

DATE <u>10/22/57</u>	TMC SPECIFICATION NO. S	
SH. _____ OF _____		
COMPILED BY _____	TITLE: PRODUCTION TESTING OF THE MODEL SBE	JOB _____
APPROVED _____		

~~COMPLETE~~ INSTRUCTIONS  
FOR THE  
PRODUCTION TESTING  
OF THE  
MODEL SBE-1

DATE 10/22/57  
SH. 1 OF 12

# TMC SPECIFICATION NO. S

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TITLE: SBE-1 TEST PROCEDURE

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## I. INTRODUCTION:

A. The SBE 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 Amp. section
- (4) The Power Supply

### B. The L.F. Modulator Section

This section heterodynes the audio input to the desired output frequency which is brought to the desired level by the linear amplifier. For example a 1000 C.P.S. audio tone combines with a 17 KC Osc. to produce upper and lower sidebands (USB, LSB) at 17.1 KC and 16.9 KC each sideband is selected by the proper filters (FX-154, FX-155) which attenuates the undesired sideband. The two sidebands are combined at the output of the filters, and the resultant passed through a Bridge T Network which serves to further attenuate the 17 KC carrier so it is at least 50 db below the sideband signal. Each sideband is then combined with a 287 KC Osc. resulting in frequencies of 269.9 KC and 270.1 KC, the proper product of this combination is selected by the double tuned transformers T107 & T108. Further Combination with a third Osc. in the 2-4 mc range then produces a frequency in the 1.73-3.73 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 Osc. is injected this is merely to prevent the diodes in A-2107 from varying impedance at th 1.73-3.73 mc level and this cause distortion.

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## C. Linear Amplifier Section

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

## D. Harmonic Generator Section

Supplies the proper high frequency injection to the final modulator (Z107) frequencies range from 8 to 34 mcs. either fundamental or harmonic.

D. The Power supply is conventional

## II. TEST EQUIPMENT REQUIRED:

- A. Audio Generator (heathkit #AG8)
- B. Counter Berkeley
- C. R.F. VTVM (Boonton Electronics Corp., Mod. 91-A)
- D. Dumont type scope
- E. R.F. Generator (model 82)
- F. Heathkit ACVTVM (Mod AV2)
- G. 75 ohm non-inductive resistance

## III. PRELIMINARY

1. Inspect the unit for mechanical imperfections and for proper placement of filters.
2. Inspect for obvious wiring errors.
3. Check oven heaters by measuring heater resistance pins D and E of 101 this would be approximately 200 ohms.
4. Check for B + shorts with ohm meter.
5. Attach jumper pins 2 & 3 of E 101.
6. Connect 75 ohm load J 102.
7. Set bandswitch to 2-4 mcs.
8. Attach cable from power supply to xciter. Turn AC power on.  
Oven indicator should light.

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## 17 KC Osc. Check

Check 17 KC injection at center of R110 (LSB BAL.) and R112 (USB BAL.) with counter this should be 17 KC  $\pm$  3 C.P.S. also connect ACTVTVM voltage should be 1-1.5V.

## 287 KC Osc. Check

Check 287 KC injection at center of R113 (L.F. Bal) with counter and R.F. volt meter there should be 1-1.5 volts. Adjust frequency to exactly 287 KC by C120 trimmer.

## METER ZERO

Let set warm up for 10 min. then set R135 meter Bal. so meter is zeroed.

## FILTER LOCATION

Insure proper orientation of USB and LSB filters by grounding Pin #1 on both filters and alternately applying an audio signal of proper freq. to Pin #4 of each filter. Freq. for FX-154 (LSB) is 13.70 KCS at the low end and 16.65 Kcs at the high end. Freq for FX-155 (USB) is 17.35 Kcs at the low end and 20.30 at the high end. The output voltage, as viewed on an AC VTVM connected to Pin #5 of the filter, should decrease rapidly beyond the frequency limits listed above.

## UPPER AND LOWER SIDEBAND BALANCE

Connect AC meter to output of FX-154 (LSB) and balance out carrier by means of R 110. Residual carrier .02-.04 volts then lock pot. Connect AC meter to output of FX-155 (USB) and balance out carrier by means of R 112. Residual carrier .01 volts, then Lock pot.

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## TEST OF AUDIO SECTION AND 17 KC MODULATOR LSB

Connect audio osc. through microphone jack J 101. Switch LSB to mike USB to OFF, short arm of R 110 or R112 to gnd. thus removing 17 KC injection. Set LSB gain to maximum adjust audio osc. output to 3.5 MV. 1000 C.P.S. check AC voltages at following points.

Cold side C250 .05 volts.

Pin 6 V103 .05 volts.

Pins 4 & 7 T104 .08 volts.

Pin 2 V107 B .05 volts.

Pin 1 V107 B 1.0 volts.

DC voltage across C158 1.0 volts

Front panel meter reads 100 on LSB.

## USB CHECK

Switch LSB to OFF, USB to mike with maximum gain. Check AC voltages at the following points.

Pin 6 V103 .05

Pin 1 V103 1.0

Pins 4 & 5 T104 .07

Pin 7 V107 B .05

Pin 6 V107 B 1.0

DC voltage across C153 1.0

## CHANNEL 1

Connect audio osc. to terminals 6 & 7 E 101 set osc. level to 50 MV at 1000 C.P.S. switch LSB to channel 1, USB to OFF, front panel meter reads 100. Switch LSB to OFF USB to channel 1, front panel meter reads 100.

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CHANNEL 2

Connect audio osc. to terminals 10 & 12 E101 set Osc level to 50MV 1000 C.P.S. Switch LSB to channel 2, USB to OFF front panel meter reads 100. Remove short from arm of R 110 reconnect audio osc. to J 101 and re-set level to 3.5MV.

With LSB on Mike, USB OFF, output of FX-154 .1V

With LSB, OFF USB on Mike output of FX-156 .1V

BRIDGE T ADJUSTMENT

Set AC meter to pin 6 V108 USB and LSB to OFF. Balance out residual 17 KC carrier by adjustment of R109 and C119. When balance is accomplished switch on either USB or LSB. The residual carrier should be at least 50 db down from the signal level.

L.F. AMPLIFIER CHECK

Check AC voltages at the following points.

Pin 2 V108A .05V

Pin 1 V108A .22V

Pin 6 V108B 2.5V

SIDEBAND REVERSAL

When the Linear Amplifier Bandswitch is turned to the other three bands the audio inputs should be switched to the opposite sideband, that is the LSB controls will work to the USB filter and the USB controls will work to the LSB filter.

CARRIER INSERTION

Remove all audio signals and insert full carrier, measure voltage pin 6 V108 B 4.0 volts.

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## 270 KC L.F. ALIGNMENT

Set R113 (LF Balance) to approximately mid position. Insert full carrier. Place sensitive meter to pin 2 or 7 V113, tune T108 and T107 to signal (270 KC) Since it is possible to select either 287 & 17 or 304 KC or 287-17 or 270 KC the signal should be examined by lissajous pattern on a scope to ensure that the 270 KC product has been selected. When alignment is correct and complete, lock slugs with special tool. Reduce carrier to zero. Set sensitive meter to pin 7 V109 B and after shorting arm of R110 or R112 to gnd. balance out 287 KC carrier, lock nut on potentiometer, remove short. Insert either USB or LSB at 100 level and observe following AC voltages with low capacity meter.

Pin 7 V109 B	.3 volts
Pin 6 V109 B	4.4 volts
Pin 2 V113	.25 volts
Pin 7 V113	.25 volts

## BANDWIDTH

Place meter on pin 2 or 7 V113 and insert LSB signal for 0 db refernece on meter vary frequency of input audio osc. until response falls 3 db 3500 cycles. Repeat inserting USB signal 3700 cycles.

## MID FREQUENCY XTAL INJECTION

Insert 2000 KC xtal position 1

Insert 4000 KC xtal position 2

Connect signal generator or PMO (2 volt level) to VMO input. S t RF voltmeter at junction of C163 & C164 measure following voltages.

Position 1 (2000 KC)	2.5 volts
Position 2 (4000 KC)	1.2 volts
VMO (2000 KC)	2.0 volts
VMO (4000 KC)	1.0 volts

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## MID FREQUENCY ALIGNMENT

The mid-frequency signal is the result of the combination of the 270 KC LF and the VMO or xtal osc. injected at the meter grid (V113) at the ends of the MF band.

Xtal or VMO	LF	Resulting Frequency
2000 KC	270 KC	1730 KC
4000 KC	270 KC	3730 KC

The mid frequency section is aligned so that the proper signal 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 tuned is 1.73 mc. With this in mind preliminary alignment may be accomplished by using the 2000 KC and 4000 KC Xtals.

Remove P107 from Z107 and set sensitive RF voltmeter to top of output potentiometer (R205). Select xtal position 1 (2000 KC) set MF dial to 2.27 mc tune T109 & T110 (slugs on underside of chassis only) Select xtal position 2 (4000 KC) set MF dial to 4.27 mc tune trimmers C140 and C141, repeat procedure. This preliminary alignment will ensure subsequent selection of the proper mixer product.

Insert full carrier, select xtal position 1 (2000 KC) set MF dial to 2.0 Mc peak T109 & T110. Select xtal position 2 (4000 KC) set MF dial to 4.0 Mc trim C 140 & C141 repeat procedure until ends of band are tracked. Reduce carrier insertion to zero.

MF carrier balance, set sensitive meter to top of R205, select xtal position 2 (4000 KC) MF dial to 4.27 mc balance out carrier by adjusting top slug of T109 (should be well into coil) and R130. Select xtal position 1 (2000 KC) MF dial to 2.27 mc not level of residual carrier if excessive balance setting should be adjusted to give approximately equal balance at both 2.27 and 4.27 mc lock nut.



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Insert USB or LSB at 100 level measure following RF voltages at top of R205. Xtal position 1 (2000 KC) MF dial 2.0 Mc output voltage 100. MF meter reading .3.

Xtal position 2 (4000 KC) MF dial 4.0 Mc output voltage 100. MF meter reading .3.

VMO (2000 KC) MF dial 2.0 Mc output voltage 100

VMO (4000 KC) MF dial 4.0 Mc output voltage 100

If difficulty is encountered in this stage the following points should be checked:

Xtal position 1 (2000 KC) MF dial 2.0 Mc.

Voltage Pin 1 V114 .2

Voltage Pin 5 V114 12V

Voltage across C168 .7 DC

Xtal Position 2 (400 KC) MF dial 4.0 Mc.

Voltage Pin 1 V114 .2

Voltage Pin 5 V114 .8V

Voltage across C168 .7 DC

## HF MODULATOR AND OSC. CHECK

Connect R.F. voltmeter to top R 205 (output control turn off m.f. osc. voltage should vary from 1v to 4v from position 0 to 14 on H.F. modulator switch (this checks H.F. osc. for output on all bands.

Now turn H.F. modulator switch to position 9 and turn R 150 H.F. balance for minimum reading.

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## R.F. ALIGNMENT

Connect RF generator to grid side of L 116 terminate generator with 68 ohms set generator for .1 v. out. Set meter switch to R.F. Connect VTVM probe across 75 ohm load (J102 turn on exciter final) Make sure jumper on terminals 2 and 3 of E101 are connected.

## 2-4 MC BAND ALIGNMENT

Set R.F. Band switch to 2-4 Mc band set dial and generator to 2 Mc tune T116 and T120 to max. Now turn generator and dial to 4 Mc and tune trimmer C191 and C179 for max. output retune ends until aligned.

## 4-8 MC BAND ALIGNMENT

Turn band switch to 4-8 Mc band set generator and dial to 4 mc tune T113, T117, T121 turn to 8 mc and tune C203, C191, C180 retune end until aligned.

## 8-16 MC BAND ALIGNMENT

Turn band switch to 8-16 mc band set generator and dial to 8 mc and tune T115, T119, T122 turn to 16 mc and tune C202, C190, C178 retune ends until aligned.

## 16-32 MC BAND ALIGNMENT

Turn band switch to 16-32 mc band set generator and dial to 16 mc and tune T114, T118, T112. Turn to 32 mc and tune C201, C189, C177 retune ends until aligned.

Check following R.F. voltages with .1 input at 8 mc (low end band 8-16)

Pin 5 of V118 2.2 Volts

Pin 6 of V119 15 Volts

E out (75 ohm load) 17 Volts

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<u>E IN</u>	<u>E OUT</u>	<u>MC</u>
.1	6 V	2
.1	20 V	4
.1	17 V	8
.1	16 V	16

## VOX CHECK

Replace audio generator with microphone set up one channel so that when talking at a normal voice level, meter reads approximately 100. Turn exciter on stand by switch to stand by position while talking into mike turn VOX gain until final light goes on. This light is turned on by VOX relay. The VOX gain control adjusts the sensitivity of VOX relay. When properly set back ground noise will not trip relay. (VOX will not function properly with carrier insert turned up.

With 3.5 MV connected to input J101 and VOX gain turned up to point when relay is activated there following voltages should be present at:

Pin 2 of V110 1 VAC

Pin 6 of V110 10 VAC

Pin of V109 + 8.5 VDC

Connect audio generator to pin 13 and 14 of E101 set generator 1 KC 10 volt output by turning squelch gain up VOX relay should become inoperative voltage should be present at:

Pin 1 of V111 90 VAC

Pin 2 of V109-110 VDC

## PUSH TO TALK

By grounding pin 3 of J101 and terminal 1 of E101 relay should be activated.

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## TRANSMITTER REMOTE

Check with ohmeter terminal 4 of E101 when transmitter on-off switch is in on position this line will be shorted also when relay is activated.

## FINAL CHECK

Check unit for proper output on four bands at low end of bands 2 mc, 4 mc, 8 mc and 16 mc. (set up unit with formular using VMO input.)

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TITLE: SBE-1 TEST REPORT SHEET

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17 KC OSC. -----

287 KC OSC. -----

LSB CHANNEL -----

USB CHANNEL -----

17 KC KNOTCH -----

270 KC SENSITIVITY -----

270 KC BAL -----

MF DIAL CALIBRATION -----

HF MOD -----

RF DIAL CALIBRATION -----

CARRIER INSERT -----

V.O.X. -----

SQUELCH -----

PUSH TO TALK -----

REMOTE CHANNEL OPERATION -----

OUTPUT CONTROL -----

FINAL OUTPUT CHECK -----

METER SEITCH -----

DATE \_\_\_\_\_

SERIAL NO \_\_\_\_\_

TESTER \_\_\_\_\_