-16	8	14
8-16	9	16
16-32	10	18
16-32	11	20
16-32	12	22
16-32	13	24
16-32	14	26
16-32	15	28
16-32	16	30
16-32	17	32
16-32	20	

In checking these points, see that dial calibration is adequate, if not, the bands should be aligned on the crystal frequencies.

1. Set unit up on any frequency and lay down flat on the table.

2. Raise front of unit about 4 inches from table and let drop several times.

Note any change in output. If output changes, investigate reason.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

DATE 30 December 1963 SHEET 14 OF 15	TMC SPECIFICATION NO. S-806	
COMPILED RRH / CHECKED	TITLE: PRODUCTION TESTING OF MODEL SBE-4	
APPROVED		

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y.

SBE-4 TEST DATA SHEET

SERIAL NO.:_____
MFG. NO.:_____

250 KC Oscillator	_____OK
250 KC Carrier Balance	_____OK
Bandwidth USB-LSB	_____OK
Microphone Input	_____OK
600 ohm Audio Inputs	_____OK
M.F. Alignment	_____OK
M.F. Injection	_____OK
M.F. Carrier Balance	_____OK
Final Amp. Alignment	_____OK
Carrier Rejection	_____OK
Carrier Re-insertion	_____OK
VOX	_____OK
SQUELCH	_____OK
Push-to-Talk Operation	_____OK
Amplitude Mod. Test	_____OK
M.F. Dual Calibration	_____OK
HF Dual Calibration	_____OK
Shock Test	_____OK
Final Output Check	_____OK

DATE_____

TESTER_____

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444

DATE 30 December 1963 SHEET 15 OF 15	TMC SPECIFICATION NO. S-806	
COMPILED RRH / CHECKED	TITLE: PRODUCTION TESTING OF TMC MODEL SBE-4	
APPROVED		

VOLTAGE CHART

(for reference only)

TUBE	VOLTS	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V101	6AB4	56V	NC	0	6.3*	150	0	1.3		
V122	12AT7	90	0	1.4	6.3*	6.3*	135	0	1.4	0
V123	12AT7	90	0	1.4	6.3*	6.3*	135	0	1.4	0
V124	6AB4	125	NC	0	6.3*	NC	0	.8	-	-
V110	6U8A	5	0	25	6.3*	0	275	1.8	1	0
V111	6AL5	0	0	0	6.3*	1	NC	-1	-	-
V127	6AB4	250	NC	0	6.3*	NC	.5	4	-	-
V126	6AH6	0	0	0	6.3*	270	125	1	-	-
V125	6AB4	130	NC	0	6.3*	NC	0	.9	-	-
V113	12AT7	170	0	2.1	6.3*	6.3*	170	0	2.1	0
V114	6AH6	0	0	0	6.3*	270	110	1	-	-
V112	12AU7A	230	0	4.1	0	0	230	0	3.9	6.3*
V115	12AU7A	155V	0	4.1	0	0	230	0	3.9	6.3*
V116	6CL6	6.0	-16	150	0	6.3*	210	6.0	NC	-16
V117	6U8A	NC	-10	115	0	6.3*	220	.1	NC	NC
V118	6AH6	0	0	6.3*	0	190	105	1.4	-	-
V119	6CL6	3.7	NC	150	6.3	0	190	0	-	0
V120	6146	28	0	190	-	0	28	6.3*	0	260
V105	12AU7A	250	8.5	6.3*	.25	150	0	0	VAR.	-

NC - No connection

* - AC Voltages

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M 8444