

MAGNUM SIX

R F SPEECH PROCESSOR

Model RF6DB-C

INSTRUCTION MANUAL

for Collins models



Communication Technology Group
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Federal Way, Washington 98002

WARRANTY

The Communications Technology Group (CTG) of Bitcil Systems, Inc. agrees to replace, without charge, any equipment, parts or accessories which are defective as to workmanship or materials. Any MAGNUM SIX which has a malfunction through no fault of the owner within 90 days of date of purchase shall be repaired without cost upon return to our plant. All parts are guaranteed for one year. Should a malfunction occur due to no fault of the owner within one year from purchase, CTG will repair the MAGNUM SIX for a \$5.00 labor charge.

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1.0 INTRODUCTION

You have just purchased a quality unit which is the most advanced and thoroughly developmental and production tested RF Speech Processor available to the discerning amateur radio operator!

The MAGNUM SIX is quality engineered in every respect and all components have been specially selected to assure long life with trouble-free operation. Each unit is subjected to a minimum of 24 hours of continuous "burn-in" operation before final test, inspection and assembly into its case. The layout and construction of your new MAGNUM SIX incorporates state-of-the-art aerospace engineering techniques to assure maximum port-to-port isolation, uses a genuine Collins 2.1 khz bandpass mechanical filter and the unit uses ground plane double-sided glass epoxy circuit boards throughout.

The unit is constructed as a sealed module to assure RF integrity and to preclude tampering so that we can offer our flat rate one year service guarantee.

Your MAGNUM SIX has been designed and developed by experienced professionals who are also ardent radio amateurs. Our goal has been to achieve a significant advance in amateur radio SSB communications. We know that once you have properly placed your MAGNUM SIX on the air, you will agree that we have achieved that goal.

Good luck and good DX !

2.0 INSTALLATION

2.1 GENERAL

Figure 2.1-1 is a block diagram depicting the functional relationship between the MAGNUM SIX RF Speech Processor and your Collins transmitter or transceiver.

The MAGNUM SIX processes your RF signal after the carrier has been nulled and a DSB (double sideband) signal has been generated in the Balanced Modulator. (See your Collins manual under "Principles of Operation"). The DSB signal is first amplified in the MAGNUM SIX and passed through a genuine Collins 2.1 khz mechanical bandpass filter. The desired sideband signal is passed through this filter and, at this point, the signal becomes SSB (single sideband) with characteristics similar to those of your original equipment. The SSB signal then follows one of two possible paths through the MAGNUM SIX that is selected by the operator using the MODE control. In the MODE OUT position, the SSB signal is routed from the filter through a source follower FET, for impedance matching, and then reinserted into the transmitter at the IF amplifier. In the MODE IN position, the SSB signal is routed from the filter into a specially selected and bias-trimmed IC op-amp (integrated circuit operational amplifier) where the peak amplitude signals are clipped to form symmetrical square waves and the lower amplitude signals are raised to higher relative levels by ≤ 6 db. The clipped and amplified output of the IC is then reinserted at the IF amplifier of the transmitter at the same voltage level that was achieved prior to installation of the MAGNUM SIX.

This partially processed clipped signal contains many undesired (splatter) harmonic components because of the nonlinear Fourier series operation being performed on it during the clipping. These harmonics all lie outside the 455 khz center frequency of the mechanical bandpass filter and are cleanly removed when the signal is passed out of the MAGNUM SIX and on through the original filter stage in your equipment, which becomes the "umbrella" filter of the system. This second filtering comprises the final step in achieving high quality RF speech processing.

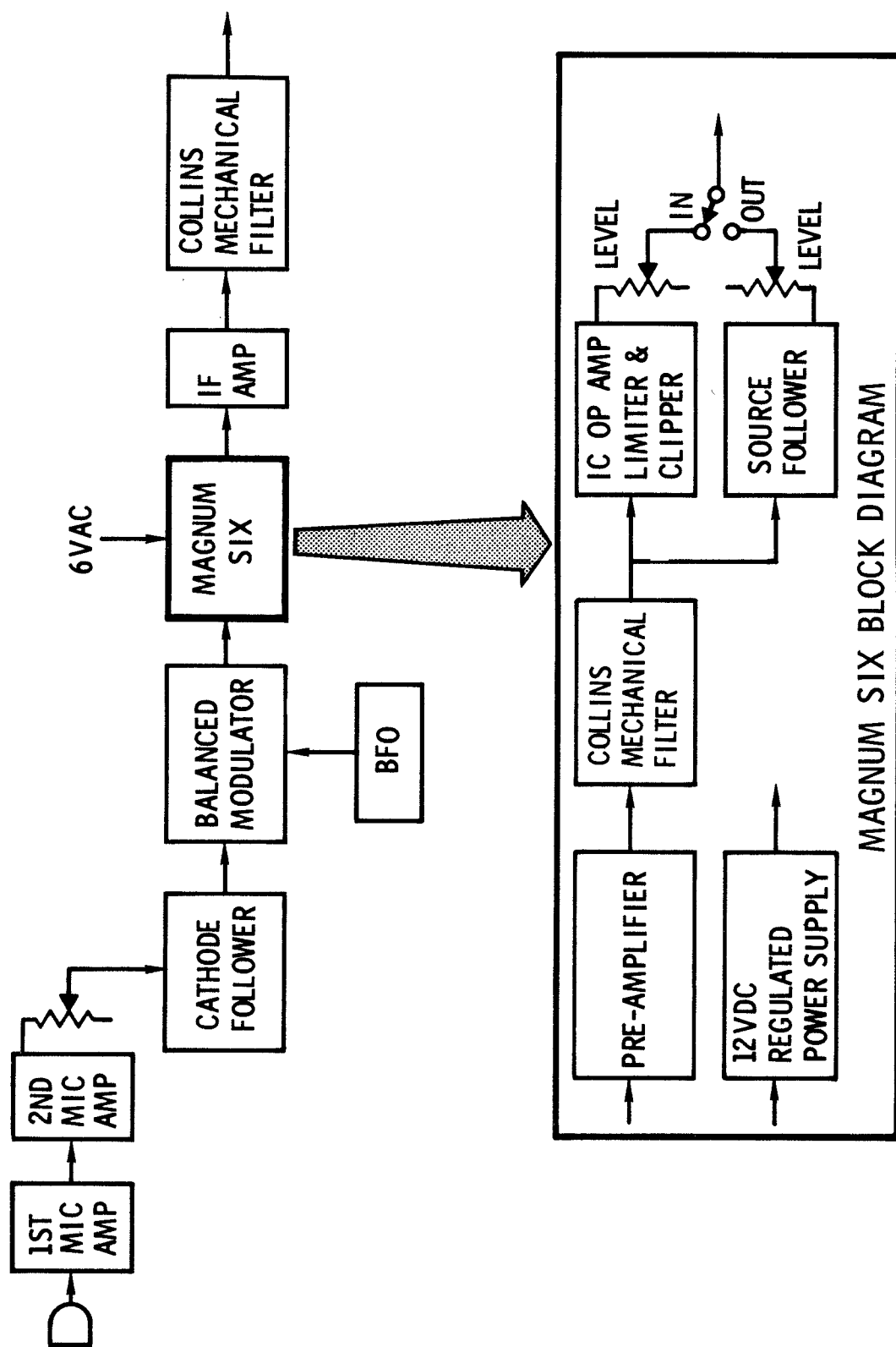


FIGURE 2.1-1 BLOCK DIAGRAM

This choice of the MAGNUM SIX filter, and the arrangement of its amplifier and clipper stages relative to the Balanced Modulator, IF Amplifier and Mechanical Filter of your original equipment, has three significant advantages over other RF Speech Processors:

1. When in the IN MODE, retention of the same narrow bandwidth output as the original equipment is assured.
2. When in the OUT MODE, the signal is passed through two 2.1 khz bandpass filters in series which will produce a narrower and cleaner output signal than the original equipment is capable of since the tolerances of the two filters around the center frequency will be additive in the narrower bandpass direction.
3. In the case of transceivers, the MAGNUM SIX is installed with NO ALTERATIONS in the receiving channel.

2.2 TRANSMITTER/TRANSCIVER MODIFICATION

Installation of the MAGNUM SIX into your Collins KWM 2/2A, 32S1 or 32S3 requires no permanent modification to the original equipment! Installation of the MAGNUM SIX is simply accomplished by removal of the IF amplifier tube V3 for the 32S1 and 32S3 or V4 for the KWM 2/2A, insertion of the wired Vector socket included with your MAGNUM SIX, and reinsertion of the IF amplifier tube into the top of the Vector socket. The two coaxial cables and the single wire lead originating at the Vector socket are routed through an existing opening in the rear of the cabinet of your unit and are connected to the appropriate phono sockets on the rear face of the MAGNUM SIX.

Before installation of the MAGNUM SIX is accomplished, it is recommended that the precalibration procedures of paragraph 3.2 are performed to ensure rapid bandswitching and tune-up during equipment operation.

3.0 PRECALIBRATION, FINAL INSTALLATION AND OPERATION

3.1 EXPLANATION OF CONTROLS

The MAGNUM SIX derives its 6 volt ac power input from the filament voltage available in your equipment. Consequently, the all-solid-state MAGNUM SIX is instantly, safely and automatically energized by its own regulated power supply upon placing your transmitter or transceiver in the ON function position. Further, it is fail-safe since no dropping resistors are employed to establish the V_{cc} of the unit.

The MAGNUM SIX has three controls: A two-position MODE switch, located in the center of the panel; and two level adjustment controls, LEVEL OUT located to the left and LEVEL IN to the right of the MODE switch. When the MODE switch is in the OUT position, the LEVEL OUT control adjusts the transmitter drive level for "straight through" operation without RF speech processing. When the MODE switch is in the IN position, the LEVEL IN control adjusts the transmitter drive level with RF speech processing.

The setting of the MIC GAIN control of your transmitter, which controls the level of the signal fed to the MAGNUM SIX's fixed clipping threshold input, determines how many db of RF speech processing are obtained. The correct settings of the MIC GAIN, the LEVEL OUT, and the LEVEL IN controls will vary from transmitter to transmitter depending on several factors such as; tolerances resulting from manufacture, usage and aging of components and tubes, microphone selected, your voice characteristics, etc.

When your MAGNUM SIX has been adjusted in accordance with the instructions that follow, the processed signal transmitted from your equipment will have an average power increase of 6 db (four times the average power)! From many on-the-air reports, it has been observed that a processed voice will contain considerably more "FULLNESS" and "TALK POWER" than before. In addition, it has been reported that RF processed SSB is actually more pleasant to copy because of the "FULLNESS" without regard to the increased signal strength.

CAUTION

CAUTION

CAUTION

CAUTION

JUST AS IS POSSIBLE WITHOUT THE MAGNUM SIX, IMPROPER ADJUSTMENT OF YOUR EQUIPMENT WITH THE MAGNUM SIX CAN RESULT IN ONE OR MORE OF THE FOLLOWING UNDESIRABLE RESULTS:

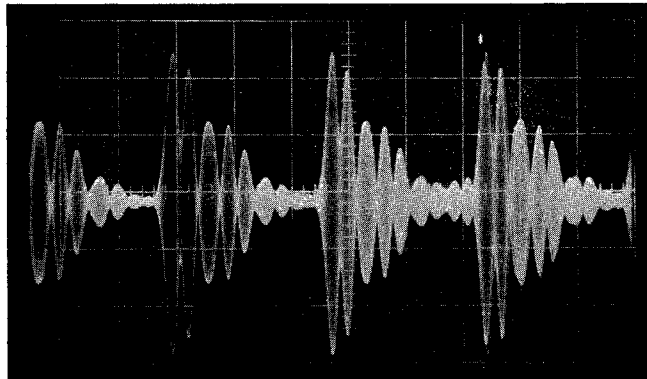
1. OPERATION OF YOUR LINEAR AMPLIFIER BEYOND THE LEGAL LIMITS PRESCRIBED BY THE F.C.C.
2. SEVERE SHORTENING OF THE LIFE OF YOUR EQUIPMENT'S TUBES AND TANK CIRCUIT COMPONENTS.
3. POWER SUPPLY OVERLOAD.
4. VOICE QUALITY DEGRADATION AND EXCESSIVE BANDWIDTH.

The MAGNUM SIX has been meticulously engineered to perform superior RF speech processing in accordance with its specifications. As with any high quality, high performance equipment, the MAGNUM SIX is not completely "IDIOT PROOF" and must be properly adjusted to operate with your particular transmitter to obtain the desired increase of average output power.

3.2 PRE-INSTALLATION CALIBRATION

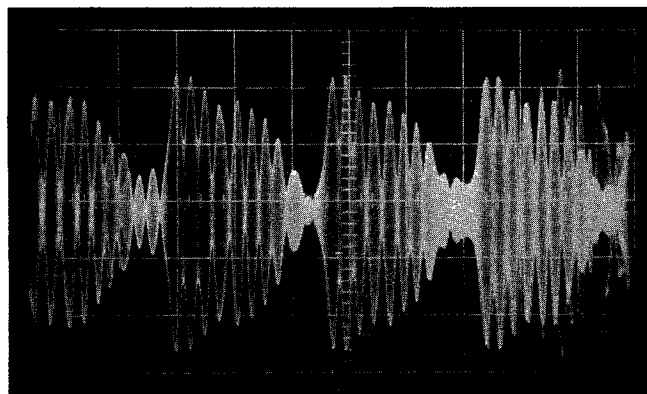
To obtain optimum operation of your MAGNUM SIX, it is highly recommended that your station be equipped with a monitor scope or other peak RF voltage output measuring device. See Figure 3.2-1 for typical output RF patterns. Use of such measuring equipment, especially if a linear amplifier is employed, will assure that overdrive and subsequent flat-topping and splatter are not generated as a result of your trying to "squeeze out an extra db".

If, however, your station is not equipped with peak RF output monitoring equipment, it is still possible to obtain the added 6 db of clean, average power gain available as a result of the addition of the MAGNUM SIX if you carefully precalibrate and adhere to the following set-up procedures.



↓
 P_{av}
↑

UNPROCESSED SIGNAL OUTPUT



↓
 P_{av}
↑

PROCESSED SIGNAL OUTPUT

FIGURE 3.2-1 RF OUTPUT PATTERNS

FREQUENCY MHZ	PLATE CURRENT MA	MIC /CW CONTROL POSITION	MAGNUM SIX	
			"OUT" CONTROL POSITION	"IN" CONTROL POSITION
3.900				
7.250				
14.275				
21.350				
28.600				
29.100				
29.600				

FIGURE 3.2-2 CALIBRATION CHART

As you perform the following steps, carefully record the observed data in the tune-up chart provided in this manual. Through use of these data future operation of your equipment will be quick, clean, more powerful and easily repeatable.

1. Prior to removal of the IF amplifier tube and the subsequent installation of the MAGNUM SIX Vector socket, the following steps should be performed with your equipment in its original configuration to allow you to make the necessary measurements that will define the operating parameters peculiar to your equipment, voice, etc., and that will assure proper operation of your MAGNUM SIX. Note that in all cases, the peaks should be sharp and clean as depicted in Figure 3.2-1. Adjust your scope so that only a few patterns are displayed to obtain the greatest information.
2. On each band that you plan to operate, tune up your rig in accordance with your Collins manual and adjust the MIC GAIN level control to the position that you normally use. If possible, make a contact with another station to assure that the audio level setting is correct for your voice and equipment. ALC average reading should be 6 db for the 32S1/32S3 and S6 for the KWM 2/2A.
3. Upon achieving step 2, switch the transmitter/transceiver METER switch to PLATE and note and record the peak plate current reading and MIC GAIN level control setting obtained during normal conversation of step 2 above. These data should be recorded on the calibration chart, Figure 3.2-2. This reading should be approximately 100-110 ma. For example; the chart should be filled out as follows during this calibration:

FREQUENCY MHZ	PLATE CURRENT MA	MIC GAIN CONTROL POSITION	MAGNUM SIX	
			"OUT" CONTROL POSITION	"IN" CONTROL POSITION
3.900	100	11 o'clock		

This completes the precalibration and you may now proceed with the final installation instructions of paragraph 3.3.

3.3 FINAL INSTALLATION

- () Refer to Figure 3.3-1 of this manual. Select the installation pictorial that applies to your transmitter or transceiver.
- () Remove V3 from your 32S1 or 32S3 or V4 from your KWM 2/2A.
- () Insert the wired Vector socket supplied with your MAGNUM SIX into the tube socket just vacated in your equipment.
- () Install V3 or V4 into the top of the Vector socket.
- () Route the two coaxial cables and the hook-up wire cable connected to the Vector socket through the openings in the back of your cabinet. For the 32S1/32S3 use the opening in the upper right rear corner of the transmitter. In the case of the KWM 2/2A use the opening provided for External VFO power. See Figure 1.1, page 1-0, of your Collins manual.
- () Connect the cable that is fabricated of hook-up wire from the Vector socket to the "6.3 VAC" socket on the rear of the MAGNUM SIX.
- () Connect the appropriately marked coax cable from the Vector socket to the "PROCESSOR INPUT" socket on the rear of the MAGNUM SIX.
- () Connect the other coax from the Vector socket to the "PROCESSOR OUTPUT" socket on the rear of the MAGNUM SIX.
- () This completes the installation of the MAGNUM SIX into your equipment. Place the MAGNUM SIX in the operating position of your choice — on top of or next to your set — and proceed with the operating instructions contained in paragraph 3.4 of this manual.

3.4 ADJUSTMENT AND OPERATION

Prior to the application of power to your equipment and the initiation of the following adjustment procedures, make sure that your MAGNUM SIX is properly connected to your transmitter or transceiver. See Figure 3.3-1. Special attention should be given to insure that the 6 volt power line and the coaxial cables between your equipment and the MAGNUM SIX are properly connected.

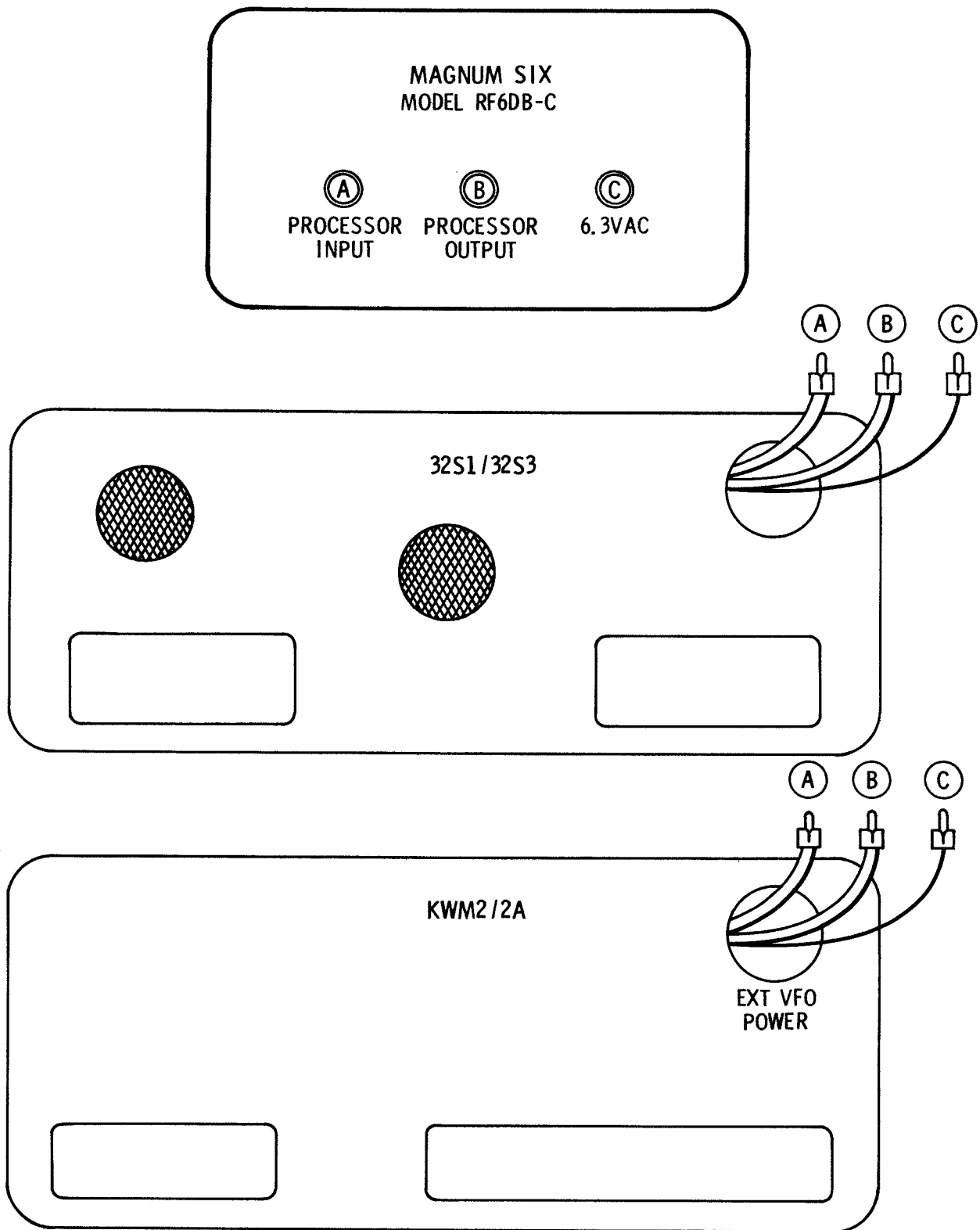


FIGURE 3.3-1 INSTALLATION PICTORIAL

1. Set the MAGNUM SIX's MODE switch to OUT.
2. Set the OUT LEVEL control in the full clockwise (right) position.
3. Turn the transmitter/transceiver ON and allow time to warm up.
4. Proceed to tune your transmitter/transceiver in accordance with your Collins instruction manual.
5. Place the MIC GAIN control to the position that you have charted during paragraph 3.2 precalibration.
6. Set the METER switch to PLATE and observe the meter reading during speech peaks. If the plate current exceeds that noted in your chart, back off (counter clockwise) the MAGNUM SIX's OUT LEVEL control until the meter agrees with your previous measurement. If the plate current reading is less than you recorded, advance the MIC GAIN level clockwise until agreement is achieved and correct your chart. Record the MAGNUM SIX OUT LEVEL control position setting and proceed to the next step.
7. Set the MAGNUM SIX's IN LEVEL control to approximately 12 o'clock.
8. Place the MAGNUM SIX MODE switch to IN.
9. While talking into your microphone, advance (or retard) the IN LEVEL control until the METER reads speech peaks of approximately 140 ma in the PLATE position. Record the IN control position setting on your chart.
10. Repeat the above and record the data for each band to be operated. Each line item of your chart, Figure 3.2-2, should now be completed and rapid tune-up of the MAGNUM SIX can be achieved by simply setting the controls as recorded in your chart. As an example:

FREQUENCY MHZ	PLATE CURRENT MA	MIC GAIN CONTROL POSITION	MAGNUM SIX	
			"OUT" CONTROL POSITION	"IN" CONTROL POSITION
3.900	100	11 o'clock	2 o'clock	1 o'clock

To complete your addition of the MAGNUM SIX and to assure a signal quality that is the "NE PLUS ULTRA" that can be achieved with existing technology, you may want to check to assure that your modulator is properly balanced to account for the lengths of coaxial cable that have been added to your equipment.

3.5 ADDITIONAL AVERAGE POWER

Some additional average power gain can be achieved by increasing the RF clipping action of the MAGNUM SIX. This added gain can be accomplished by advancing the MIC GAIN level control (do not attempt to attain this added power by advancing the MAGNUM SIX's IN LEVEL control) beyond the setting noted in your chart. However, if this option is exercised, you should be aware of the following precautions:

1. Background noise level will increase at some advanced MIC GAIN setting and it will tend to defeat your purpose.
2. Overdrive and flat-topping of your exciter and/or your linear may occur.
3. At some point, audio distortion will become apparent and the signal may become broad.
4. In any event, carefully monitor the PEAK PLATE CURRENT SHOWN ON YOUR METER AND NEVER ALLOW IT TO EXCEED 150 ma.

3.6 OPERATING CONSIDERATIONS

The addition of the MAGNUM SIX to your equipment causes your exciter and linear amplifier to work harder and with an increased duty cycle. This added work causes considerably more heat to be generated by your equipment and it is essential that ADEQUATE VENTILATION be provided. NEVER place anything on top of your equipment that will restrict air flow. In cases where linear amplifiers are not equipped with a fan or blower, the addition of one should be considered. As an added precaution, you may desire to provide a fan or blower to circulate air through the final of your exciter; however, experience has shown that if your equipment is operated within the limits listed in your tune-up chart, no apparent equipment life degradation will occur.

3.7 OPERATION WITH CLASS AB LINEARS

If your station is equipped with a Class AB₁ or AB₂ Linear Amplifier, you may find that excessive grid current may be indicated when the MAGNUM SIX is adjusted in accordance with your chart. If this condition occurs, back-off the IN LEVEL and OUT LEVEL controls of your MAGNUM SIX to regain proper operation of your amplifier. FAILURE TO OBSERVE THIS REQUIREMENT MAY SHORTEN TUBE LIFE AND/OR CAUSE FLAT-TOPPING WITH ATTENDANT SPLATTER. Please refer to Figure 3.2-1 for correct output patterns.

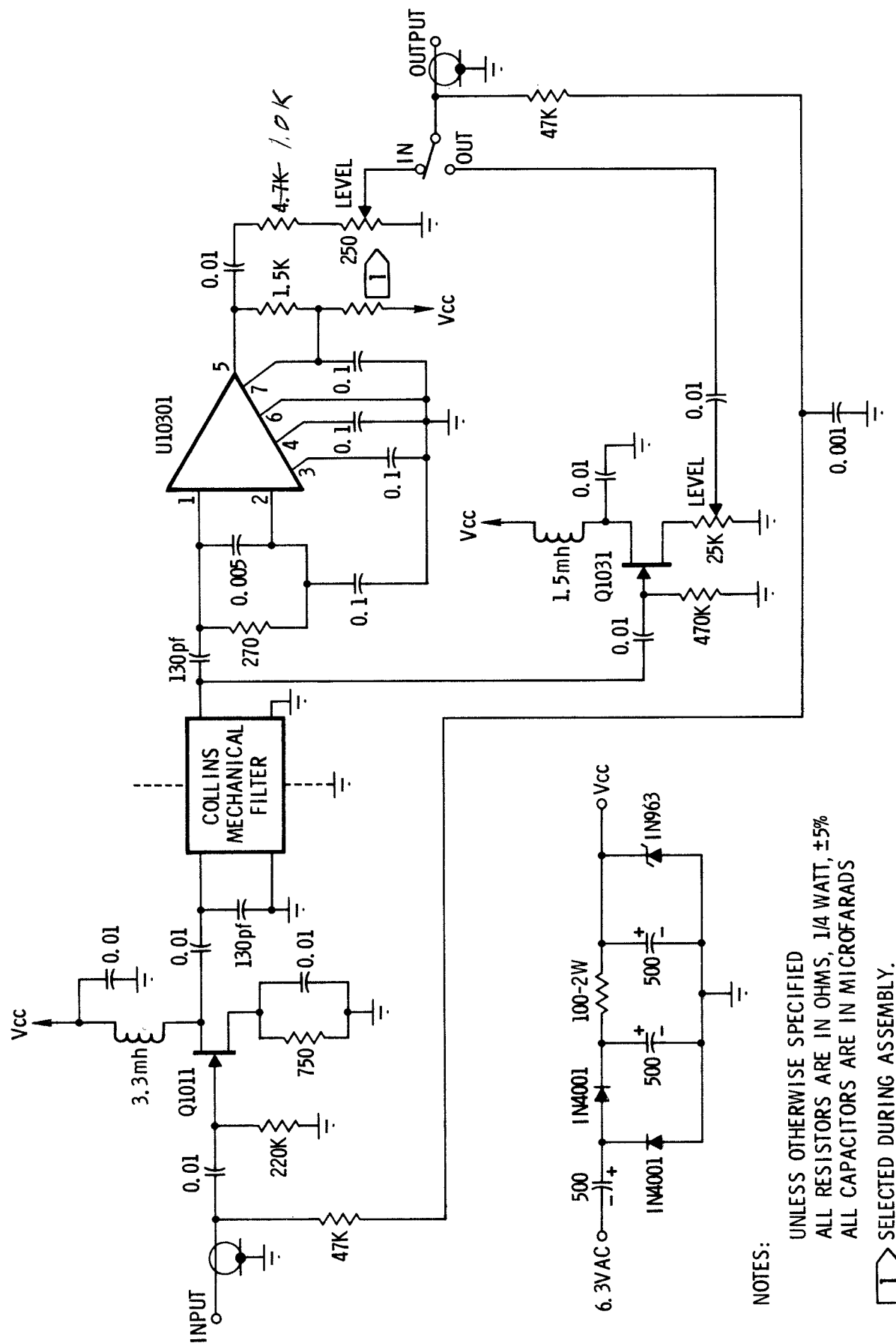


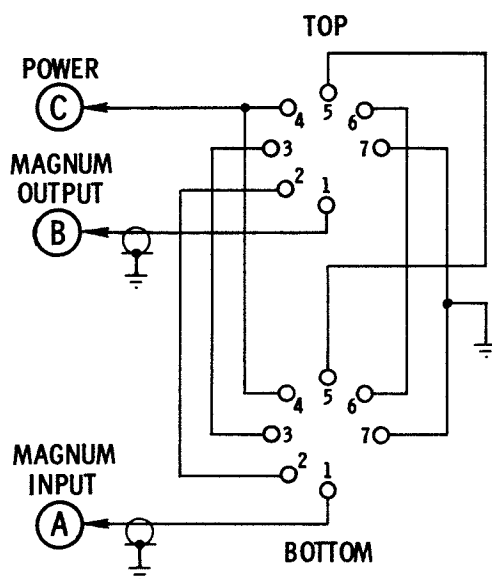
FIGURE 4.0 SCHEMATIC DIAGRAM MAGNUM SIX MODEL RF6DB-C

5.0 TROUBLE SHOOTING AND SERVICE

As a result of our solid state design, extensive pre-production developmental testing, and pre-delivery burn-in and test, the MAGNUM SIX should deliver years of trouble-free operation. In the event a malfunction occurs, the following checks should be made:

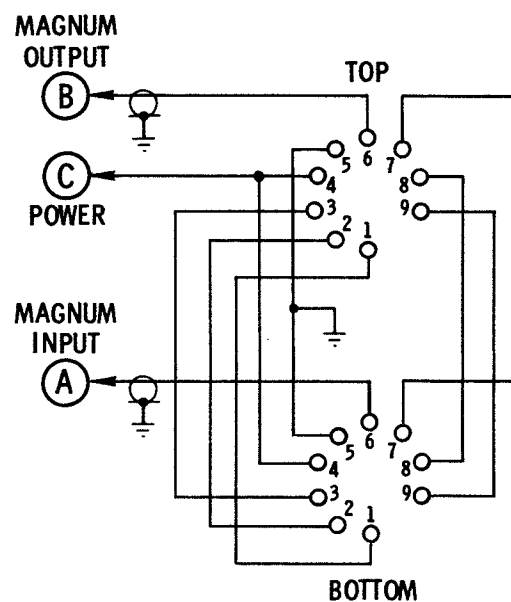
1. Check all interconnect cables for continuity and/or shorts.
2. With power applied, measure the ac voltage to ground at the 6 volt ac phono socket at the rear of the MAGNUM SIX to determine that 6.3 volts ac is available from the exciter.
3. Measure the dc voltage at the anode (striped) end of the Zener diode, on board 104, to verify that a dc voltage of approximately 12 volts is available.
4. Using an 11 megohm VTVM with RF probe or an oscilloscope, probe the PROCESSOR IN phono socket to determine if an RF voltage of 150 to 200 mv is available when the exciter is in the KEY-DOWN or TUNE condition and the MIC GAIN control fully clockwise.
5. Using the VTVM or oscilloscope, measure the PROCESSOR OUT phono socket of the MAGNUM SIX for an RF voltage of 150 to 200 mv with the MAGNUM SIX in both the IN and OUT MODE and with both LEVEL controls advanced fully clockwise and the transmitter in the KEY-DOWN or TUNE condition per test 4.
6. Disconnect the MAGNUM SIX from your exciter, remove the Vector socket and cables from your equipment and place V3 or V4 back into its socket. This restores your transmitter/transceiver to its original equipment configuration. Proceed through the tune-up directions in your Collins manual and ascertain that your exciter is operating properly.
7. If improper operation of the exciter is observed, check your Collins manual for trouble shooting procedures.

8. If all of the above checks have been performed and the malfunction has not been isolated, and you believe that the problem is with the MAGNUM SIX, write to our staff describing the symptoms and forward all data pertaining to the above trouble shooting procedures. We will evaluate your findings and either advise you of further tests to perform or send you instructions for returning the MAGNUM SIX to our plant. If the unit is within the warranty period and the unit has in our opinion not been altered or maltreated, the unit will be repaired or replaced at our discretion. If the unit is beyond the warranty period, we will provide free trouble shooting and will advise you of the repair costs prior to performing the repair.



32S1/32S3

V3



KWM2/2A

V4