Solutions for Advancing Communications

M15- OWNER'S MANUAL

M15

Solid-State VHF Aeronautical Band Radio Receiver/Transmitter

Mobile Transceiver

(118.000-136.975 MHz)

Mentor Radio, LLC.
Phone: 216-265-2315 * Fax: 216-267-2915

M15-OM-3/12

INTRODUCTION

The Mentor Model M15 receives and transmits on up to six discrete channels in the VHF aviation band between 118 and 137 MHz (25 KHz channel spacing). It operates from a 14 VDC supply, and is intended for both vehicular and airborne applications as well, and can also be used as a base station when a power supply is added (M15B). Its advanced design features and surface mount construction provide compactness, light weight and high reliability. The only external components required are a suitable antenna with coaxial cable, an aviation-type microphone and a 4- or 8-ohm external speaker.

CIRCUIT DESCRIPTION

The receiver is a single-conversion superheterodyne with four varactor-tracked RF tuned circuits and dual-gate MOSFET transistors in the RF amplifier and mixer stages. The local oscillator uses 3rd overtone crystals, and is followed by a MOSFET frequency tripler stage. Receiver selectivity is primarily determined by a six-pole 10.7 MHz crystal filter connected between the mixer and I.F. amplifier. The latter consists of two cascode integrated circuit amplifier stages. Automatic gain control is applied to the RF amplifier and the first I.F. amplifier stages.

A conventional diode detector is followed by a noise limiter, audio amplifier, squelch “gate” and an integrated circuit audio power amplifier capable of delivering 4.5 watts of audio power into a 4-ohm speaker. The transmitter oscillator also uses 3rd overtone crystals, followed by varactor tracked MOSFET tripler and buffer amplifiers. Three untuned broadband stages boost the transmitter carrier power to approximately 5 watts. Amplitude modulation is applied to the last two stages, the "driver" and “final” amplifiers.

The transmitter signal passes through a 7-element Tchebychef low-pass harmonic filter which also contains two PIN diodes functioning as a T-R switch. The transmitter modulator is separate from the receiver audio amplifier, and includes an audio AGC amplifier that automatically adjusts for variations in operator “microphone technique”. This circuit also prevents over modulation.

The modulator power amplifier consists of an integrated circuit amplifier followed by complementary bipolar transistors. This arrangement eliminates the need for an audio transformer, resulting in less low frequency distortion while minimizing the size and weight of the radio.

The 25 watt RF transmitter power amplifier contains a single mosfet power transistor, operating class AB, on a microstrip type printed circuit board. Two internal relays operate when the push-to-talk microphone switch is pressed. These relays switch the amplifier’s input and output connections, so that in the receive mode the signal from the antenna is passed directly back to the M15’s receiver, while in the transmit mode the M15’s transmitter output is applied to the 25 watt amplifier, whose output is in turn connected to the antenna. The power amplifier also contains a 5

section low-pass filter that greatly attenuates transmitter harmonics so that the system meets FCC requirements for signal purity.

INSTALLATION

The M15 can either simply rest on a shelf or desk, or it may be mounted in a vehicle. This unit does not contain a cooling fan, and does not normally need one. Installation kit is included for vehicle mounted applications.

The volume control knob (marked VOL) adjusts speaker loudness to the level preferred by the operator.

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 background 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.

If the M15 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 re-adjusts all tuned circuits for the new channel. There may be small channel-to-channel variations in the 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 M15'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.

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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 background and room noise, including the voices of other persons talking, radios playing, etc.

The front panel red led lights only when transmitting. The MB-R includes a transmitter transmit timeout timer. This protects the unit from unintended non-stop transmission and also frees the channel in the event of a "stuck-mic" . The transmit timeout will shut down the transmitter after approximately 30 seconds of continuous transmission. The unit will not transmit again until after the "PTT" line is released. During this time the unit transmit LED will remain turned off.

The antenna connector is type N. If the antenna coax does not mate with this type, adapters are available from Mentor Radio or from many electronic distributors. Connections for remote operation, when needed, are made via the 25 pin connector (type DB25) on the rear of the cabinet. The antenna should be either a wideband type (118-137 MHz) or a narrow band type tuned to the channel frequency. If a 3 or 6 dB gain antenna is used, communications range will be increased, because gain antennas effectively increase both receiver sensitivity and transmitter power.

Low loss coaxial cable is recommended, especially if the cable length exceeds 30 feet (10 meters). Plug an aircraft type or suitable pedestal type microphone into the microphone jack on the front panel of the M15. Be sure the plug is pushed all the way into the jack. If remote operation is to be used, refer to the section on this subject later in this manual.

OPERATION

To operate the M15 transceiver, turn on the unit by rotating its volume control switch clockwise. If the squelch control knob is turned fully counterclockwise, receiver noise should be heard in the speaker; the noise should get louder as the volume control is rotated more clockwise. If there is to be no operator at the radio, and only remote operation is to be used, the volume control may be set to minimum (fully CCW, without turning radio off).

If the background noise is annoying, it can be eliminated by rotating the squelch control clockwise. Turn the squelch knob only as far as necessary to stop the noise—turning it farther than necessary may prevent calls from distant aircraft from being heard in the receiver's speaker. If it is anticipated that it may be necessary to receive some very weak signals, use no squelch at all (control fully CCW).

To transmit to an aircraft, fully depress the push-to-talk (PTT) switch on the microphone and speak clearly and distinctly into the front of the microphone. Use a normal voice—not too soft nor too loud (many readability problems are caused by poor "mike technique"). If the microphone is a noise-canceling type it is absolutely necessary to hold the microphone very close to your mouth—these microphones are very sensitive to this distance.

A red LED lamp on the M15 lights up when power is applied to the transmitter by pressing the PTT switch. If this lamp stays on after the PTT button is released, a "stuck microphone" is indicated. If you cannot release the PTT switch (button), turn off the radio or remove the microphone plug so that your continuous transmission will not prevent others from using the radio channel.

In an emergency, you can transmit by plugging the microphone back in each time you want to transmit. Although this equipment has been designed for congested radio signal environments, very strong nearby transmissions on other channels may "bleed through" or desensitize the receiver. This does not mean that the receiver is operating improperly. If interference is a significant problem, contact Mentor Radio for assistance.

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REMOTE OPERATION

The 25 pin D-subminiature type connector on the rear panel contains all the connections needed for various types of remote operation. The functions of the different connector pins are as follows:

PIN NO.	FUNCTION	COLOR
1	mic PTT	gray
2	mic audio	violet
3	ground	black
4	ground	black
5	ground	black
6	ground	black
7	4 ohm rcvr out	green
8	4 ohm rcvr out	green
9	500/600 ohm rcvr out	green
10	squelch break	blue
25	+14 vdc	yellow

Connections to the mating connector can use #22 gauge wire. Note that there are four ground terminals and two terminals for the 4 ohm receiver audio output. The ground terminals may be used as needed for various remote connections; in some circumstances it may be desirable to "double-up", using two ground pins in parallel. (Each pin is rated for 1 ampere.) The 4 ohm audio receiver outputs can be used with one or two external speakers. The +14 vdc can supply up to 500 ma. to operate external remote equipment.

The 500/600 ohm receiver audio output can be used for remote stations or for a tape recorder output. It's level is factory adjusted to 0 dBm (0.77 v rms) but may be adjusted internally for any level from -7 to +10 dBm by trimmer potentiometer R205 on the printed circuit board inside the M15-25. Both the 4 ohm and the 500/600 ohm receiver audio outputs are unaffected by the volume control on the M15, the latter affecting only the speaker on the front panel of the M15-25.

The remote microphone audio input should be in the range -10 to -16dBm (0.3 to 0.15 v rms). If this voltage is too high the modulation may be distorted when transmitting—that is, the voice transmissions may not sound as clear. If this occurs, trimmer potentiometer R207 (on printed circuit board inside M15-25) can be adjusted to reduce the microphone audio level.

The colors listed above refer to the usual color codes when using Mentor part no. 1101368 6-conductor remote cable.

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MAINTENANCE

No routine maintenance is necessary, other than to remove accumulated dust. If the equipment is accidentally impacted or dropped operation should be fully checked and an internal inspection made for loose or broken parts.

SERVICING AND REPAIR

Should the M15 require warranty servicing, return it to Mentor Radio, LLC. (see address on website at www.mentorradio.com) with a description of the problem. For out-of-warranty servicing, returning the unit to Mentor Radio LLC. is also recommended. If local servicing is preferred service manuals can be obtained. Service should only be attempted by technicians experienced with this type of equipment and who have available the appropriate test equipment.

LICENSING

In the United States, all transmitters must be licensed by the Federal Communications Commission (FCC). Application is filed on FCC form 406 for base stations. List the M15 transceiver (FCC identification no. QQTM15) on the application.

With each new M15, Mentor Radio, LLC. includes instructions on how to complete form 406 online at the FCC Internet web site (Dwg. 1100958). If the M15 is to be used on a channel in the frequency range 128 to 132 Mhz (the “enroute” channels), the license application is handled differently. Assignment of specific frequencies and the completion of form 406 is done by Aeronautical Radio Incorporated (ARINC), a private organization which contracts to the FCC to manage this part of the spectrum. Refer to Mentor Radio, LLC. Dwg. 1101472, enclosed with new units containing an enroute frequency.

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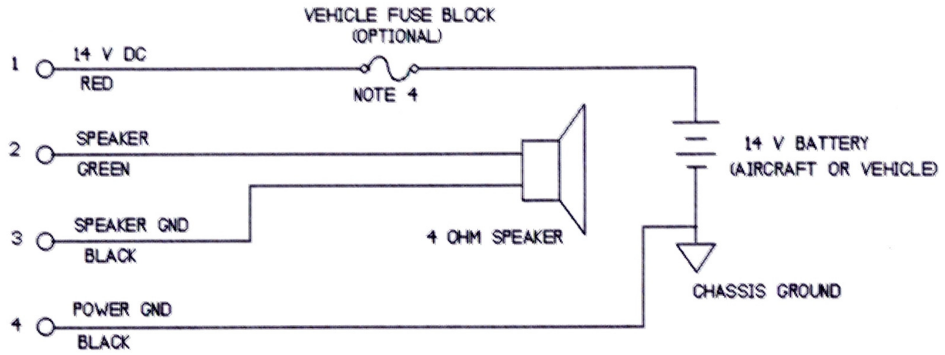
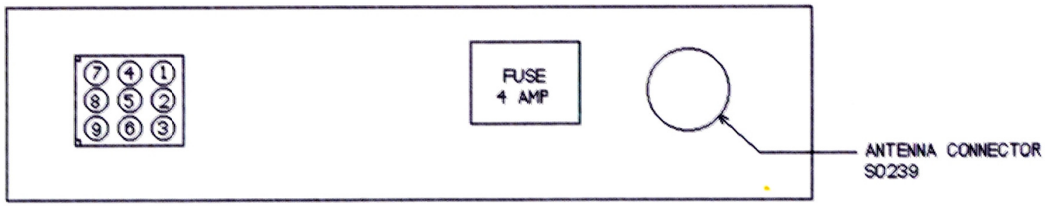
REV	CHANGE	DATE



old



REAR VIEW

NOTES:
1. WIRE COLORS ARE THOSE USED IN HARNESS SUPPLIED BY MENTOR RADIO COMPANY.
2. BLACK WIRES (PINS 3 & 4) ARE INTERCHANGEABLE.
3. FOR FULL 3.5 WATTS AUDIO USE 4 OHM SPEAKER. 8 OHM SPEAKER MAY BE USED (POWER WILL BE ONLY 2.0 WATTS)
4. IF 14 V IS TAKEN FROM VEHICLE FUSE BLOCK, FUSE FOR SUM OF LOADS. ALLOW 4 AMPS FOR M15.
5. NEGATIVE SIDE OF BATTERY MUST CONNECT TO VEHICLE CHASSIS.

MENTOR RADIO CO.

TYPICAL INSTALLATION, MODEL M15

DWN	DATE	APPD		DWG NO
JWS	8-1-91			1101454

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FCC LICENSE NOTICE

The radio equipment you have purchased requires FCC licensing. This was formerly done by completing and mailing FCC Form 406. This has been replaced by electronic online filing via the Universal Licensing System (ULS). The Internet address for this is http://wireless.fcc.gov/uls/. This site provides instructions for the application, as well as online forms to complete and transmit electronically, as well as instructions for payment of filing fees.

In the past, Mentor Radio provided information required by Form 406 for its specific models. This information may still be needed when you make the online application, and is provided below for your assistance. The Mentor Radio Model identification is not the same as the FCC Identification. The first table below gives the FCC Identification and the transmitter power for Mentor models.

For all Mentor Radio transmitters enter "6K00A3E" for "emission and bandwidth ("0" is a numerical zero, not the letter following "N").

You may be asked for a "Class of Station". The second table below can help you select your Class. You must apply for a frequency that the FCC permits for your selected Class. Some of the permissible frequencies are listed below. For a complete listing of available frequencies, consult the FCC rules, Part 87.173 (available online at http://www./wireless.fcc.gov/rules.html).

Mentor Model	FCC Identification	Transmitter Output
M15	QQTM15	5 watts
M15-25	QQTM15 and QQTPA25	25 watts
MB	QQTMB	10 watts

Class of Station	FCC Code	MR Models	Typical Use	Frequencies Available
Aeronautical Advisory	FAU	MB, M15	Unicom	No tower: 122.700, 122.800 Tower on field: 122.950 Heliport: 123.050, 123.075
Aeronautical Multi-com	MFL	MB, M15	Air/Ground	Coordination 122.850, 122.900, 123.100
Search & Rescue	SAR	MB, M15		123.100
Aviation Support	FAS	all	Flight Schools, Soaring	123.300, 123.500, 121.950
Aero. Utility Mobile	MOU	M15	Airport vehicles Gnd. Cont. & tower freqs	
Aeronautical Enroute	FA	all	ARINC, Corp.	128.825 to 132.000
Flight Test	FAT	all	Manufacturers	123.200, 123.225
Control Tower	FAC	MB, M15-25	numerous	118.000-136.975

Mentor Radio, LLC
1100958 (rev 11-07)

LIMITED WARRANTY

Your Mentor Radio, LLC. equipment is warranted to the original consumer purchaser only, for one full year, to be free from defects in materials and workmanship under normal use. This warranty does not include damage to the product resulting from accident or misuse. This warranty will not be effective unless you submit a Warranty Registration online at www.mentorradio.com .

If the equipment should become defective within the warranty period, we will elect to repair or replace it, without charge, if returned, postage prepaid, to the address shown below. We are not liable for defects or damages caused by the use of unauthorized replacement parts and/or service.

ALL IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITTNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR. Some states do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.

MENTOR RADIO, LLC., BECAUSE OF LACK OF CONTROL OVER THE CONDITIONS OF USE OF THIS EQUIPMENT, IS NOT LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. ANY RECOVERY MAY NOT BE GREATER THAN THE PURCHASE PRICE PAID FOR THE EQUIPMENT. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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