WHODUNNIT?

TBSSBSCRM

OR

WHAT DID WHAT TO WHOM?

This dissertation concerns "The big single sideband suppressed carrier receiving mystery", or "what happens when I flip this switch or turn this dial", and particularly refers to what we fondly call the Single Sideband Adapter, Model GSB-1.

Oh boy, what a nice bunch of names, exalted carrier, first mixer, BFO, steep skirts, adjacent channel interference, suppressed carrier, passband tuning, amplitude modulation, single sideband, double sideband etc., etc.

The GSB-1 has five switches on the front panel, a phone jack, a volume control and a knob that turns a dial, the latter being calibrated upper-side band plus or minus 3 KC, and lower sideband, same way, and logging.

So let's take 'em by the numbers, reading left to right:

1. Phone Jack. (You plug your phones in here if you want to).

2. Noise Limiter, On/Off. (This turns a noise limiter on or off and cuts out impulse noise. It clips both the positive and negative peaks).

3. Sideband Upper/Lower. (Actually changes frequency of the variable oscillator from 438 to 472 KC or vice versa).

4. A.V.C. On/Off. (We want to help the receiver out so we provide A.V.C. - See specs. for operation).

5. A.V.C. Fast/Slow. (Means just what it says. The A.V.C. attacks fast or slow depending on how you throw the switch).

6. Volume Control. (Aw, g'wan, you're kidding!).

7. Dial Knob. (Tunes an oscillator over the range 438 KC plus or minus 3 KC or 472 KC same way, depending on where you throw the upper or lower sideband switch).

8. A.M./S.S.B. (Switches amplitude modulation (ancient modulation if you like) to S.S.B. (quack, quack, if you like). In A.M., BFO is off and an A.M. detector is used. In S.S.B., a carrier is generated at 17 KC and an SSB (I.E. Product) detector is used.

Now let's forget all about this new fangled radio except that two frequencies in a mixer produce a different frequency.

We tap into the I.F. of a receiver at 455 KC. Actually, depending on the bandwidth, (I.E. Passband), of the receiver, if it is six KC wide, we get essentially all frequencies from 452 to 458 KC.

This band of frequencies comes into an amplifier (A.V.C. may or may not be used). Nothing much happens to it except amplification and the fact that the A.V.C. tries to hold it constant.

Then it goes into a mixer, oops! trouble --

We want to change its frequency, because we have a sharp filter coming up - sharp on the skirts we mean, nice flat top 2.5 KC wide and then sharp attenuation either side. To make it simple, let's say we're receiving one frequency only - 455 KC.

Now this filter goes from 17.4 to 19.9 KC, and we want to change our frequency to fit into this filter, and we can do it two ways. We can beat it against a signal 455 KC plus 17.4 to 19.9 KC, or 455 KC minus 17.4 to 19.9 KC. And this is what the dial shows! Depending on how you throw the upper/lower switch, you vary an oscillator centered at either 438 KC or at 472 KC.

Let's take AM phone first. It has a carrier and two sidebands. The carrier is at 455 KC (if it is centered in the passband) and both sidebands have the same intelligence. One set extends from 452 to 455 and the other from 455 to 458. If you beat this carrier with a frequency of 455 KC plus 18.65 or minus the same amount, you will put the carrier smack in the middle of the filter. It now sounds pretty awful! Why? Because the filter is only 2.5 KC wide. You got the carrier in fine, but only 1250 cycles of the intelligence on either side. No highs!

Now, we said that both sidebands contain the same intelligence, so why duplicate? Let's beat the 455 KC carrier with 455 KC plus or minus 17.4 KC. Sounds better, doesn't it? Why? Because you're now receiving all frequencies from the carrier at 17.4 KC to 19.9 KC or 2500 cycles. Many more highs, huh? Sounds pretty good? - and you know what you did? You received either the upper or lower sideband plus carrier. Now, comes a devious thought. Suppose you had an interfering carrier at 456 KC in the I.F. of the receiver.

This guy would produce a 1000 cycle beat note with your carrier, and is right in the middle of the upper sideband. This ordinarily would knock out your AM signal! But if you use only the lower sideband, (Carrier 455 KC plus sidebands 455 to 452 KC) you're going to drop the interfering signal outside the filter! Presto! Band pass tuning, - one of the advantages of the GSB-1.

Exalted carrier? Whaddyamean! What good is it? Well, to exalt is to raise - right? It is characteristic of an A.M. signal that the carrier can fade with regard to its sidebands. So why use a fading carrier? The receiver needs a carrier for detection purposes, so we'll provide a nice steady one. Nice and powerful and stable too! But to provide it, we have to switch to SSB because this turns an oscillator on - fixed at 17 KC. Why 17 KC? Well, we're not really exalting your old carrier. This oscillator is your new carrier, exalted (raised in amplitude), many times to prevent over-modulation when the signal fades. But why choose 17 KC? Because the filter goes from 17.4 to 19.9 KC and, we want our new carrier where it will be useful for both suppressed carrier and exalted carrier. If we were receiving broadcast exalted carrier, we would put the new carrier at 17.4 KC - smack on top of the old one to reproduce the frequencies from 0 to 400 cycles.

These frequencies are much attenuated in suppressed carrier transmission because no filter is infinitely thin and you want to get rid of the carrier. This way best intelligence can be made from the output of the filter. Either sideband will fall into the filter slot, and you can switch sidebands without retuning your receiver! In other words, you double your advantage. You receive one sideband with exalted carrier which lessens fading, and if you are interfered with, you switch sidebands. Real neat advantage for the GSB-1, hey?

By now, TBSSBSCRM should be getting clearer to you. Single Sideband? Sure, you only need one! Suppressed carrier? We can provide a nice steady carrier at the receiver so why transmit one? Upper or lower sideband? Of course!

So why provide a dial? Well, we don't know why it wasn't done before. It's pretty logical. It gives you real ease of tuning. You don't continually have to re-tune your receiver. You don't even have to tune it on the nose because the dial gives you a plus or minus 3 KC swing. Just get a good "S" meter reading and the GSB dial pops the station in immediately. It would be real nice if all stations came up exactly on frequency, but they don't. You're dealing in cycles per second now. Tuning any receiver in a 100 cycle region is tough, and believe you us, it's a real pleasure to have a handle on this SSB thing.

We'll bet you knew the answer all the time!

THE TECHNICAL MATERIEL CORPORATION
Mamaroneck, New York

PRELIMINARY INSTRUCTION BOOK

for

SINGLE SIDEBAND ADAPTER

MODEL GSB-1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, NEW YORK OTTAWA, ONTARIO

SECTION I

GENERAL DESCRIPTION

1. DESCRIPTION

The TMC Model GSB, Single Sideband Adapter is a precision built unit, housed in an attractive metal cabinet to match the TMC Model GPR-90 Communication Receiver. Cable and connectors are provided with each GSB to permit shielded connection between the I.F.Output of the GPR-90 and the I.F. Input of the GSB.

The GSB is a filter type adapter designed for use with receivers having a 455 Kc I.F. It permits simple and accurate tuning of single sideband signals and greatly facilitates the reception of AM and CW signals.

A tuning control tunes the incoming signal for proper relation to the band-pass filter which, with a bandwidth of 2.5 Kc at the 6 db. point and a skirt width at the 50 db. point of 3.5 Kc, permits sharp rejection of unwanted signals. A product detector follows the band-pass filter and provides carrier reinsertion for demodulation of Single Sideband, Exalted Carrier and CW signals to the best advantage. A low pass filter, with a cut-off at 5 Kc and high attentuation at 17 Kc, follows the product detector and eliminates all unwanted signals. Added protection of the first mixer against overload is provided by the use of a separate AVC system. Fast or slow AVC is provided by a switch on the front panel. This AVC system controls the signal beyond that provided by the receiver. A built-in audio amplifier eliminates the necessity of using the receiver's audio system. Further, by paralleling the two speaker outputs of the GSB and the receiver, one speaker may be used for the reception of Single Sideband, AM or CW signals.

An UPPER/LOWER SIDEBAND switch permits the selection of either sideband. In the reception of AM signals, the use of this switch permits selection of the sideband on which unwanted signals are least objectionable. With the AM/SSB switch in the SSB position, it is possible to receive AM signals with exalted carrier induced by carrier reinsertion produced in the GSB circuitry.

A noise limiter is also provided which clips both positive and negative peaks and is placed in or out of the circuitry by means of an ON-OFF switch on the front panel.

The only requirement for using the GSB, with any other receiver having 455 Kc I.F, is that a shielded connection be brought out from the plate of the last I.F.tube for connection to the I.F.input of the GSB.

SECTION II

INSTALLATION

1. UNPACKING

Carefully unpack the GSB and check any instructions which may be accompanying the instrument. The equipment should be checked for any damage that may have occured during shipment or storage.

2. INSTALLATION

The Model GSB, although originally designed for use with the Model GPR-90 receiver, (which already provides proper terminals) may be used with any receiver which will provide .3 volts (rms) R.F. input at approximately 455 Kc. For connection to the GPR-90 receiver, refer to the attached print IN-119. If there is no external provision for this connection on your receiver, it will be necessary to bring a lead out through a 10 mmfd coupling capacitor from the plate of the final I.F. stage. The use of RG-58/U low loss coaxial cable of short length, is recommended. This cable and fittings are enclosed with each unit.

The Audio output of the Adapter is available for loudspeakers, line or headphones. Connect a loudspeaker to the proper terminals on the rear apron of the GSB. Use of a headset on the Adapter opens the loudspeaker circuit.

If desired, the output of both the GSB and receiver may be used with a single loudspeaker or headset. Connect a single lead from an Audio Output terminal on the receiver to a terminal with nearly the same impedance on the GSB. The shield of the I.F. connecting co-axial cable is the circuit ground return. The output impedance at the terminals has now been halved. Therefore, to match the loudspeaker correctly it must be connected to the next higher impedance terminal on the GSB. Inserting the headset in the GSB jack disconnects the loudspeaker as before and still permits output from both the adapter and receiver. The output of either the adapter, receiver, or both will be controlled by the proper manipulation of both Audio Gain Controls.

SECTION III

OPERATION

1. DESCRIPTION OF CONTROLS.

a. Audio Gain - Power/off control; Clockwise rotation of this control first applies power to the GSB. Further rotation controls the output of Audio Amplifier.

b. Sideband - Upper/Lower control. This switch places the 1st oscillator in the correct position to permit either the upper or lower sideband to pass through the bandpass filter.

c. The Band Spread control varies the 1st oscillator over a limited range from the mid-frequencies of 438 and 472 Kcs. This permits a fine adjustment of the incoming signal to the bandpass filter and to the 17 Kc 2nd oscillator.

d. The AM/SSB switch turns on the 17 Kc 2nd oscillator in the SSB position. This oscillator is used for carrier reinsertion for SSB, exalted carrier or BFO for CW.

e. The AVC ON/OFF Switch provides overload protection for the first mixer by controlling the gain of the first I.F. amplifier.

f. The AVC Fast/Slow Switch provides two time constants. Fast for SSB and AM signals, slow for CW signals.

g. Noise limiter clips both positive and negative noise peaks.

2. TUNING PROCEDURE

A. Single Sideband Signals.

1. CONTROL POSITIONS:

SSB-AM Switch	SSB
BAND SPREAD	ON ZERO
SSB Switch	Either Upper or Lower, depending on which reception is desired.
AVC ON/OFF Switch	FAST for voice
NOISE LIMITER Switch	OFF until necessary

Tune the receiver for maximum momentary deflection on the S meter. This assures that the signal is centered in the receiver I.F. pass band. Tune the Band Spread knob on the Adapter very slowly for maximum intelligibility of the received signal. If the signal sounds garbled regardless of the Band Spread position, switch to the opposite sideband. For best AVC action, the R.F. gain of the receiver should be fully advanced. However, if reception is extremely noisy, the R.F. gain setting should be reduced.

B. AM SIGNAL

1. CONTROL POSITIONS:

SSB-AM	AM
BAND SPREAD	ON ZERO
SSB Switch	Upper or Lower
AVC ON/OFF	ON
AVC SLOW/FAST	FAST for voice
NOISE LIMITER Switch	OFF until necessary

Tune the receiver for maximum deflection on the S meter. Turn the Band Spread knob on the Adapter very slowly for maximum intelligibility of the signal. Correct demodulation will occur when the carrier and one sideband are placed in the filter bandpass. If interference appears on the signal, switching sidebands will eliminate its effects. Retuning the Band Spread control will again be required to bring the other Sideband and carrier back into the filter passband.

C. EXALTED CARRIER RECEPTION OF AM

1. CONTROL POSITION:

same as for SSB

The reception of H.F. AM signals may be accompanied by selective fading. The random fading of the carrier and its sidebands will produce considerable distortion. This can be eliminated by the demodulation of the signal with a locally generated carrier. This is accomplished in the GSB with the AM/SSB switch on SSB. Tune the Band Spread control to obtain a zero beat with the carrier. If interference is found, switching sidebands will eliminate it. No retuning of the Band Spread control is necessary.

D. CW SIGNAL

1. CONTROL POSITION:

same as for SSB except AVC Fast/Slow Switch on Slow.

CW may be received very simply with the GSB by simply tuning the Band Spread knob to obtain the desired audio tone.

SECTION IV

ALIGNMENT

1. 17 Kc OSCILLATOR.

With the AM/SSB switch on SSB the frequency of the 17 Kc second oscillator may be determined at the plate of the second mixer V5. Use of a frequency meter or E put counter will give direct readings of frequency while a lissajou pattern method using an accurate audio generator and oscilloscope will give an indirect method of measurement. Adjust the trimmer screw C-24 which projects out the top of the 17 Kc oscillator assembly until 17,000 cycles is obtained.

2. 472 Kc OSCILLATOR.

Set the Sideband Switch in the UPPER position. Set the Band Spread dial at Zero. Connect some frequency measuring device to the plate of V4 and adjust the slug in L1 until a frequency of 472 Kc is obtained.

3. 438 Kc OSCILLATOR.

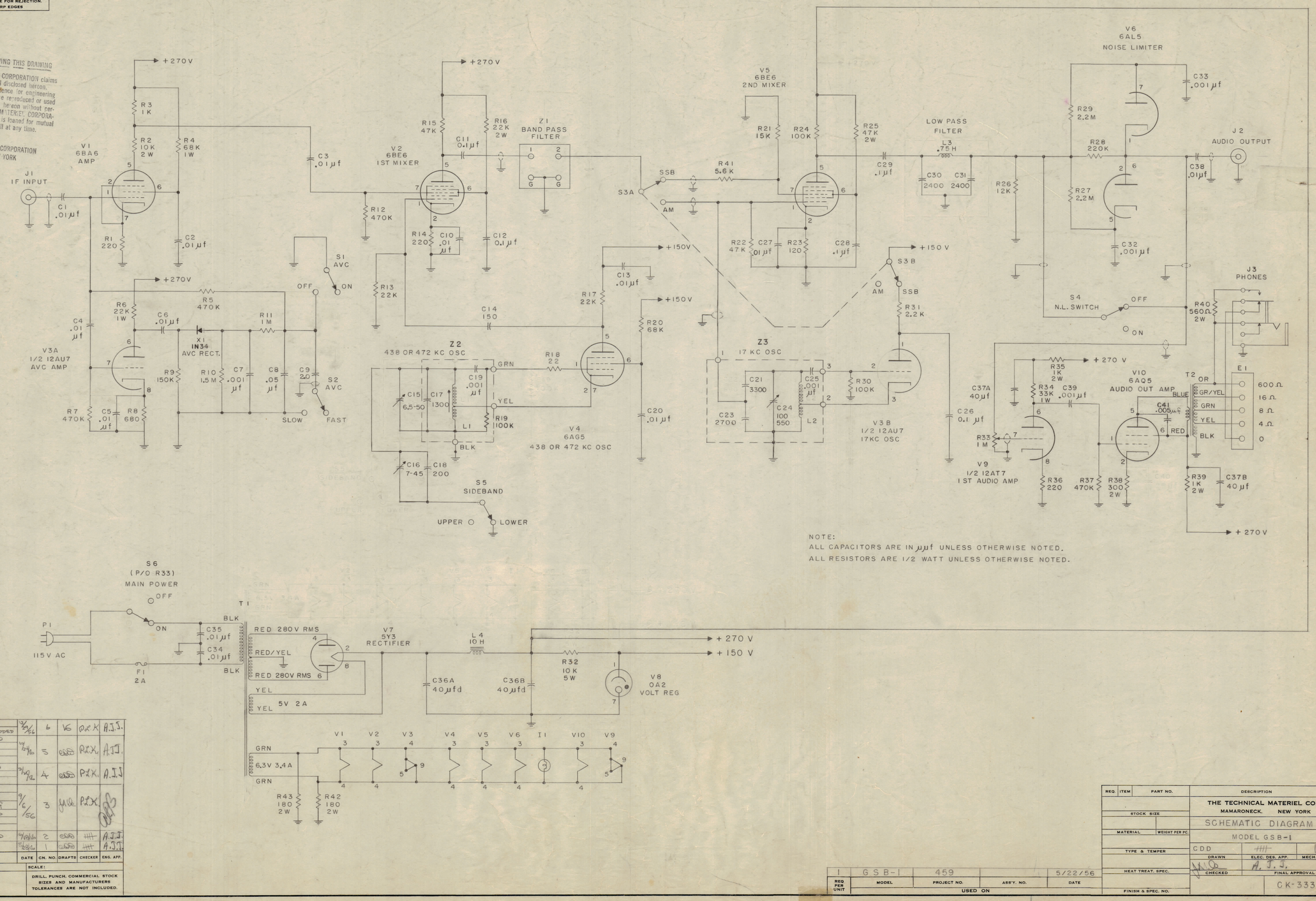
Set the Sideband Switch in the LOWER position. Follow the same procedure as for the 472 Kc Oscillator, but in this case C16 should be adjusted. An air test will tell if the upper and lower frequencies are correct. Tune in an AM signal with the AM/SSB Switch on SSB. Tune as for Exalted Carrier in the upper sideband position. When a zero beat is obtained switch to lower sideband. No change of zero beat should occur. If so readjust C16.

NOTE: When no frequency calibration equipment is available, the GSB may be aligned to the receiver. The GSB Adapter has been aligned for use with a receiver with a 455 Kc I.F. If the receiver you are using is slightly different, but within range of 452-458 Kc, it may be aligned as follows:

Set the Band Spread dial at zero, the Upper-lower sideband switch to Upper, the AM-SSB Switch to SSB. Tune in an AM signal on the receiver for maximum S meter deflection. Adjust the slug, in L1 for zero beat which then will give maximum intelligibility. Switch to lower sideband and adjust C16 for zero beat and maximum intelligibility. The GSB is now aligned.

IF IT IS FOUND DESIRABLE TO CHANGE ANY TOLERANCE OR OTHER DETAIL SPECIFIED ON THIS DRAWING NOTIFY THE PURCHASER PROMPTLY.

MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND DEVIATIONS WILL BE CAUSE FOR REJECTION. REMOVE ALL BURRS AND SHARP EDGES



ISSUE	ITEM	CHANGED FROM	DATE	CN. NO.	DRAFTS	CHECKER	ENG. APP.
F.	2	R19 MOVED TO Z2	12/29/56	6	VG	Q&K	A.J.J.
	1	SYMBOLS Z2 & Z3 ADDED					
E	4	RA1-A2-A3 ADDED	11/14/56	5	GMD	P&K	A.J.J.
	3	C40 DELETED					
	2	R21 WAS 20K					
	1	C39 WAS .01					
D	3	Q23 WAS 5100	9/19/56	4	GMD	P&K	A.J.J.
	2	C22 DELETED					
	1	R22 WAS 20K					
C	6	C41 ADDED	9/6/56	3	GMD	P&K	A.J.J.
	5	C27 WAS .1 µf					
	4	C26 WAS 1.0 µf					
	3	C24 WAS 0.2, 140					
	2	C23 WAS 10,000					
	1	C21 WAS 2780					
B	1	AUDIO AMP. ADDED	4/10/56	2	GMD	###	A.J.J.
A	1	S2 WAS CW-SSB	5/8/56	1	GMD	###	A.J.J.

TOLERANCES

ALL OTHERS: DEC. DIM. ± ; FRAC. DIM. ± ; ANGULAR DIM. ±

SCALE:

DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED.

REQ PER UNIT	MODEL	PROJECT NO.	ASS'Y. NO.	DATE
1	GSB-1	459		5/22/56

USED ON

REQ.	ITEM	PART NO.	DESCRIPTION	SYMBOL
			THE TECHNICAL MATERIEL CORP. MAMARONECK. NEW YORK	
STOCK SIZE			SCHEMATIC DIAGRAM	
MATERIAL	WEIGHT PER PC.		MODEL GSB-1	
TYPE & TEMPER			CDD / DRAWN: ### / ELEC. DES. APP. / MECH. DES. APP.: W.C.	
HEAT TREAT. SPEC.			H.L. / CHECKED: A. J. J. / FINAL APPROVAL	
FINISH & SPEC. NO.			CK-333	F

CK-333 F

FORM — 111