Model MB

Solid-State VHF Aeronautical Band
Radio Receiver/Transmitter
Base Station
(118.000-136.975 MHz)

OWNER'S MANUAL

MODEL MB SOLID-STATE VHF
AIRCRAFT BAND RADIO RECEIVER/TRANSMITTER

INTRODUCTION

The Mentor Model MB receives and transmits on up to six discrete channels in the vhf aviation band between 118 and 136 MHz. It is a base transceiver for air carriers, airports, fixed-base operators, corporate flight departments, hospital helipads, etc. Extensive use is made of integrated circuits and the latest MOS and bipolar technologies. The advantages of the solid-state design include high inherent reliability, reduced size and weight, low power consumption and minimum heat dissipation. The unit is self-contained except for the antenna, coaxial cable and the microphone. Optional features include a key-operated on-off switch, remove operation and relay rack mounting. It operates from a 105-125 volt 50/60 Hz power line or from 210-250 volts by selecting that range on the power entry module on the rear. Power cords are available for nearly any country in the world.

CIRCUIT DESCRIPTION

The receiver is a single-conversion super heterodyne with a triple-tuned dual gate MOSFET RF amplifier stage preceding a dual gate MOSFET mixer. The separate local oscillator is crystal controlled, using 3rd overtone crystals operating at one-third the injection frequency. In radios having two or more channels, the channel selector switch simultaneously connects the proper crystals into the receiver local oscillator and transmitter oscillator circuits. This switch also applies a DC voltage to receiver and transmitter RF tuned circuits, which are electronically tuned by voltage-variable capacitors (varactors). Receiver selectivity is primarily determined by an eight-pole monolithic crystal filter connected between the mixer and IF amplifier. Automatic gain control is applied to the RF amplifier and the first of the two integrated circuit IF amplifier stages. A conventional diode detector is followed by a noise limiter, an audio preamplifier and squelch circuits. An automatic leveling circuit (ALC) gives added gain for weaker audio signals, but less gain for strong signals, providing a relatively constant speaker level and preventing unpleasant blaring from strong, heavily-modulated signals. This circuit also compensates for variations in voice strength when modulating during transmissions. Following the volume control, three stages of audio amplification deliver up to 5 watts of audio to an internal 8 ohm speaker. Separate IF and RF AGC amplifiers allow the receiver to handle a very wide range of signal strengths with little change in speaker loudness.

The transmitter consists of a crystal-controlled oscillator, a frequency tripler, a buffer-amplifier stage and a 4-stage broadband RF power amplifier, the last three stages of which are collector (amplitude) modulated. The channel frequency is generated using precision 3rd overtone crystals operating at one-third the final frequency. At the transmitter output a low-pass filter network reduces harmonics to meet U.S. FCC regulations. Additional circuits at the output include an electronic transmit-receive (T-R) switch, RF level sensing, and a reflected-power sensing bridge (antenna SWR indicator circuit) that shows the condition of the antenna system.

MODEL MB VHF AIRCRAFT BAND RADIO RECEIVER/TRANSMITTER

INSTALLATION

Select a desk, counter, shelf or table top on which to place the Model MB, convenient to the operator but inaccessible to unauthorized persons. The MB is also available with optional relay rack mounting. Allow several inches space behind and above the unit for air circulation; this is especially important if heavy use is anticipated. Plug the line cord into a properly grounded standard 3-wire electrical outlet. If an extension cord is needed, a 3-wire type should be used. For operation outside of North America, an appropriate line cord must be used, and to prevent damage to the radio be certain that the voltage selector at the power inlet is set for 220 volts if that is the voltage available at the site.

The performance of both the receiver and transmitter is affected considerably by the antenna and coaxial cable installation. For greatest range in all directions, the antenna should be as high as practical, consistent with regulations concerning heights of structures near the airport. If possible the antenna should be higher than nearby buildings to prevent shielding or "shadowing". Antenna height is especially important for communications with lower altitude aircraft, or if there is higher terrain within desired communications distances.

The antenna for the Model MB should be located well away from other communications antennas if at all possible. Strong nearby signals from transmitters on other channels can block or interfere with reception in any radio receiver. If there are other aviation bad transmitters and antennas on the airport, the minimum recommended distances between these and the MB antenna depend on the frequency separations, and are as follows:

FREQUENCY SEPARATION	**DISTANCE BETWEEN ANTENNAS**
less than 0.5 MHz	0.5 miles (800 meters)
0.5 to 2 MHz	1000 ft. (300 meters)
2 to 5 MHz	500 ft. (150 meters)
over 5 MHz	300 ft. (100 meters)

If it is impossible to locate the MB's antenna sufficiently far from other antennas, and interference results, consult with Mentor Radio.

The coaxial cable ("coax") connecting the antenna to the Model MB causes signal attenuation proportional to its length in both receive and transmit modes, so that a short cable is desirable. This factor often conflicts with the need to locate the antenna high, away from structures and distant from other antennas. For longer cables, coax types with lower signal loss should be used. Type RG-58 coax is suitable for lengths up to 50 feet (15 meters). Type RG-8, or similar, can be used for lengths to 150 feet (45 meters). For more than 150 feet, consult with Mentor Radio about very low loss cables.

Very low loss coaxial cables are thicker, heavier and stiffer and are therefore harder to work with and install. For lengths that exceed 150 feet (50 meters), consider remote operation.

The coaxial cable should be terminated at the radio end by a "UHF" type connector, some-times called a "PL259". The connector should be installed by a person skilled in this operation. This connector plugs into the mating connector (type "SO239") on the rear of the MB—be sure to turn the ring with the internal threads CW until the connection is firmly made. At the antenna end, if there is

no similar connector, any unshielded center lead should be no longer than 2 inches (5 cm.)

A number of acceptable microphone choices exist. Whether of the hand held aircraft style or a table or desk “dispatchers” style, a transistorized dynamic microphone element is much preferred over the older carbon type elements which have poorer performance and shorter lives. Many readily available microphones, such as a “condenser”, un-amplified dynamic and ceramic types will *not* work with the model MB. The microphone plug must be of the 3/16 inch diameter 2-circuit type, as commonly used in aircraft. The microphone plug should be inserted completely and firmly into the microphone jack at the lower left of the front panel of the MB.

If the Model MB is to be operated remotely, refer to additional installation instructions that accompany the various kinds of remote accessory equipment.

MODEL MB VHF AIRCRAFT BAND RADIO RECEIVER/TRANSMITTER

OPERATION

The Model MB is turned *on* and *off* by the rocker switch near the lower right corner of the MB front panel. When the MB is *on* the green lamp built into the switch will light.

The volume control knob (marked VOL) adjusts speaker loudness to the level preferred by the operator. Since the on-off switch is not combined with the volume control, the volume setting may be left unchanged when the radio is turned off. The volume control does not affect transmitter operation.

The squelch control allows the operator to eliminate undesirable receiver background noise when no signal is being received. Turning the knob (marked SQ) fully counterclockwise “unsquelches” the receiver, allowing background noise and very weak signals to be heard. Some operators may prefer to leave the receiver unsquelched at all times. For those who prefer to use the squelch, periodic unsquelching can serve as a receiver test, since a large reduction in background noise might indicate receiver malfunction. To squelch the back-ground noise, rotate the SQ control clockwise only as far as necessary to just stop the noise. Further rotation may result in not hearing more distant aircraft. There may be some circumstances in which an operator does not wish to hear more distant aircraft, such as when such aircraft are communicating with a different ground station. In this situation the control may be rotated fully clockwise. The squelch control does not affect transmitter operation.

The signal strength meter (S-meter) is useful for checking receiver sensitivity and the relative strengths of aircraft transmitters whose positions are known. For example, if several aircraft at a specific ramp or taxiway position produce S-20 readings, while another produces only S-3, the latter's transmitter or antenna is probably not operating properly. Similarly, if most aircraft calling “5 miles out” produce an S-7 reading, another aircraft there that barely moves the S-meter needle probably has a poor transmitter or antenna. How-ever, if an aircraft calls and produces a good meter deflection (S-3 or higher) yet sounds weak, the aircraft’s transmitter is producing a good carrier signal but has poor modulation (perhaps from a bad microphone). The S-meter can also be used to study the effects of shadowing of the base station antenna due to nearby buildings, structures, terrain, etc., by having a cooperating aircraft fly a constant radius circle around the airport and calling at different locations. If the Model MB receiver is working properly and the operator is familiar with “average” S-meter readings for aircraft at various distances, then the meter can be used as a crude indicator of the aircraft’s distance from the station. The S-meter can also suggest loss of Model MB receiver sensitivity, if the readings from all aircraft become “less than usual”. Intelligent and thoughtful observations of the S-meter can often suggest the causes of communications problems. The dial

markings of “s-units” on the S-meter are somewhat arbitrary. If the MB receiver is operating normally, the following data are approximately correct:

READING	SIGNAL STRENGTH	MICROVOLTS
S1	weak	3
S3	fair	6
S5	good	12
S7	very good	25
S9	strong	50
Above	very strong	50-50,000

It takes about an S1 signal to “break squelch” at the minimum squelch setting. If the operator observes some small needle deflections, but hears no sound in the speaker, he can unsquelch the radio to determine whether the calls are directed to his station.

If the Model MB has more than one channel, the rotary channel switch on the front panel is used to select the desired channel. Transmit and receive frequencies are switched simultaneously. Changing the switch position connects a different pair of crystals (one each for receiving and transmitting) and readjusts all tuned circuits for the new channel. There may be small channel-to-channel variations in receiver sensitivity (as may be indicated by the speaker noise level) but this will not affect communications significantly. In case of a communications problem, check that the frequency selector switch has not been inadvertently changed to a different channel.

An aviation type noise-canceling microphone is recommended. To transmit, press the push-to-talk (ptt) switch on the microphone. Hold the microphone close (1/4 inch or 1/2 cm) to your mouth and speak directly into the center of the microphone’s acoustical opening, at a moderate voice level.

While the MB’s audio leveling circuits compensate for variations in microphone output, “microphone technique” is extremely important for good clear transmissions. Aviation microphones are purposely designed to be highly directive and are very sensitive to the distance from the speaker’s mouth. This is done to reduce pick-up of background noise. It is impossible to overemphasize the importance of holding these microphones close to the mouth and speaking clearly.

MICROPHONE TECHNIQUE

1. Hold microphone close to mouth (1/4 inch or 1/2 cm)
2. Enunciate clearly
3. Speak with average loudness-not softly (but don't shout)

If a non-noise canceling pedestal (dispatcher's) microphone is used, it is not as essential to hold the microphone close to the mouth. These microphones will pick up more back-ground and room noise, including the voices of other persons talking, radios playing, etc.

The three indicator lights at the upper right on the front panel are all of the high brightness light-emitting diode (LED) type. They operate only when transmitting. From left-to-right the indicator functions and colors are: transmitter carrier (yellow), modulation (green) and antenna (red).

The transmitter carrier indicator circuit samples the transmitter radio frequency power out-put at the Model MB antenna connector. Thus the circuit is more than just a "stuck micro-phone" indicator. If the lamp is on, the transmitter is producing a radio frequency carrier signal. If the microphone p-t-t switch is pressed, and the lamp does not turn on, the transmitter is not working properly.

The modulation lamp should light only when the operator speaks into the microphone. Due to the nature of voice modulation, this lamp will "flicker" as you talk. Failure to light indicates a problem in the microphone, the microphone connector or the modulation circuits. Note that the lamp will not light if the microphone is held too far from the speaker's mouth.

The red antenna lamp warns of a bad antenna system. It lights when transmitting if there is more than 10% reflected antenna power. This is equivalent to an SWR (standing wave ratio) exceeding 2:1. Most good antenna installations have an SWR less than 1.6, with reflected power less than 5%. If the ANT lamp lights, a person skilled in antenna installations should inspect the coaxial cables, connectors and the antenna itself, and correct any problems found. Note that some antennas must be cut to a certain length to match the frequency in use. If the Model MB has two or more widely spaced channels, a "broadband" antenna may be necessary to achieve low reflected power on all channels.

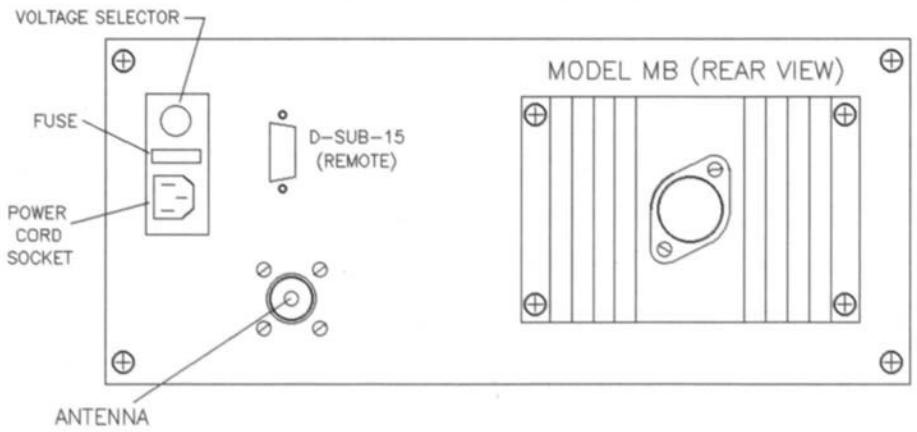
Note: The Model MB is designed to withstand high SWR. It is not necessary to cease transmissions if the ANT lamp comes on. However, the system should be inspected as soon as possible, since performance is impaired. In particular, make sure the antenna connector on the rear of the MB has not been inadvertently removed or loosened.

Thoughtfully used, the three transmitter indicator lights can suggest the causes and solutions to many communications problems. The following information pertains to the optional Remote Control Interface for those customers with this option installed. For customers seeking to add this capability to their existing installation, please call us.

TERMINAL ASSIGNMENTS FOR THE D-SUB-15 REMOTE CONNECTOR ARE:

D-SUB PIN NO.	FUNCTION
1	MIC PTT
2	MIC AUD
3-4-5-6	GROUND
7-8	4/8 OHM SPEAKER
9	500/600 OHM AUD
10	SQUELCH DISABLE
11	SIGNAL RCVD (COS)
15	+14 V *

*MB CAN SUPPLY UP TO 500 MA. TO EXTERNAL EQUIPMENT



MENTOR RADIO CO.		
Title: MODEL MB REMOTE INTERFACE CONNECTIONS		
Number: 1101620		Revision: A EC2381
Date: 8-31-95	Drawn By: J. STREATER	
File: TANGO\DRW\1101620.PCB	Sheet: 1 of 1	

Model MB Remote Interface Option

This option consists of a 15-pin D-sub connector mounted on the rear of the Model MB, an internal integrated circuit audio amplifier (type LM383) and associated components and the wiring between the connector, amplifier and other parts of the MB.

The D-sub connector pin functions are identified on drawing 1101620. Additional information follows:

Pin 1: Grounding the "Mic PTT" terminal activates the transmitter. This is equivalent pressing the microphone push-to-talk switch.

Pin 2: The remote microphone audio level required is approx. -20 to -10 dBm (80 to millivolts), which corresponds to the audio output of typical aircraft type microphones. This terminal connects internally to 13.8 VDC, via 2000 ohms, providing a "bias" current of approx. 6 ma. to the microphone.

Pins 3-4-5-6: Provide connections points for separate ground connections from the microphone, external tape recorders or other devices, and for power to external equipment.

Pins 7-8: Can be connected to two 4 ohm or four 8 ohm remote speakers (maximum total audio power output is approx. 7 watts).

Pin 9: The 500-600 ohm receiver audio output can be used with amplifier-type remote stations (like the SSC 805AY or equivalent), or amplifier-type remote speakers, or to transmit the MB's audio output over telephone lines, or for a tape recorder. The level adjustment trim pot is accessible with the MB's top cover removed, at the rear right of the main pc board. If the audio is to be transmitted over telephone lines, set the level to approx. 0 dBm (0.77 v).

Pin 10 Grounding this squelch disable terminal unsquelches the receiver (remote operator can confirm that the MB is "on" or can hear weak signals.

Pin 11: If the receiver is squelched, this voltage is approx. 0.1 VDC. When the squelch is broken (when a signal is received) the voltage rises to approximately 12 VDC.

Pin 15 Approx. 14 VDC at 500 ma is available to power external equipment such as remote amplifiers or remote stations like the SSC model 805AY. If more current is required, use an external power supply.

Both audio outputs contain not only the receiver audio output, but also the transmitter modulation ("Sidetone"). If a remote speaker is connected, it must be well removed from the transmitting microphone, to prevent a squeal or howl due to feedback from the speaker to the microphone. When the 500-600 ohm audio output is connected to a tape recorder, the voices of both the pilot and the ground operator will be recorded.