



SIGMA 5 & GT-5 5-band Vertical Dipoles

FREQUENCY RANGE: 20, 17, 15, 12, 10 meters

Force 12, Inc.

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This manual is used for both the Sigma-5 and Sigma-GT5 antennas. The two antennas are electrically the same; the differences are in mechanical construction: Sigma-5 is in 2' sections and lightweight; the Sigma-GT5 is in 4' sections and heavier, more for semi-permanent or permanent installations.

The Force 12, Inc. ZR antenna, first introduced in 1995, was a breakthrough in vertical antennas. The key to its performance is that it is an efficient, true vertical dipole. This provides a balanced vertical antenna, vs. having a vertical radiator and radials. The feedpoint on the ZR is elevated, thereby adding to the performance by slightly lowering the take-off angle and having less current in the lower portion of the antenna in proximity to ground. Overall, the typical ZR antenna has an efficiency greater than 95%, and, depending on the design, as high as 99%. The performance of the ZR has been unchallenged until the new SIGMA design in early 2001.



**DXpedition to Rourke
Island, 3XY6A, 3XY8A**

The past four (4) years have found Force 12, Inc. designing, building and testing a wide variety of verticals to match the performance of the ZR, but with simplified installation. The result is a new vertical design called the "Sigma" series. All Sigma verticals share the true vertical dipole aspect with the ZR. In the Sigma design, the vertical is resonated by using either a "T" bar across each end of the antenna, or "T" bars, plus very high Q center loading coils of small electrical size, having a negligible effect on efficiency.

The objectives of the Sigma antenna are to maintain efficiencies in the mid-90% range, while keeping the physical size as small as possible, and also to enable simple installation. These objectives are accomplished through more design and build time at Force 12, Inc., resulting in a superior product for the customer.



Sigma-GT5 at 170Y

The Sigma-5/GT5 is composed of a center vertical element and two (2) "T" bars, one at each end of the center element. The feedpoint is at the middle of the center element and there is a printed circuit board ("PCB") with several efficient, relay-controlled loading coils on each side of the feedpoint. The input feed

impedance varies on each band, but is matched with a single helical hairpin to the 50 ohm feed line. The VSWR will be less than 1.3:1 on all bands at the lowest point. The 2:1 VSWR bandwidth on 20 meters is >300 kHz and the Sigma-5 completely covers the other bands with less than 2:1. Power rating is 700 watts CW, 1,200 watts PEP on SSB (voice peaks), 300 watts RTTY, 100 watts AM (100% modulation).

For reference, the following table is how each Sigma-5/GT5 is tuned at the factory:

Band	Factory Setting	VSWR Bandwidth at Factory
20 meters (14.000 – 14.350)	14.200 <1.3:1	14.000 <2:1 and 14.350 <2.2:1
17 meters (18.068 – 18.168)	18.100 <1.2:1	<1.4:1 across the band
15 meters (21.000 – 21.450)	21.200 <1.2:1	21.000 <1.4:1 and 21.450 <1.6:1
12 meters (24.890 – 24.990)	24.930 <1.2:1	<1.4 across the band
10 meters (28.000 – 29.700)	28.450 <1.4:1	28.000 <1.7:1 and 29.700 <2:1

The above table can be used to determine the general value of the installation. Antennas are sensitive to surrounding objects and if an object is coupling to the Sigma-5/GT5, the VSWR's and frequencies in the table will not be achieved. Usually, coupling into a metallic object will pull the frequencies of lowest VSWR downward. The ends of the T-bars are the ends of the dipole, so they will have the highest voltage present during transmitting and they are also the most sensitive points on the antennas for coupling. If the Sigma-5/GT5 is way off according to the table, moving it even a few inches can make a significant change. The coax feed line and relay control line can also couple into the Sigma-5/GT5, so they need to be run away from the antenna at a 45 degree angle (or higher) for several feet. It will be obvious if they are coupling to the antenna, as the VSWR value and frequency will change with small movements of the coax feed line and/or control cable.

The relays on the center PCB (sealed relays inside the cover) control the frequency of the antenna. No relays energized (no power to the relays) is 20 meters. To move through the bands, matching pairs of relays are energized and they short out pairs of inductors at the center of the antenna. Power requirements are only 95ma at 12VDC. For convenience, the rotary band switch has 20 meters at both ends of the rotation.

A caution needs to be included here: using more than 100-200 watts on a vertical dipole will create a strong energy exposure field that can exceed the FCC recommended limits. Before running more than this power level, please compute the allowable limits. You will also find that almost all stations can be worked with the Sigma-5/GT5 using low power, due to its high efficiency.

All of the hardware is stainless steel, except for the wing nuts. These can be replaced with brass wing nuts (thread size is 10-24) if the antenna is in salt air.

The entire antenna can be painted to eliminate any glint in the sun. The styrene cover and caps can also be painted using non-metallic paint (do not use aluminum paint!). Black is often a good color. Greens are good where trees and shrubs are near-by. Making a camouflage design will be useful.

Tools required: NONE

I. OVERVIEW

1) All the parts to the Sigma-5/GT5 are pre-set and pre-tuned. The bandwidth on 20 meters will not quite cover the entire band, so it has been centered in the band and can be moved either up or down by changing the spacing on the internal coils as described later. A tuner can also be used instead.

- ____ 2) Lay out all the parts and match them up by their letters.
- ____ a) Base
 - ____ b) Center radiator (several sections)
 - ____ b1) Sigma-5 is in 2' sections
 - ____ b2) Sigma-GT5 is in 4' sections
 - ____ c) Lower and upper T-bars
 - ____ c1) Sigma-5 has 1/2" diameter T-bars
 - ____ c2) Sigma-GT5 has 1" diameter T-bars
- ____ 3) Extend the feedpoint extension using two (2) 10-24 machine screws, lock washers and nuts.
- ____ 4) Slide the Sigma-5/GT5 parts together, align and secure each joint with 10-24 machine screws, lock washers and nuts or wing-nuts. It is not necessary to over-tighten the nuts.
- ____ 5) Attach the coax feed line to the balun and secure the balun and 5-conductor relay control line to the feedpoint extension with two (2) tie-wraps.
- ____ 6) There are several methods to install the Sigma-5/GT5:
- ____ a) Using a 5-gallon bucket with cement for the base post
 - ____ b) Installing a slightly larger pipe in the ground for the base post
 - ____ c) Place the Sigma-5/GT5 on the ground and guying it once using non-conductive guy rope.
 - ____ d) The Sigma-GT5 can also be attached to a chimney, being careful to keep the lower T-bar away from metal on the chimney and roof.
- ____ 7) The Sigma-5/GT5 should not be placed too high above ground. If vertical antennas are placed too high, the energy splits off and creates a high angle lobe that actually has more energy than the desired low angle lobe. As the vertical is raised, the height above ground changes in terms of wavelength and the bands are not the same (i.e. 10 meters changes twice as fast as 20 meters). The feed point will also change, as the higher heights lower the feed point impedance. Elevated heights might mean the single matching hairpin will not provide an excellent match on all 5 bands. A higher VSWR does not mean the antenna is less efficient – that is independent of the match. The efficiency of the antenna remains the same (>90% on all bands), regardless of its location. It is only the VSWR that changes. A VSWR of >1:1 is not much of a concern. Some recent software by the A.R.R.L. shows the small amount of loss associated with VSWR's of >1:1 on various coax lines. More useful knowledge about VSWR can be found in the A.R.R.L. publication, Reflections by Maxwell.
- ____ 8) Run the coax and 5-conductor lines away from the antenna, at approximately a 45 degree angle, as far as possible. Straight out for several feet is excellent. If the feed line and control lines are dropped close to the Sigma-5/GT5, current from the antenna will couple into the lines and the antenna will be de-tuned. This can easily be checked by moving the lines and watching the VSWR.
- ____ 9) Connect the rotary switch control and 12 VDC as shown.

II. FINAL CHECKOUT

- ____ 1) Apply power and have fun.

III. MOVING 20 METERS

- ___ 1) Remove the cover on the center unit. Cover is either white tube with caps, or black 2-part assembly.
- ___ 2) Locate the 20 mtr coils, which are the large ones at both ends of the PCB.
- ___ 3) To move the frequency higher in the band, VERY SLIGHTLY spread the turns.
- ___ 4) To move the frequency down in the band, VERY SLIGHTLY close the turns.
- ___ 5) When as you desire, replace the covers.

IV. RELAY CONTROL

- ___ 1) All relays open is 20 meters (nothing energized) – both ends of switch rotation are 20 mtrs.
 - ___ a) 12VDC to Brown is 10 meters
 - ___ b) 12 VDC to Red is 12 meters
 - ___ c) 12 VDC to Orange is 15 meters
 - ___ d) 12 VDC Yellow is 17 meters
- ___ 2) Common (-12VDC) is to end of barrier strip for convenience – black wire.
- ___ 3) +12VDC is to next barrier location and white wire to switch.

Notice.....

PLEASE BE CAREFUL AND DO NOT LET THIS ANTENNA COME INTO CONTACT WITH POWER LINES OR OTHER DANGERS. YOU CAN BE INJURED OR KILLED BY IMPROPER HANDLING OF THIS ANTENNA.

Thank you for selecting our product. We hope you enjoy using it.

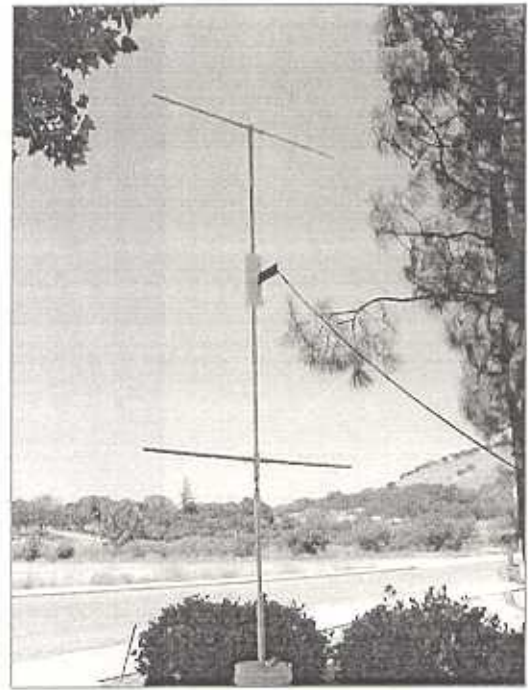
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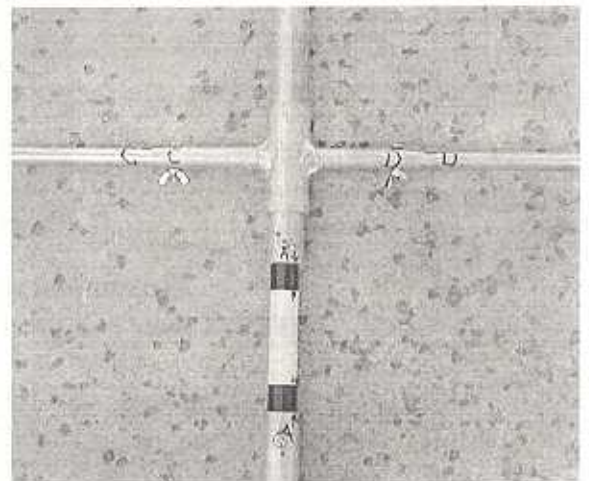
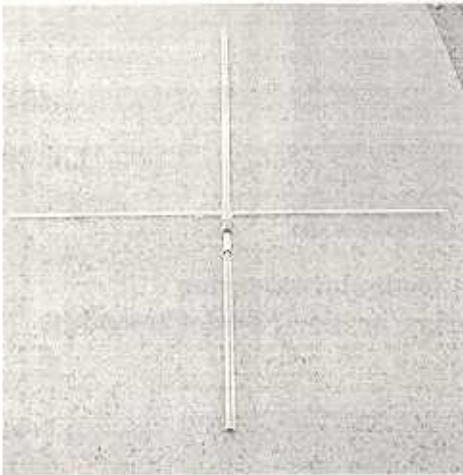
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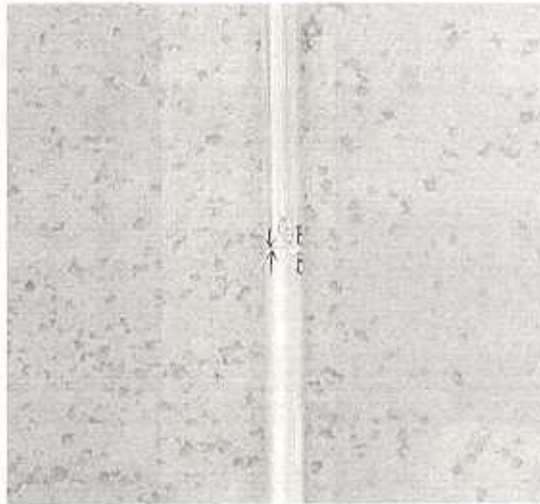
← Sigma-5



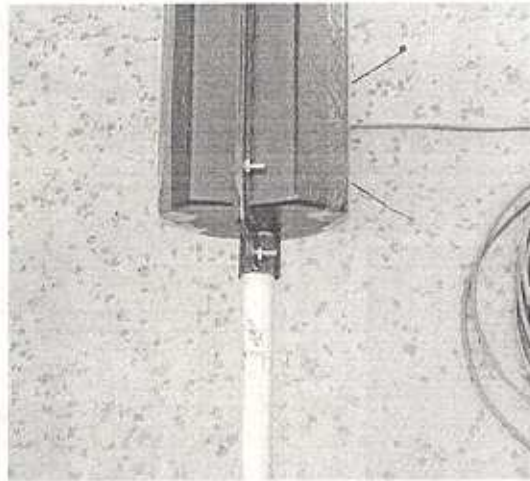
Sigma-GT5 above



Base sections

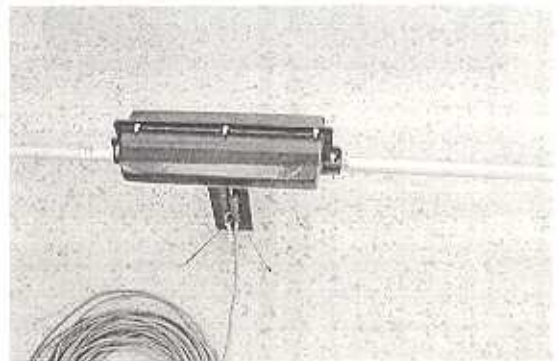


Section between base and center.

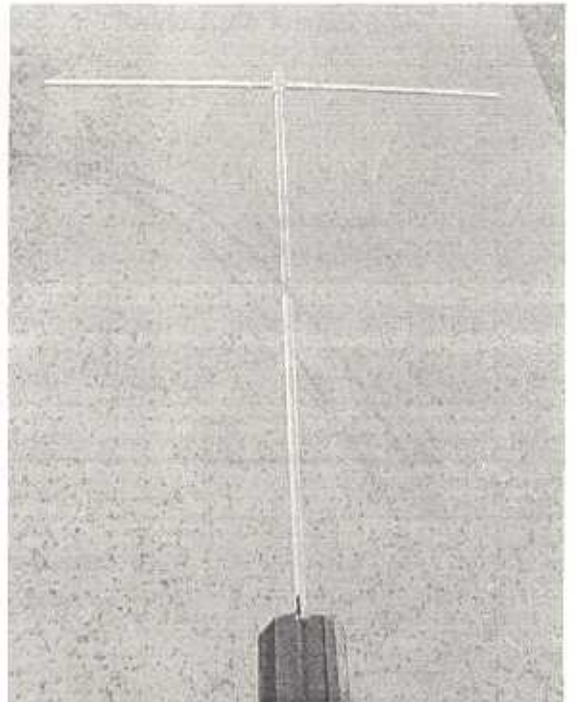
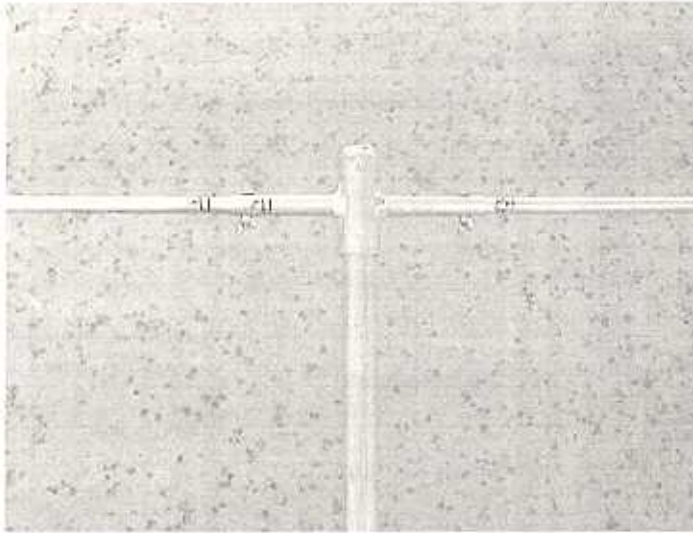


Attachment to Center. Tie wraps on feedpoint extension.

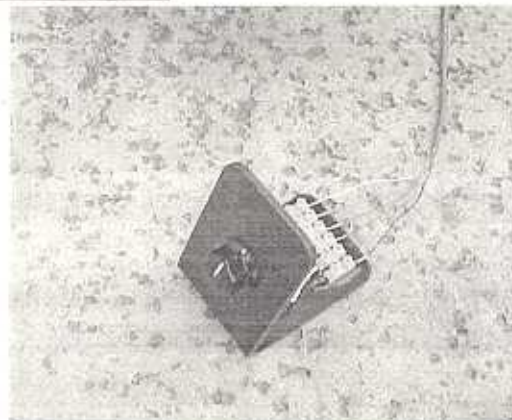
NOTE: Cover can be either white tube with caps, or black 2-part assembly.



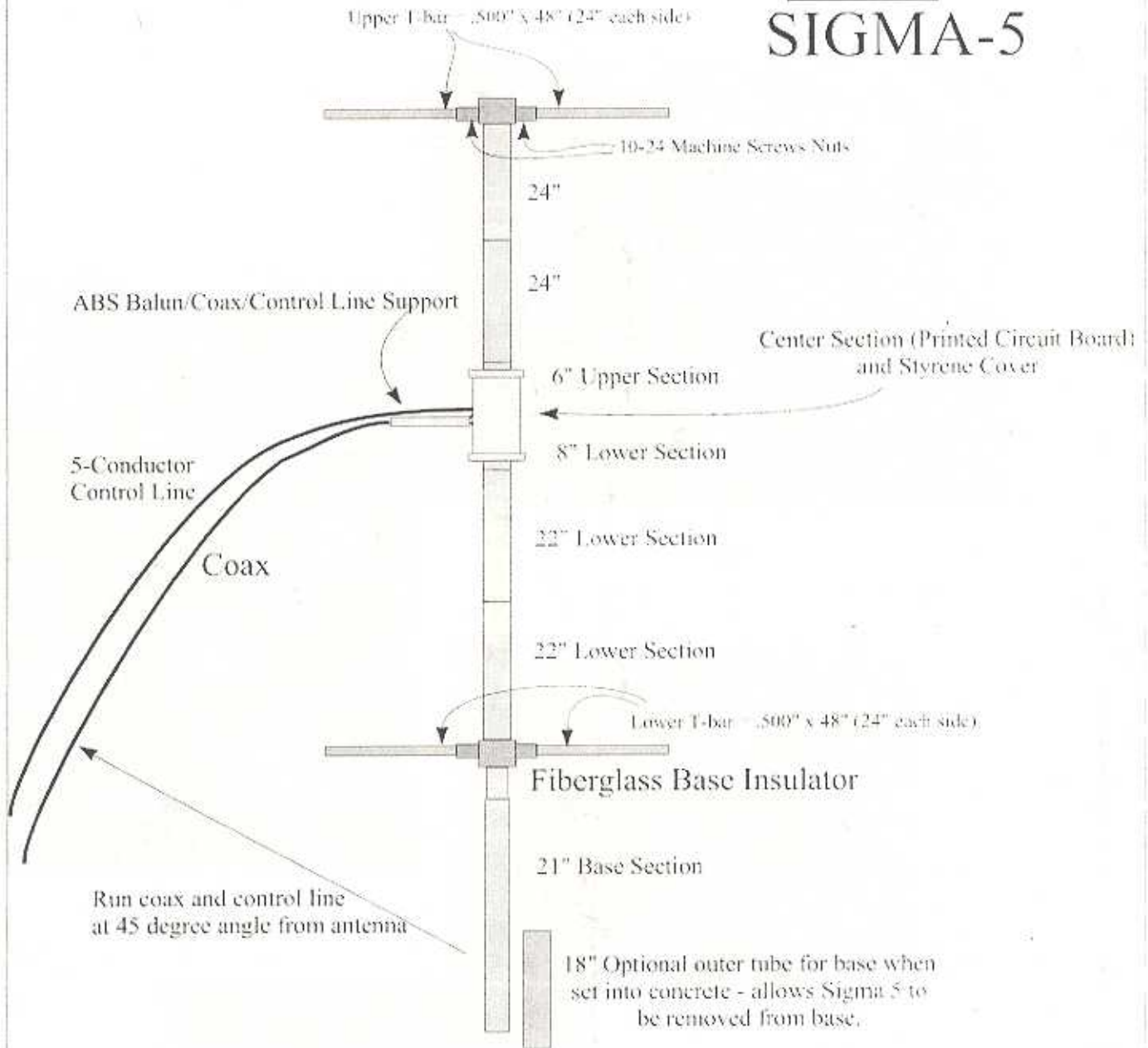
Upper Section.



Controller

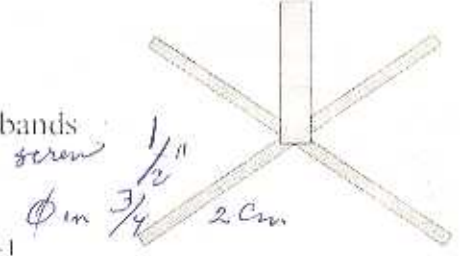


Force 12
SIGMA-5



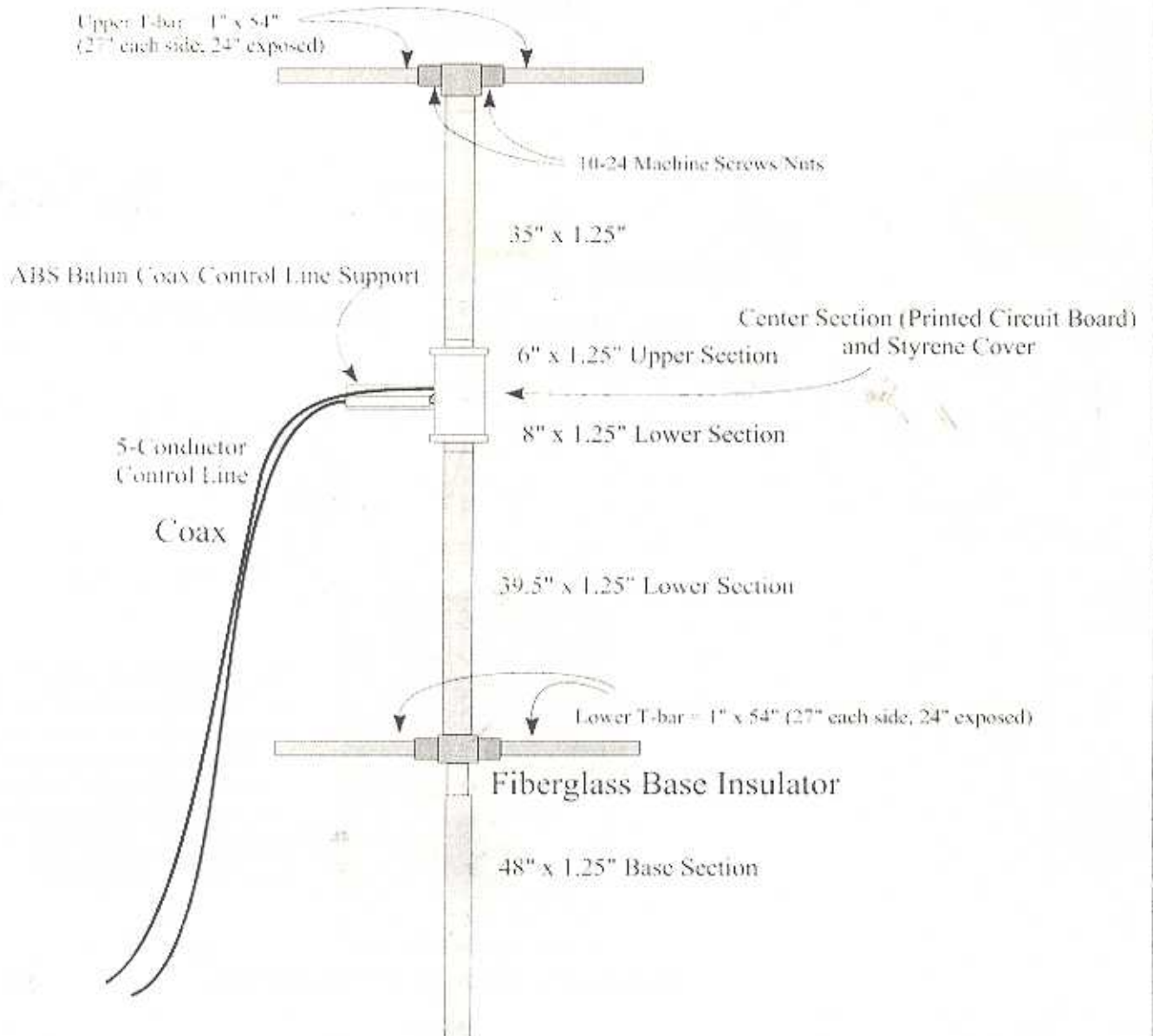
Sigma-5 Vertical Dipole
Antenna Height is 64" (5 1/2')
T-bars are 24" each side (48" total)
Direct 50 ohm feed, Hairpin Match >91% efficient on all bands
VSWR <2:1 across all bands (20 mtrs <2.2:1)

18" Optional T-base in 24" sections,
ideal for portable use.



DW-SIGMA-5-r1-1

SIGMA-GT5



Sigma-GT5 Vertical Dipole with TV elements

Antenna Height is 88" (7.4')

T-bars are 27" each side (54" total)

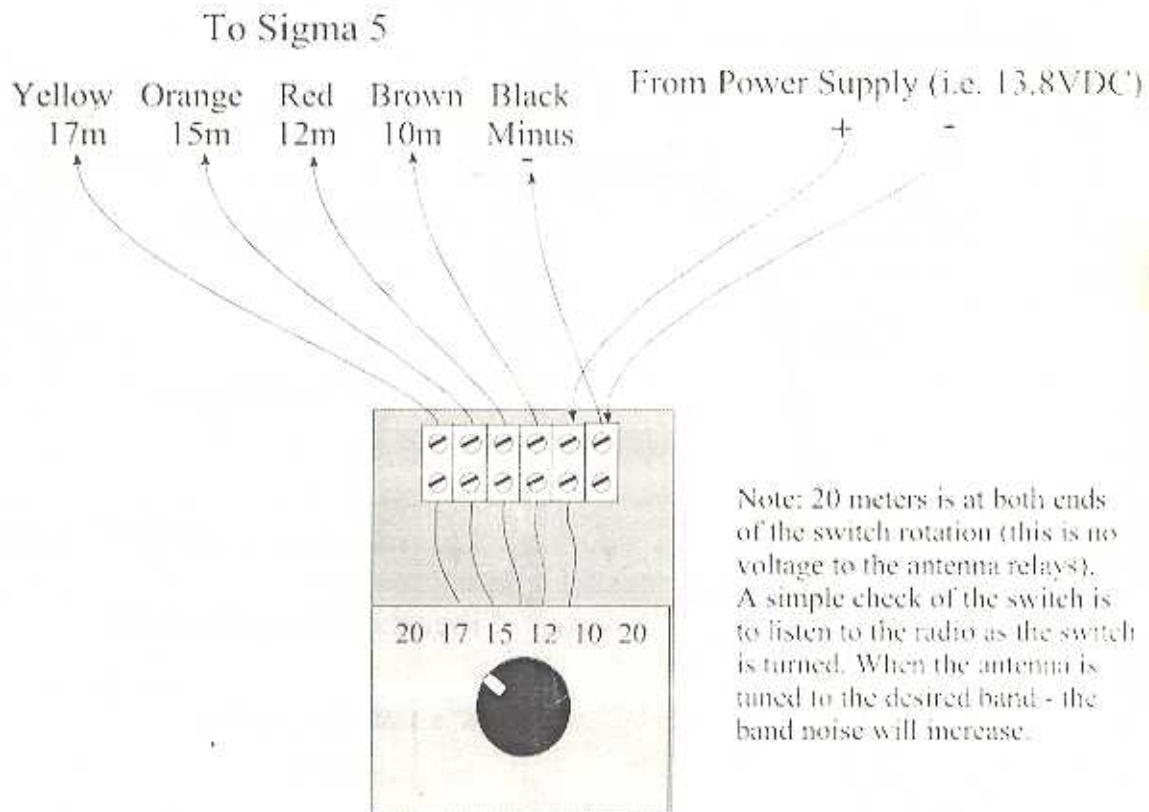
Direct 50 ohm feed, Hairpin Match >91% efficient on all bands

VSWR <2:1 across all bands (20 mtrs <2.2:1)

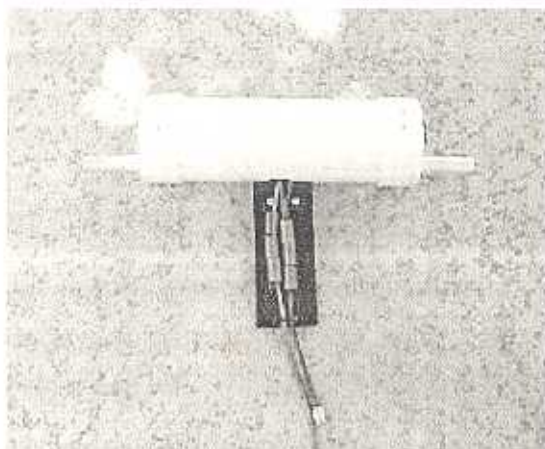
DW-SIGMA-GT5-F1-1

Sigma 5 Relay Wiring

Basic Wiring Diagram
Control Switches

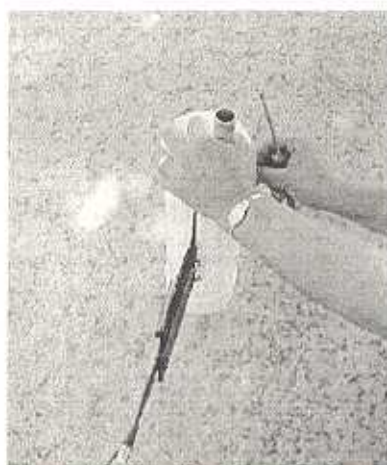
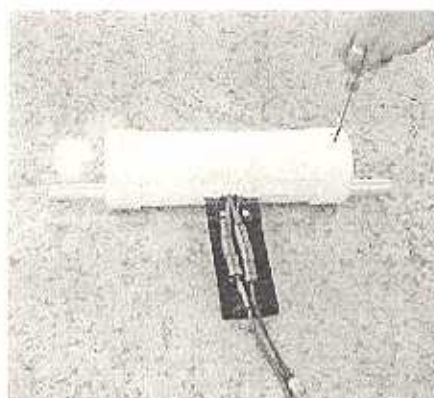


20m is all off (no power to relays)

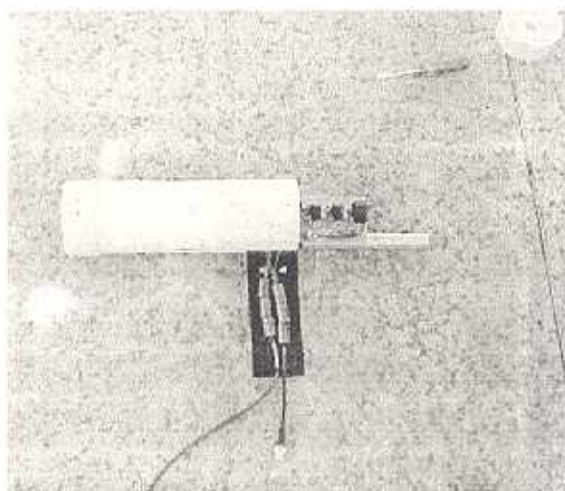


Force 12
SIGMA-5
Cover Removal

Center Section as it is delivered.

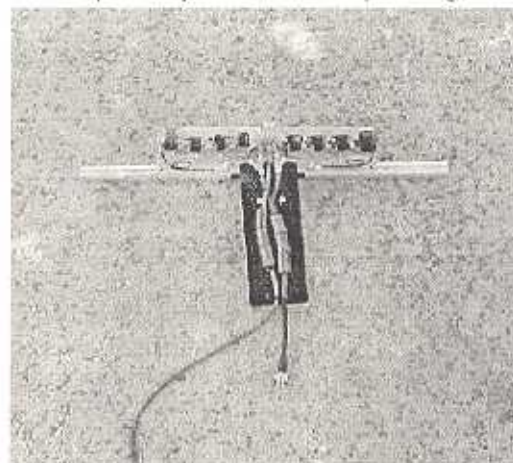


Use a small screw driver and remove screws from cap on one end, then slide cap off end of tubing.



Slide cover off, being careful not to damage coax balun and control wire.

Coils are:
20 - 17 - 15 - 12 Hairpin 12 - 15 - 17 - 20
(note: coils are shown fully compressed,
not spread apart after factory tuning)



DW-SIGMA-5-cover-r1-1

NOTES.....

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