Assembly Instructions V2.0
MacTenna Multi-band Switched Length Dipole Antenna

The MacTenna switched length dipole antenna can be assembled to cover as many of the HF bands as you want. Refer to the drawing of a typical installation on page 3 to be sure that you have all the components that you need.

Operating Position

At the operating position you will need:

1) Controller, to select the desired band.
2) Injector, to put power and control signals on the feed line
3) Power cable, to connect the controller to a power supply and to the injector.

Feed Line

The feed line should be 50 Ohm coax rated for the maximum power that you intend to run. Be sure to install a gas discharge type surge suppressor to protect your radio equipment. The suppressor should be located as close to a ground rod as possible.

Antenna

The antenna consists of the following:

1) Splitter (MT-SPL), to separate RF power to the antenna and DC power to the switching modules. The splitter also acts as the center insulator. It also has a coax connector for attaching the coax feed line to the antenna.
2) A pair of switching modules (MT-SM-2) for each additional band beyond the first band. One pair of modules forms a 2 band antenna. Two pairs of modules form a 3 band antenna and so on.
3) The last pair of switching modules (closest to the ends) must be part number (MT-SM-2L). The "L" designates the last module. This module contains components to "wet" the relay contacts by drawing a DC current. Other modules are "wetted" by the current that passes through them to power the modules that follow.
4) A pair of end insulators (MT-EI-2).
5) Wire to interconnect the splitter, switching modules, and end insulators.

Modules

The switching modules, splitter, and end insulators, include stainless steel hardware and copper ring lugs. A kit of extra hardware and lugs (MT-EXH) is available just in case you lose items during assembly.

Wire

Two electrically parallel wires are needed between the splitter and switching modules in order to conduct DC power and control signals to the modules. We recommend #14 antenna wire for the main support wire, and #18 or larger stranded, insulated wire for the other conductor.

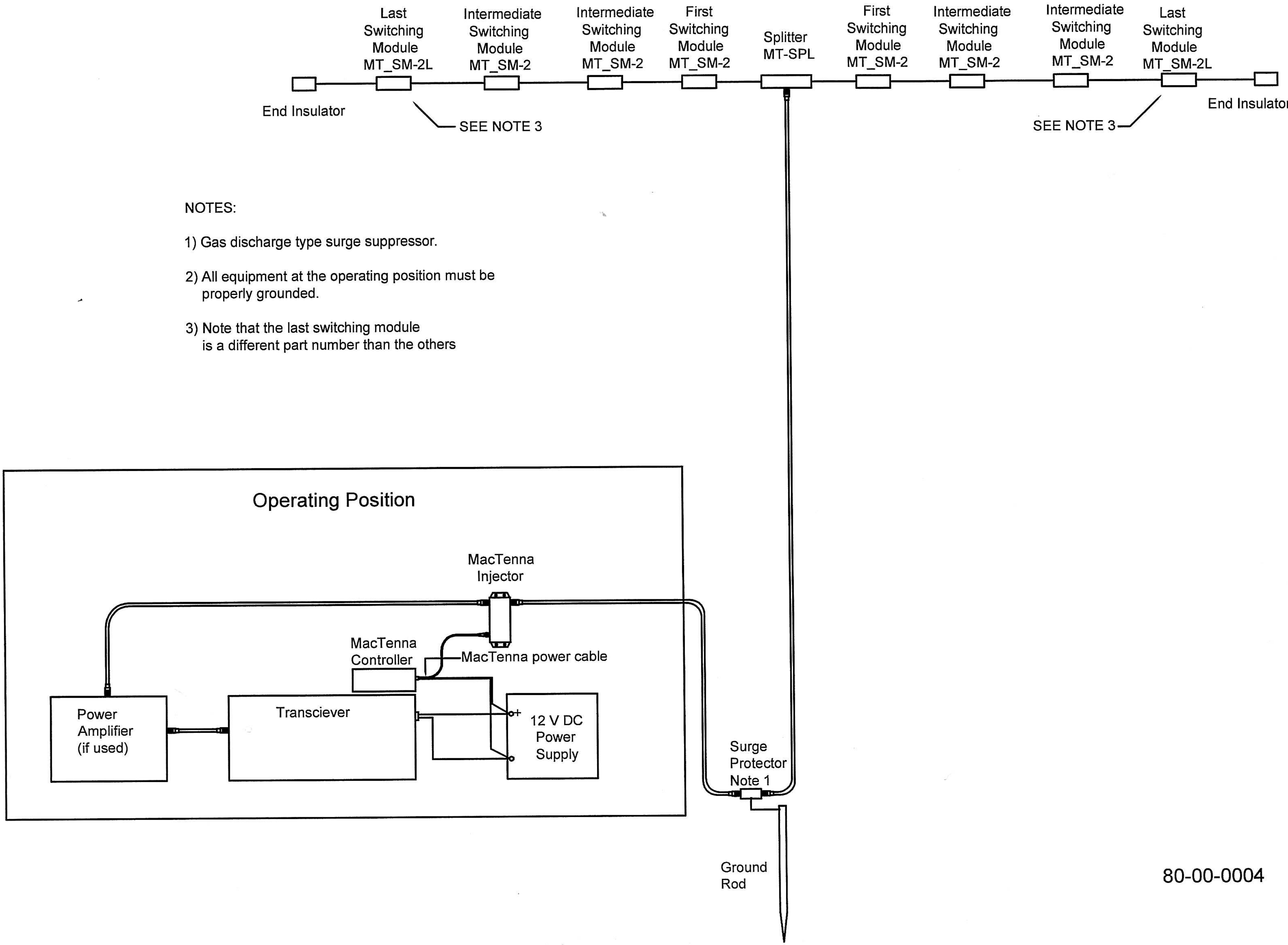
Only a single #14wire is needed between the last module and the end insulator.

Antenna wire is actually stranded steel wire that is coated with 30% copper by weight. Steel is used to minimize stretch under tension. Since RF only travels on the outside surface of a conductor, the copper coating makes it a low loss conductor for RF.

We recommend Belden part number 8000 antenna wire or Wireman part number 511 antenna wire (www.thewireman.com).

Maintaining Correct Polarity

The splitter module and each switching module have 4 screw terminals. There are plus (+) signs molded into the modules to indicate the polarity of the terminals. The switching modules have only one plus sign. This plus sign marks the input end of the module (the end that should be oriented toward the splitter). The two output terminals of the switching module have the same polarity as the input terminals. If the top input terminal is marked (+), then the top output terminal is also positive.



NOTES:

1) Gas discharge type surge suppressor.

2) All equipment at the operating position must be properly grounded.

3) Note that the last switching module is a different part number than the others

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Wiring the antenna components.

Figure 1 shows the splitter module and several switching modules with only the bare antenna wire running between them. The bare antenna wire is connected to the negative terminals. The insulated wire will connect to the positive
terminals.

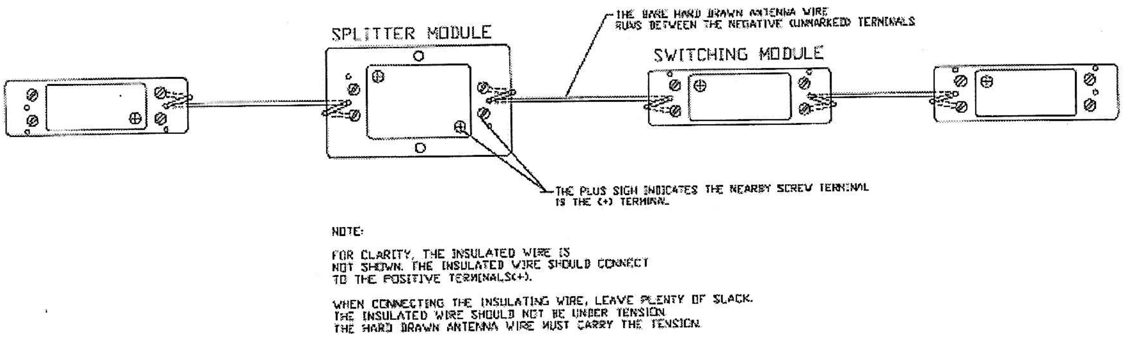


FIG 1

We have found that a good wiring technique is to connect all the modules and end insulators together with only the bare antenna wire. This assembly is then strung between 2 supports and placed under tension in order to take up the slack and keep everything straight. Leave the insulated wire on its spool and connect it to a positive terminal as described later. Then walk along the antenna and pass the spool of insulated wire around the bare wire as you go. One wrap every 6 feet or so is sufficient to keep the wires together. Tape the insulated wire to the bare wire near the modules to hold it in place while you make the connections. Leave some slack in the insulated wire to make sure it will not be under tension when the antenna is raised. All of the tension must be carried by the bare antenna wire.

Antenna Dimensions

The length of a dipole antenna at a particular frequency is affected by many variables. Two of the major variables are discussed below.

Supports
The way an antenna is supported will affect its length. A dipole can be supported from the ends and hang in an arc. One end may be higher than the other. It may be supported in the center by a tower or a mast and form a lazy "w". The ends may be lower than the center and form an inverted "V". A center supported dipole might not be in a straight line. One end support might be off of the center line etc. etc. etc.

Nearby Objects
Proximity to trees, buildings, power or telephone wires and to other antennas can also affect the ideal length of a dipole.

Because of these variables it is common practice to calculate the approximate end to end length of the dipole using the formula:

Length in feet = 468 / Frequency in MHz

The minimum SWR point must then be found using an SWR bridge or antenna analyzer. The length of the antenna must then be increased or decreased to get the minimum SWR point to occur at the desired frequency.

It is important to note that adjusting the length of a dipole moves the frequency of the minimum SWR point but does not affect the actual value of the minimum SWR. The value of the SWR at the minimum point is determined by the support arrangement, nearby objects and the height above ground. There is a common misconception that adjusting the length of a dipole is done to get the lowest possible SWR (as close to 1:1 as possible). This is not true. The adjustment process is to get the minimum SWR point (it may be 1.7:1) to occur at a particular frequency (like the center of the phone band).

It is because of the above mentioned variables that MacTenna can not provide complete pre-assembled dipole antennas.

Approximate dimensions for various band selections are included at the end of this manual. Follow the procedure described in the section labeled "Adjusting the antenna" to optimize the dimensions. The dimensions on the drawings are 2 inches less than calculated. This will hopefully allow bands to be adjusted by using "tails" (refer to drawings) rather than moving modules.

Modules for higher frequency bands can be left out without affecting the lengths to lower frequency modules. Leaving out a particular module will affect the proper position of any modules for bands of a higher frequency than the one that is left out. As an example, if you have a 20M beam and want to leave out the 20M modules, the position of lower frequency modules is not changed, however the position of the 17M modules may need to be adjusted.

Making connections to modules.

Pass the end of the bare wire through the module from the bottom as shown in photo 1. Crimp the ring terminal (lug) to the wire with the tab oriented as shown. Solder the lug to the wire. Be sure that the end of the wire is totally covered with solder to prevent rusting of the steel core. Next wrap the wire in a gentle loop around to the bottom of the module and place the lug around the screw. Place a lock washer and then the nut on the screw. After the screw and nut are tightened, push the loop into the hole, and pull on the wire to make the loop as small as possible. See Photo 1.

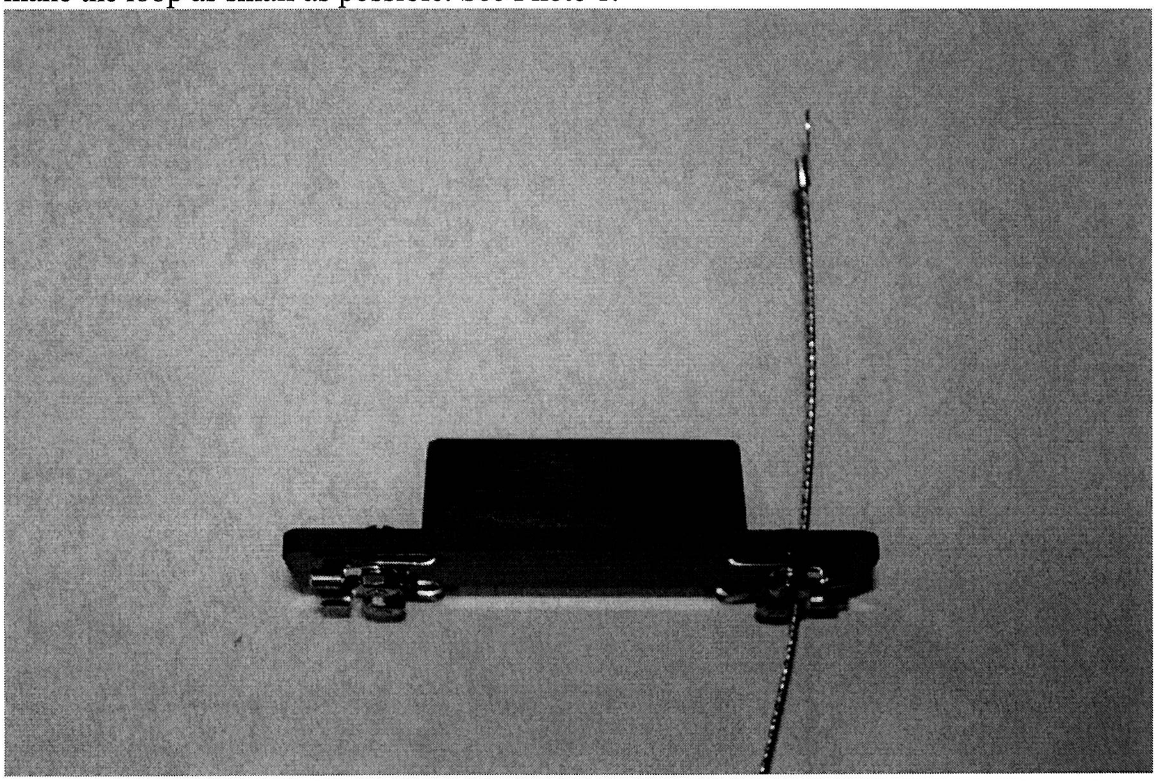


Photo 1

Testing At Ground Level

It is a good idea to test the switching action of all of the modules **before** hauling the antenna into the air.

Connect a piece of coax between the antenna connector on the injector and the splitter. Connect the controller power cable to a power supply that is between 12V and 15V DC (the nominal 12V power supply used with many transceivers is actually close to 13.8V DC).The red wire should be connected to the positive (+) terminal of the power supply.

Plug the controller cable into the back of the controller. Connect the BNC connector on the controller cable into the BNC connector on the injector. No connection is required to the transceiver connector on the injector at this time.

Turn the selector switch on the controller fully counter-clockwise and turn on the DC power supply.

A) The red LED on the controller should light up.
B) You should measure 12V between the 2 terminals on the left side of the splitter (the terminal with the plus sign in a circle should be positive (+)). Now measure between the 2 terminals on the right side of the splitter. This should also be 12V there.
C) You should measure 12V between the input terminals on the first switching module on each side of the antenna (the terminal with the plus sign should be positive (+)).
D) Measure the voltage on the output terminals of the first switching module on each side of the antenna. It should be a very small voltage that is due to 10 meg ohm resistors that are across the relay contacts.
E) Turn the selector switch on the controller to the next position. Now the 12V DC should appear on the output terminals of the first switching module on each side of the antenna, and the input terminals of the second switching module on each side of the antenna.
F) Repeat Step " E " for each switching module. On the last module you may measure up to 4V on the output before the module switches on. If the ground test goes ok, the antenna is almost ready to be raised. Provision should be made so the antenna can be raised and lowered easily in order to tune the lower frequency bands.
G) Strain relieve the coax connector on the splitter using heavy string or cord as shown in photo 2. The cord must support the weight of the coax feed line. Wrap the cord around the coax and cover it with electrical tape so that it cannot slip. See Photo 2.

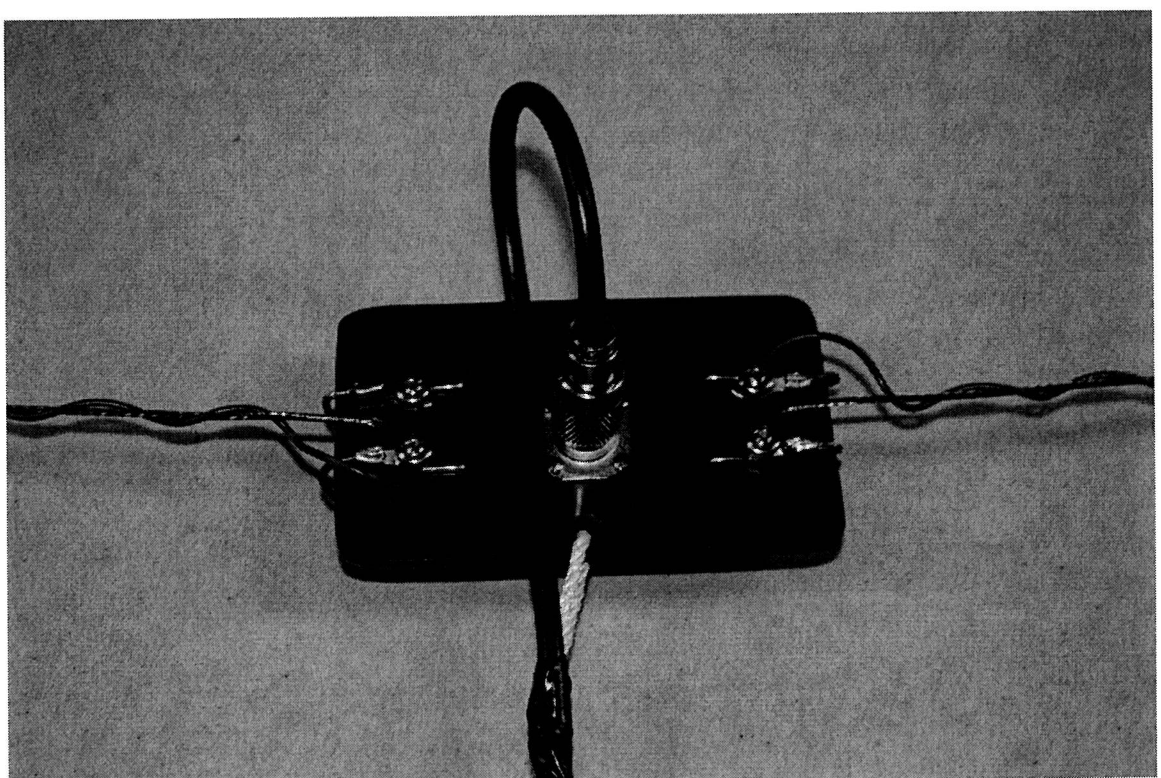


Photo 2

Labeling the controller bands

The band selector switch on the controller is marked with the most popular bands. If you have skipped bands, it is necessary to change the band numbers on the band switch. A set of adhesive backed band numbers is included with the controller. As an example, if you built your antenna without modules for 12M, 17M, and 30M, then you can apply the numbers so that the band selector switch reads 10M, 15M, 20M, 40M, etc.
Some amateurs use the same controller to operate a MacTenna Simple Beam (10M, 12M, 15M, 17M and 20M) and a wire dipole (40M, 75M, and 160M). There are enough adhesive backed band numbers to dual label each switch position. For the example dipole described above, the band positions would be labeled 10M/40M, 12M/75M, 15M/160M, 17M, and 20M.

Adjusting the antenna

Because of the many variables that can affect the center frequency (minimum SWR point) of a dipole, the total length and the position of switching modules may need to be adjusted. The drawings at the end of this manual show the approximate dimensions for some of the most popular band selections. As described earlier, adjustments may be required to get center frequencies where you want them to be. You will need an antenna analyzer to make SWR and frequency measurements. The analyzer should be connected to the connector on the injector that is labeled "Transceiver". The antenna will most likely need to be raised and lowered several times to adjust each band.

The positions of the highest frequency modules need to be closer to the center of the antenna than calculated from the formula on page 5. This is because there is capacitive coupling to the wire segments that are connected to the output of the module. The position is affected by the number of modules and wire segments for the other bands. The optimum position of the higher frequency modules depends on the number and position of lower frequency modules. Because of this, the optimum length of the lowest frequency band must be adjusted first. The lowest frequency band will be the same length as a normal dipole for the same frequency.

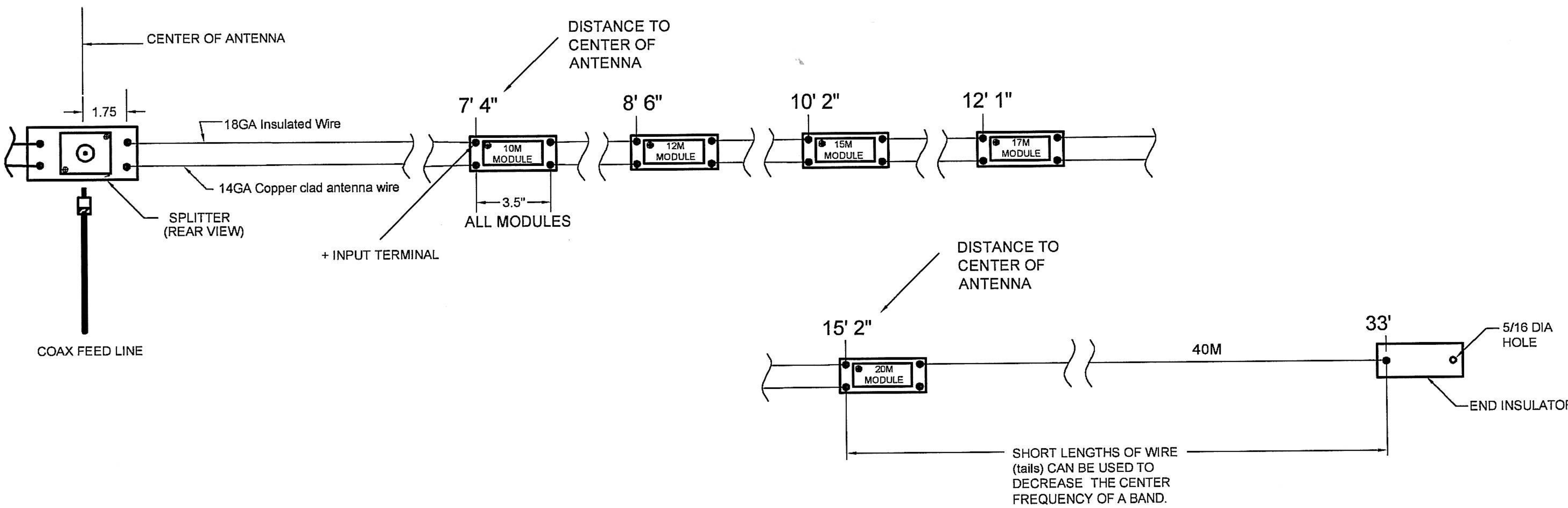
After the overall length is correct for the lowest frequency band, move to the next higher frequency band. Actually moving the position of a module is a little difficult. To avoid this it is better to position a given pair of modules closer to the center to begin with, and then lower the frequency of the minimum SWR point (if required) by adding a "tail" as shown on the attached drawings. The dimensions on the drawings are 2 inches less than calculated. This will minimize the need to move modules and allow frequency adjustment by the use of the "tails". It is convenient to use solid wire for "tails".

Typical Operating Position

The following photo shows the operating position of KQ8E. The controller is placed on top of the transceiver. The injector is screwed to a grounded panel which also holds a coax switch. The coax switch is used to connect either the MacTenna Simple Beam or the MacTenna wire dipole to the injector output. This brand of coax switch has a replaceable gas discharge tube for lightning protection. The switch also grounds the center conductor of all unused antennas. It is recommended that a gas discharge type lightning arrester also be placed in each coax feed line outside of the building entry point as close to a ground rod as possible.
At one time there were two coax switches mounted on the aluminum panel. These were used to select between 8 separate antennas. The MacTenna system has reduced this to just two antennas.

10M, 12M, 15M, 17M, 20M, 40M

(NOT DRAWN TO SCALE)



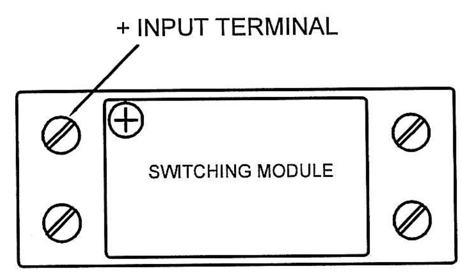
NOTES

1) MODULES ARE NAMED BY THE BAND THAT THEY DETERMINE BEFORE THEIR RELAY IS ENERGIZED.

2) ADDITIONAL MODULES CAN BE ADDED TO BREAK THE 160M AND 80M BANDS INTO MORE SEGEMENTS. THE ANTENNA CONTROLLER CAN WORK WITH UP TO 11 MODULES (12 BANDS)

3)THE BARE ANTENNA WIRE SHOULD BE 3 INCHES LONGER THAN THE DISTANCE BETWEEN MODULE SCREWS BECAUSE 1.5 INCHES IS USED AT EACH CONNECTION POINT

4) WIRE LENGTH DIMENSIONS ARE TYPICAL AND COULD VARY FOR A PARTICULAR INSTALLATION. REFER TO THE INSTRUCTIONS FOR DETAILS.



10M, 12M, 15M, 17M, 20M, 30M, 40M

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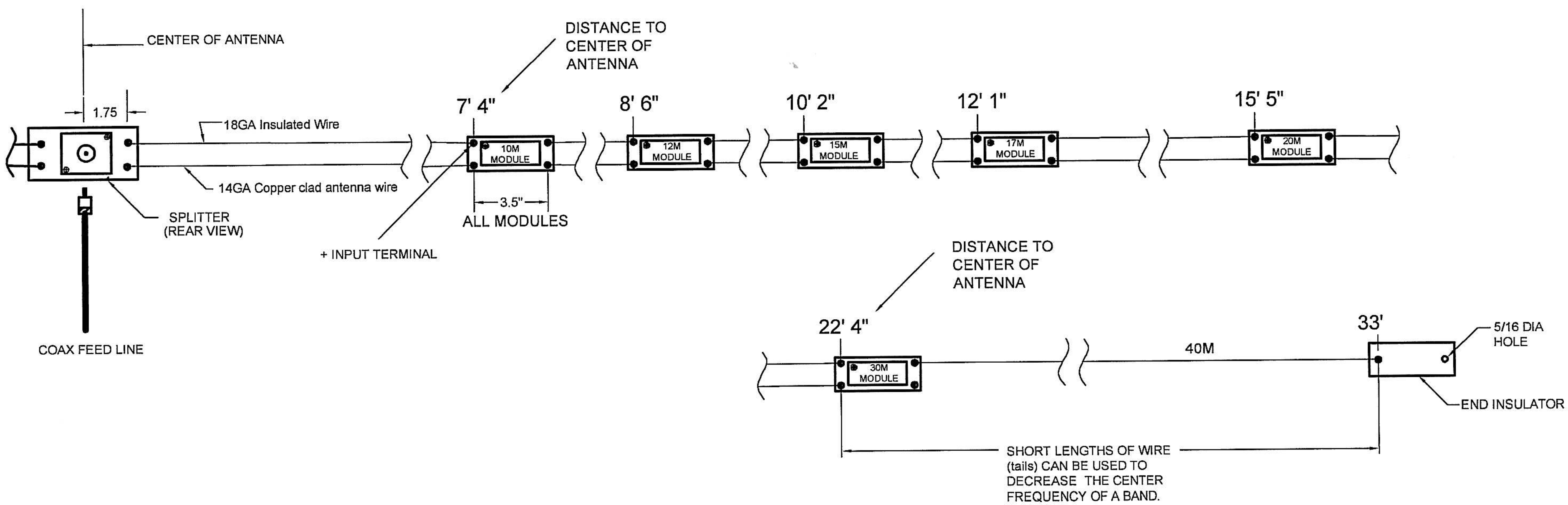

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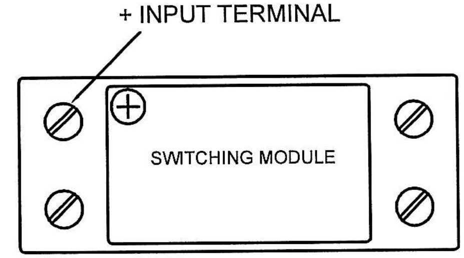

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12M, 17M, 40M, 75M

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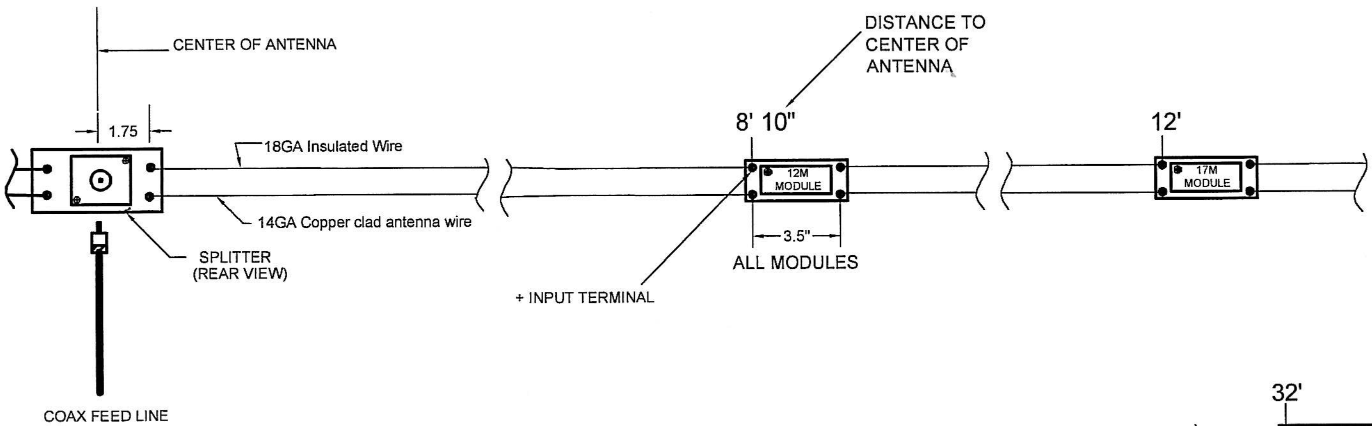

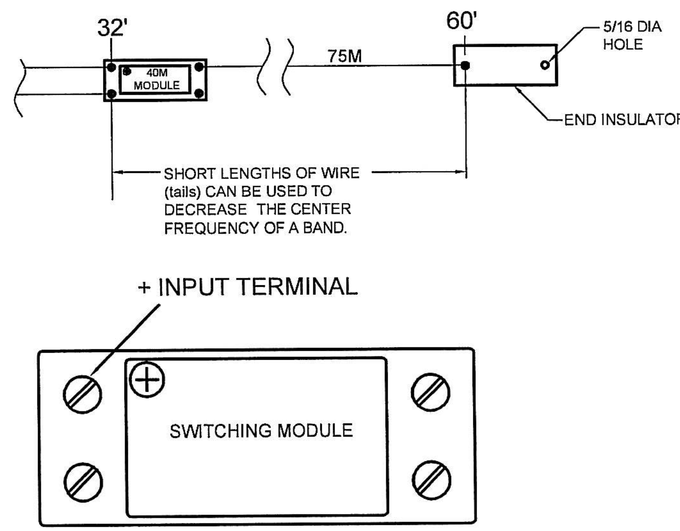

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10M, 12M, 15M, 17M, 20M, 40M, 75M

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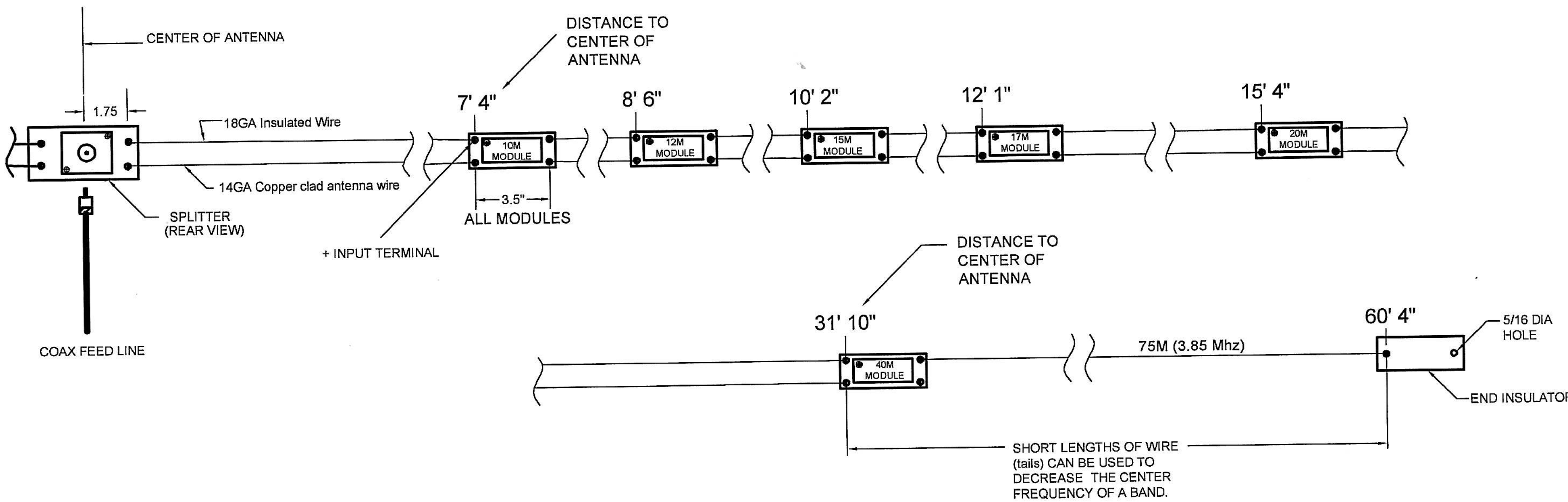

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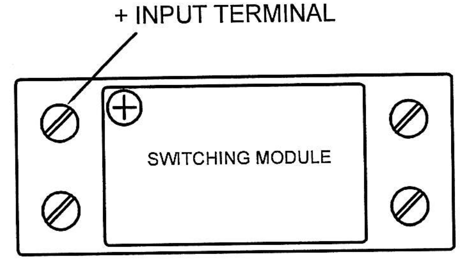

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10M, 12M, 15M, 17M, 20M, 40M, 60M, 75M

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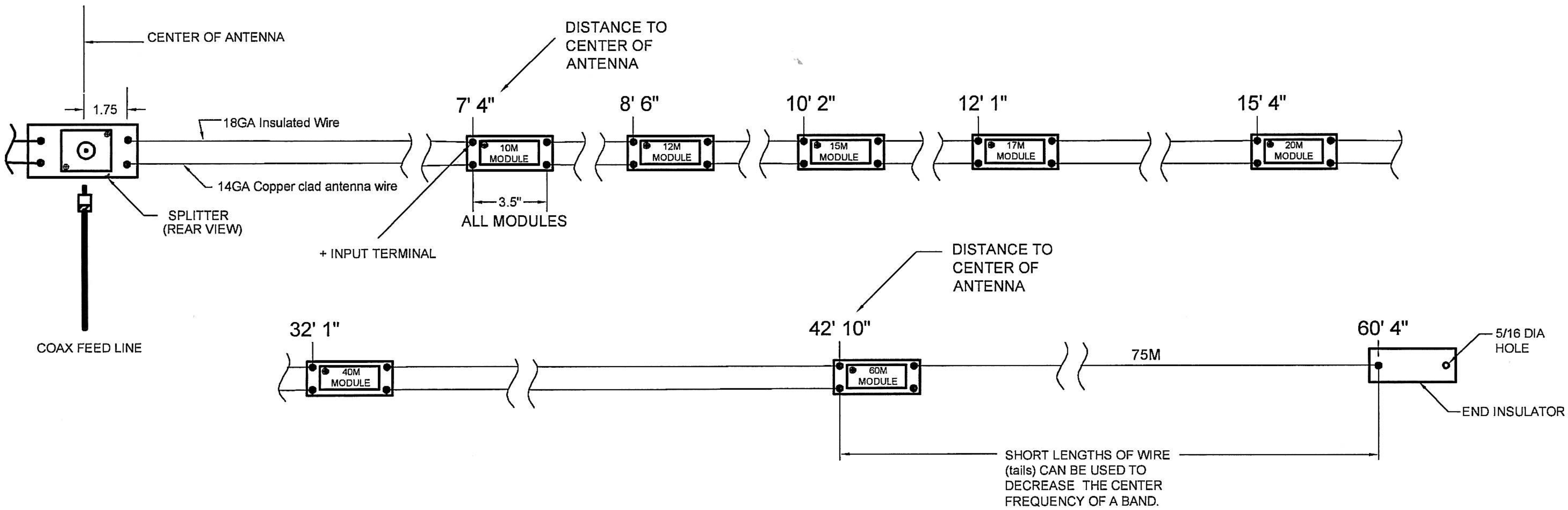

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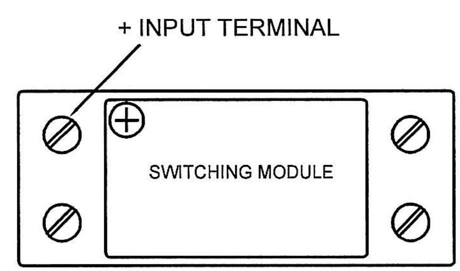

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10M, 12M, 15M, 17M, 20M, 30M, 40M, 75M, 80M

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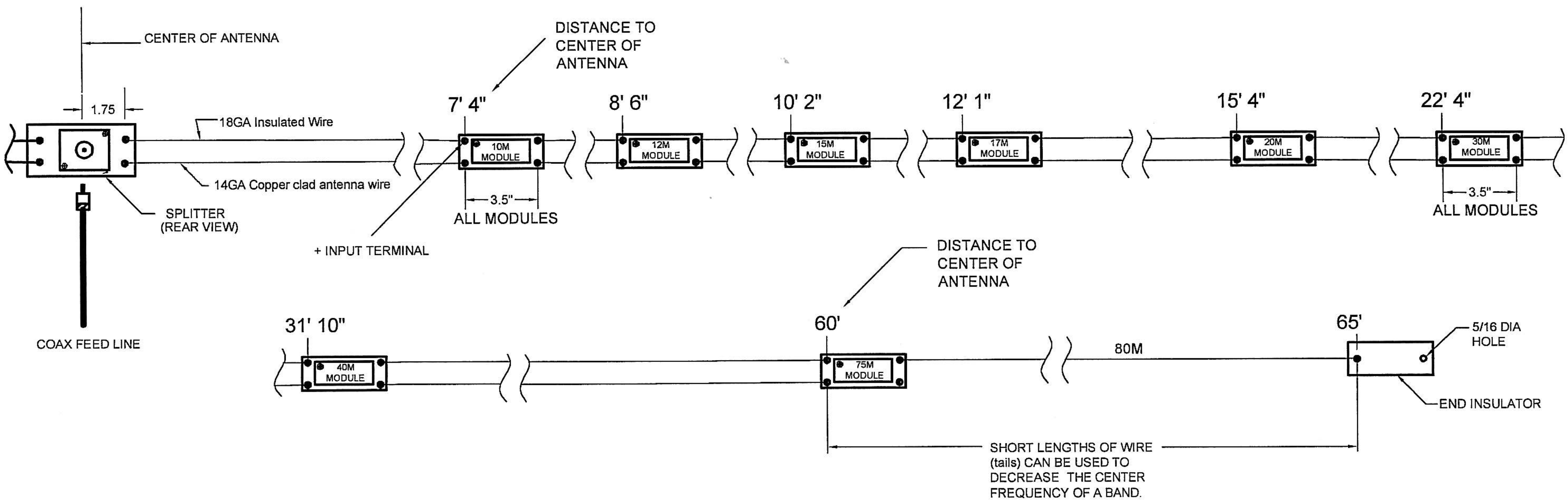

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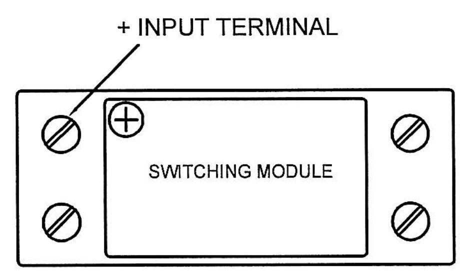

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10M, 12M, 15M, 17M, 20M, 30M, 40M, 60M, 75M, 80M

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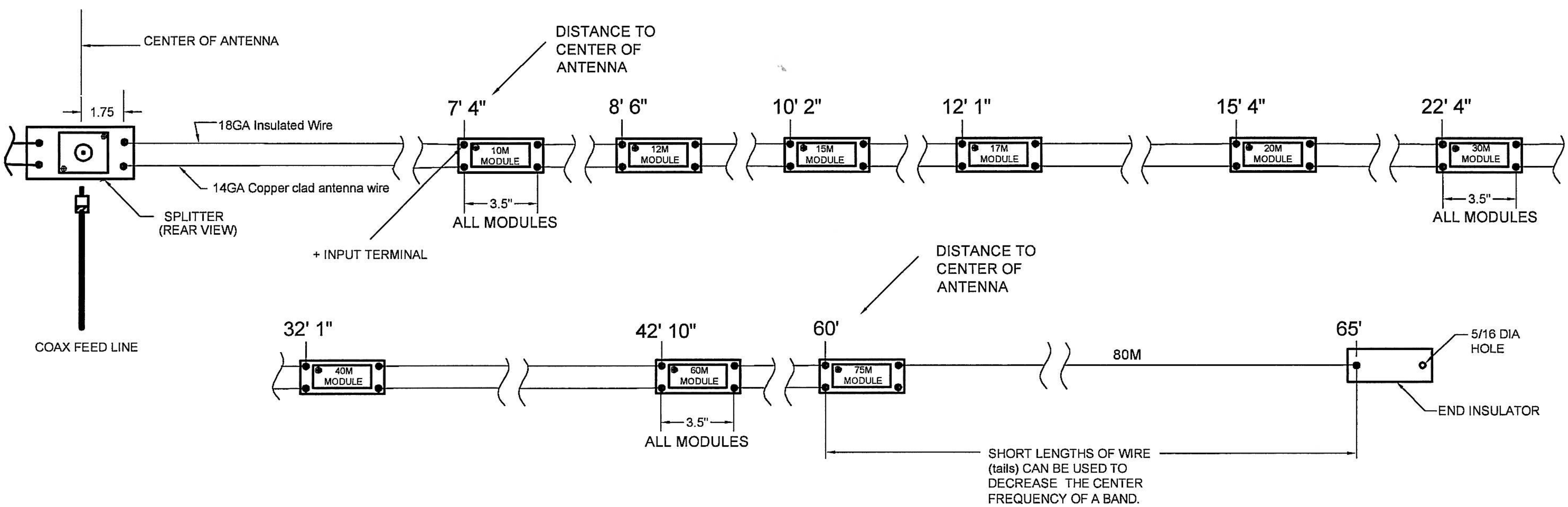

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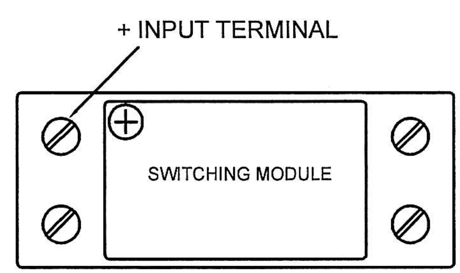

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10M, 12M, 15M, 17M, 20M, 40M, 75M, 160M

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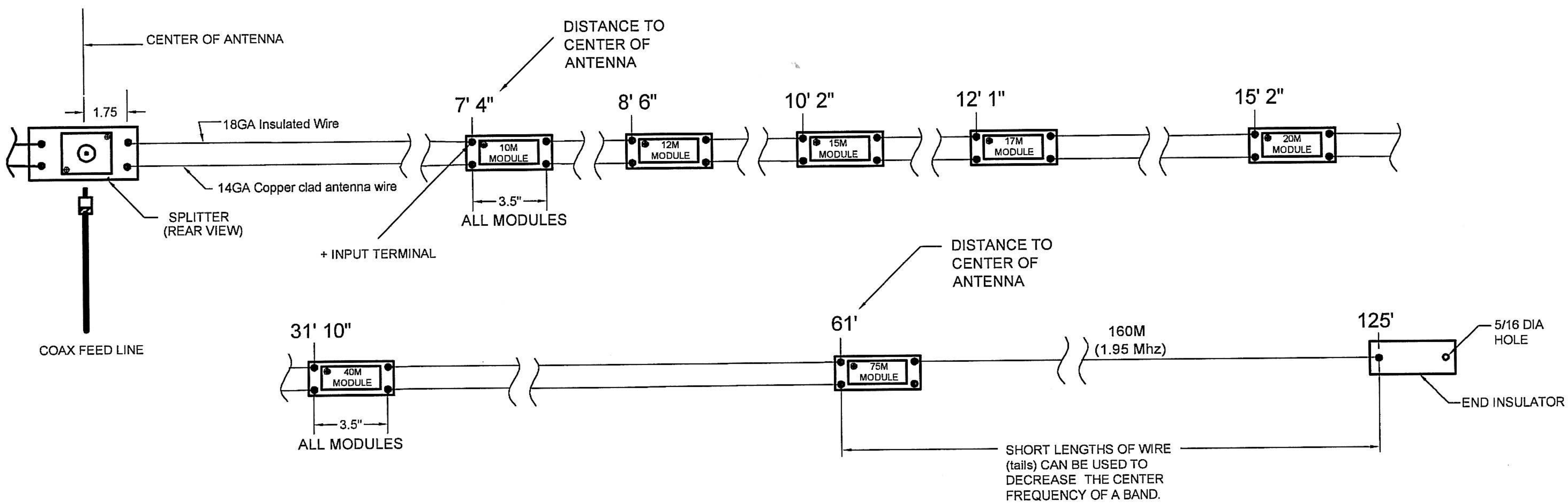

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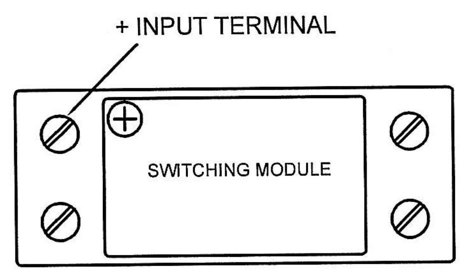

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10M, 12M, 15M, 17M, 20M, 40M, 75M, 80M, 160M

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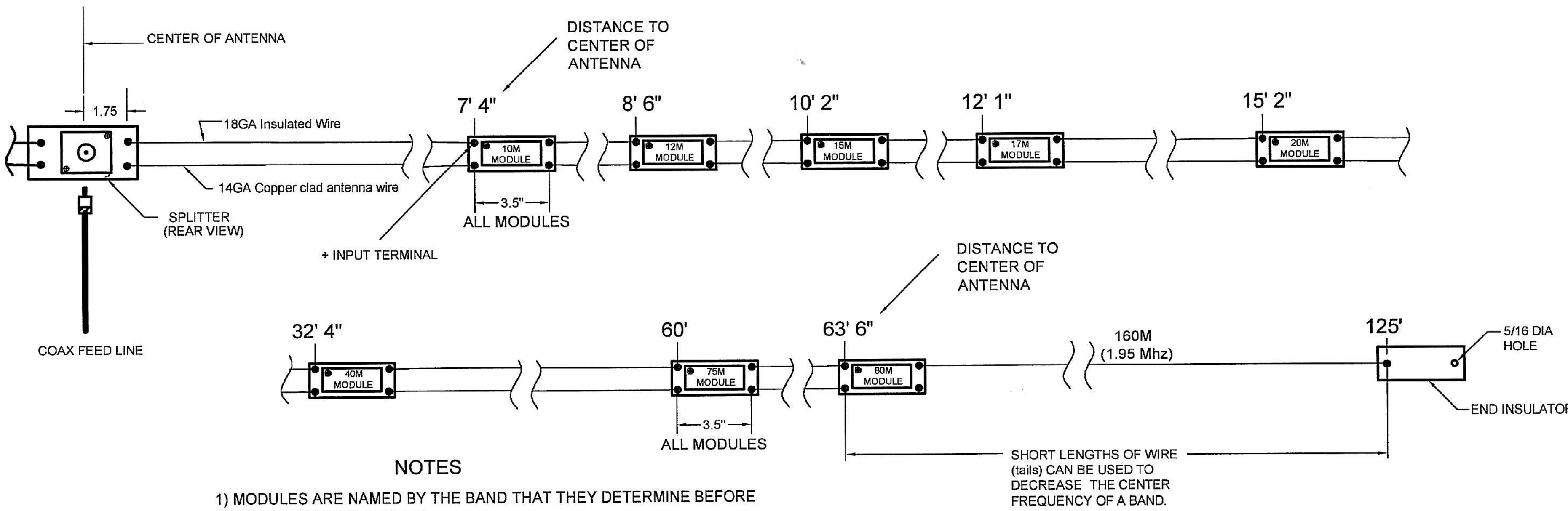

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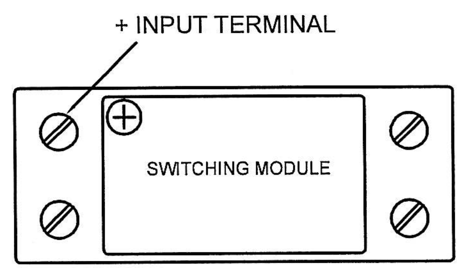

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10M, 12M, 15M, 17M, 20M, 30M, 40M, 75M, 80M, 160M

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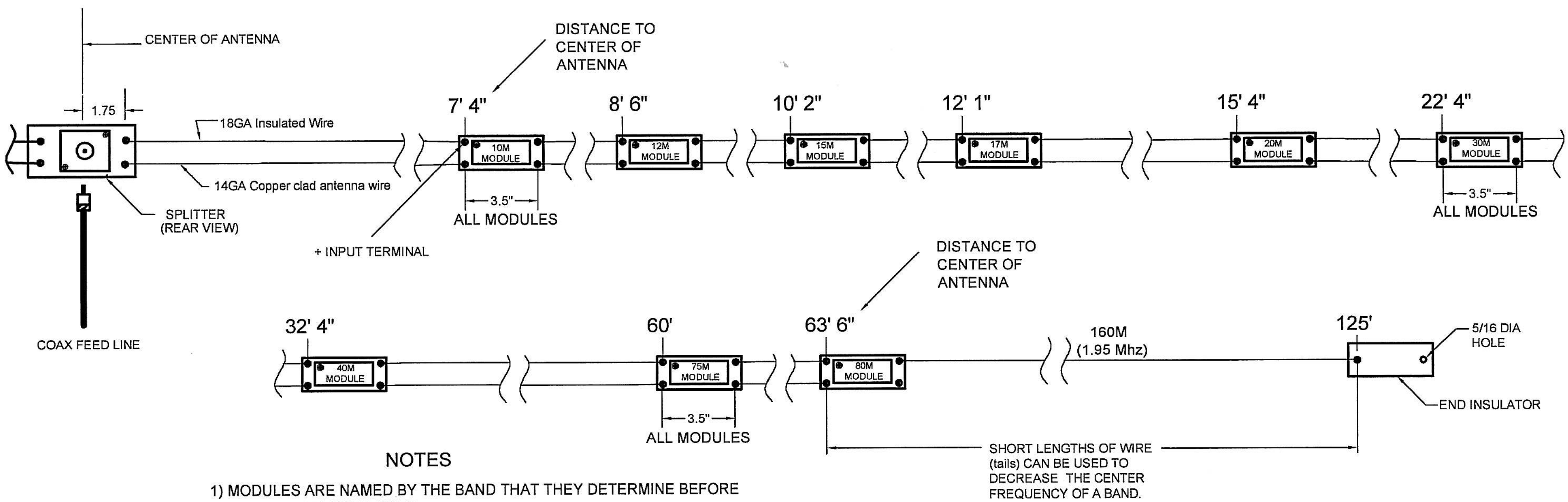

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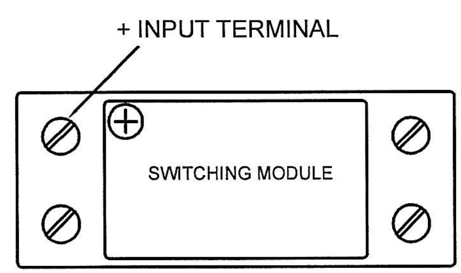

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10M, 12M, 15M, 17M, 20M, 30M, 40M, 60M, 75M, 80M, 160M-A (1.95 Mhz), 160M-B (1.85 Mhz)

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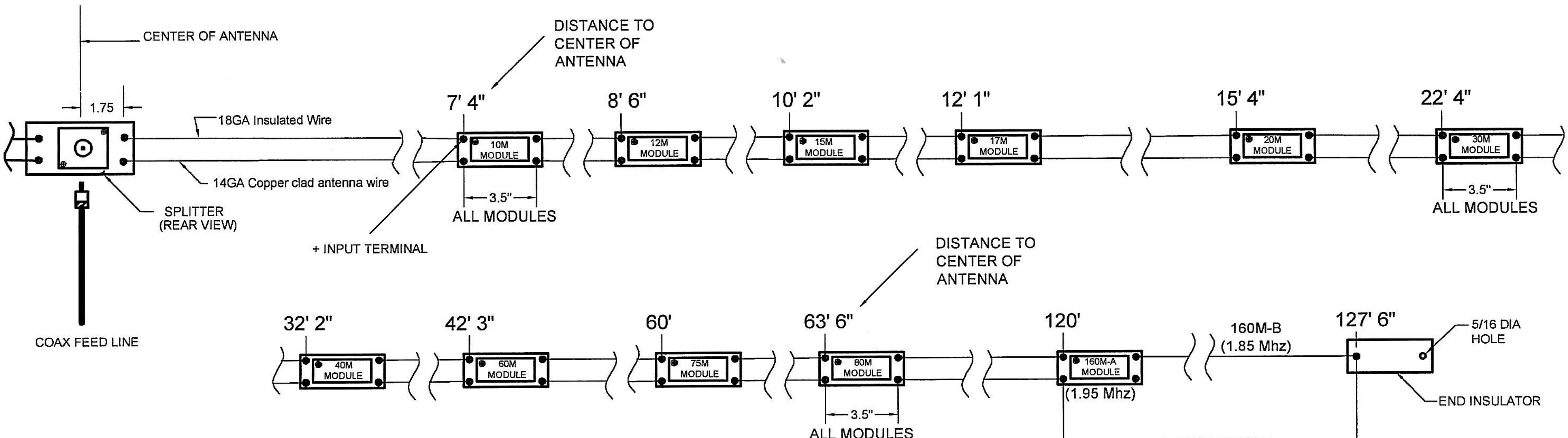

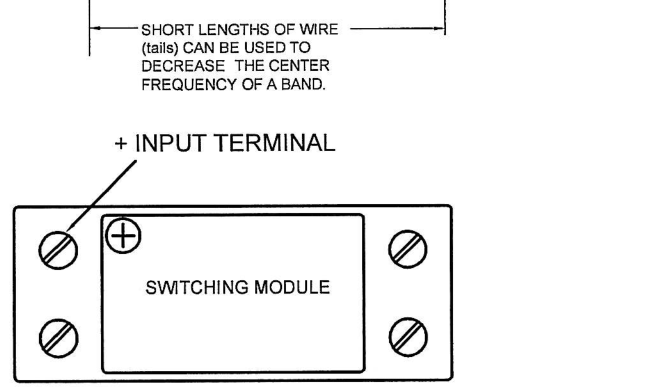

NOTES

1) MODULES ARE NAMED BY THE BAND THAT THEY DETERMINE BEFORE THEIR RELAY IS ENERGIZED.

2) ADDITIONAL MODULES CAN BE ADDED TO BREAK THE 160M AND 80M BANDS INTO MORE SEGEMENTS. THE ANTENNA CONTROLLER CAN WORK WITH UP TO 11 MODULES (12 BANDS)

3)THE BARE ANTENNA WIRE SHOULD BE 3 INCHES LONGER THAN THE DISTANCE BETWEEN MODULE SCREWS BECAUSE 1.5 INCHES IS USED AT EACH CONNECTION POINT

4) WIRE LENGTH DIMENSIONS ARE TYPICAL AND COULD VARY FOR A PARTICULAR INSTALLATION. REFER TO THE INSTRUCTIONS FOR DETAILS.

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