



INSTRUCTION MANUAL

WIDEBAND DISCONE

ANTENNA

MODEL EM-6105

10 kHz - 2 GHz

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WIDEBAND DISCONE ANTENNA

10 kHz - 2 GHz

ELECTRO-METRICS

MODEL EM-6105

SERIAL NO: TYPICAL

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WARRANTY

This Model EM-6105 Wideband Discone Antenna is warranted for a period of 12 months (USA only) from date of shipment against defective materials and workmanship. This warranty is limited to the repair of or replacement of defective parts and is void if unauthorized repair or modification is attempted. Repairs for damage due to misuse or abnormal operating conditions will be performed at the factory and will be billed at our commercial hourly rates. Our estimate will be provided before the work is started.

DESCRIPTION AND USE ELECTRO-METRICS MODEL EM-6105 WIDEBAND DISCONE ANTENNA

1.0 Introduction

The Model EM-6105 Wideband Discone Antenna is a broadband omni-directional antenna that performs electric field measurements from 10 kHz to 2 GHz. With an output impedance of 50 Ω (nominal), it can be used with any 50 Ω instrument.

The EM-6105 consists of two separate antenna designs:

- a. An upper active vertical rod (adjustable) antenna covering from 10 kHz to 200 MHz,
- b. A lower passive discone antenna covering from 200 MHz to 2 GHz.

A combiner circuit connects the two antenna outputs to a single Type "N" (male) output connector.

Power is supplied by an external EM-6106 Battery Pack that contains a battery-powered 15 VDC power supply, rechargeable sealed lead acid batteries, and battery charge circuit. The nominal operating time on a fully charged battery pack is 20 hours while the battery charging time is approximately 12 hours.

The bottom of the base has a 1/4-20 threaded receptacle for mounting to the Model EM-TRI-3022 Tripod.

2.0 Specifications

2.1 Electrical

Frequency Range (Calibrated):	10 kHz to 2 GHz.
	(Antenna Factor Graph furnished with each antenna.) (Calibration data taken with rod fully collapsed.)
Impedance:	50 Ω nominal.
Overload:	2 V/m below 50 MHz. (+5 dBm at output connector)
Polarization:	Vertical.
Connector:	Type "N" (Male).
Power Source:	15 VDC supplied by external EM-6106 Battery Pack/Charger Module.

(Refer to Section 6.0 for complete EM-6106 specifications)

2.2 Mechanical

Height:

W/o upper rod:	572 mm (22.5").
With upper rod:	Fully collapsed: 826 mm (32.5"). Fully extended: ≈2030 mm (≈80").

Length:

Upper Antenna Rod:	Fully collapsed: 254 mm (10"). Fully Extended: ≈1450 mm (≈57").
Lower Radial Elements:	406 mm (16").

Diameter:

Stowed Configuration:	114 mm (4.5").
Deployed Configuration:	457 mm (18").
Antenna Disk: (Counterpoise)	321 mm (12.6").

Weight:	2 kg (4.5 lbs).
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3.0 EM-6105 Description

The EM-6105 consists of a vertical tube with a circular base and topped by a circular antenna disk. Below the antenna disk are the radial elements of the discone antenna while above the antenna disk is the active vertical rod antenna.

3.1 Active Vertical Rod

Frequency Range: 10 kHz-200 MHz.

The upper active vertical rod consists of a removable--adjustable rod inserted into a banana plug type connector, a removable circular aluminum antenna disk, and an active amplifier circuit. The rod is adjustable from 254 mm (10") to ≈1450 mm (≈57").

The circular antenna disk (counterpoise) forms the ground plane for the active rod antenna.

3.1.1 Active Amplifier Circuit

Electric field signals are intercepted by the rod antenna and coupled to a source follower. The high input impedance of the source follower and its biasing network permit maximum transfer of the E-Field signal from the rod (which is essentially a small capacitance in its ideal form) to the source follower. The output of the source follower is then

capacitively coupled to the base of an emitter follower which is used to drive a 50Ω load, i.e. the test receiver. The output of the active amplifier is applied to a combiner circuit in the base of the EM-6105.

3.2 Passive Discone

Frequency Range: 200 MHz-2 GHz.

The Passive Discone consists of sixteen (16) 406 mm (16") radial elements inserted in a circular pattern below the removable antenna disk.

The circular antenna disk (counterpoise) now forms the disk end of the discone antenna.

3.3 Combiner Circuit

The combiner circuit consists of two passive filters:

- a. A low pass filter for the 10 kHz-200 MHz range (active vertical rod).
- b. A high pass filter for the 200 MHz-2 GHz range (passive discone).

The filtered signals are then combined and applied to the RF Signal Output Connector.

3.4 RF Signal Out Connector

Type: "N", Male.

Function: The connector has two functions:

- a. To connect the output of the EM-6105 to the RF Input Connector of the EM-6106 that then connects the signal to the 50Ω instrument being used.
- b. To supply the DC power required to operate the active circuitry of the antenna. The center conductor feeds the +15 VDC while the shield is the DC ground return.

4.0 Operating Procedure

4.1 Antenna Set-Up Procedure

- a. Mount the antenna base to the Model EM-TRI-3022 Tripod. The antenna base is secured to the tripod by screwing it in a clockwise direction, as viewed from above.
- b. Place the three offset slotted holes in the antenna disk (counterpoise) over the three thumb screws on the top of the antenna disk support ring. Secure the antenna disk by tightening down the three thumb screws.
- c. Plug the adjustable vertical rod into the socket on the top of the antenna housing. Adjust the rod for the length desired.

- d. Remove the radial element hold-down to allow the elements to deploy in a cone shaped pattern.

4.2 Electrical Connection

- a. Connect the 2 m (6') coaxial cable (CNC-6--N FEMALE-TO-N FEMALE) from the RF Output Connector (Type "N" Male) on the antenna base to the "Input" Connector (Type "N" Male) on the EM-6106 front panel.
- b. Connect a 3 m (10') low loss coaxial cable (N MALE-TO-N MALE) from the Output Connector (Type "N" Female) on the EM-6106 front panel to the spectrum analyzer or receiver being used.

4.3 Power Turn-On

- a. Activate the EM-6105 active circuitry by turning on the EM-6106 front panel Power On Switch (two position rocker). This activates the +15 VDC power supply within the EM-6106.

NOTE: **The internal DC power supply of the EM-6106 is designed to operate only with the internal battery. The EM-6106 will not operate connected to an AC Power Source.**

4.4 Operational Checkout

NOTE: **The following procedure is performed using a 50-ohm spectrum analyzer. any similar 50-ohm instrumentation could be used.**

- a. Turn "ON" the spectrum analyzer.
- b. Set the spectrum analyzer front panel controls to obtain a trace line on the CRT.
- c. Tune the spectrum analyzer to a frequency between 10 kHz and 200 MHz.
- d. Connect the spectrum analyzer to the Output Connector on the front panel of the EM-6106.
- e. Connect the EM-6105 Output to the Input Connector of the EM-6106.
- f. Turn on the EM-6106 and note an increase in the noise level on the front panel CRT of the spectrum analyzer.

5.0 Electric Field Measurements

With the Model EM-6105 Wideband Discone Antenna, connected to the selected spectrum analyzer (or any similar 50Ω measurement instrumentation) as described above, tune or set the spectrum analyzer to the frequency range of interest. Read the two-terminal voltage indicated by the analyzer for the particular signal of interest. Refer to the instruction manual for the instrument being used for the relevant calibration and operating procedures.

To convert the resulting two-terminal reading to the appropriate field strength when using the EM-6105, simply add the "antenna factor in dB/m" at the frequency of interest from the Antenna Factor Chart for the antenna being used.

NOTE: The calibration data is taken with the rod fully collapsed (254 mm) and is therefore valid only for that condition.

Example:

Signal Amplitude Indication.....	+20 dB(μV)*
Two-terminal voltage indication is thus	+20 dB(μV)
Antenna factor from graph (typical)	+14 dB(1/m)
Field Strength intercepted by antenna is.....	+34 dB(μV/m)

* **NOTE:** Some instrumentation automatically adds any instrument internal attenuation to the amplitude reading. Other instrumentation does not include this capability and the user must add the appropriate attenuation level to the amplitude indication to obtain the correction input signal level.

In most cases, the user must also include coaxial cable losses (if applicable) plus any other signal path or system attenuation.

From 25 MHz to 140 MHz, the rod can be adjusted to obtain the best sensitivity (sensitivity and rod length will vary with frequency). This procedure has two negative side effects:

- a. Increases the possibility of overloading the antenna,
- b. The calibration data is invalid.

At frequencies below 30 MHz, it is a good idea to make electric/magnetic field measurements in the near field since one component may be much stronger than the other.

6.0 EM-6106 Battery Pack/Charger Module

6.1 EM-6106 Specifications

6.1.1 Electrical

DC Output:	15 VDC, Nominal.
AC Power Source:	90-265 VAC, 47-440 Hz.
DC Power Source:	18 V rechargeable battery (sealed lead acid)
Operating Time:	Nominal 20 hours between chargings.
Recharge Time:	Nominal 12 hours.
Fuse:	0.5 AMP 2AG FAST ACTING (subminiature)
Connectors:	Input: Type "N" Male. Output: Type "N" Female.

6.1.2 Mechanical

Height:	88 mm (3.47").
Width:	212 mm (8.35").
Depth:	168 mm (6.6").
Weight:	2.7 kg (6 lbs).

6.2 EM-6106 Description

The EM-6106 comprises a rectangular aluminum box containing a battery-powered 15 VDC power supply, rechargeable sealed lead acid batteries, and battery charge circuit. The nominal operating time on a fully charged battery pack is 20 hours while the battery charging time is approximately 12 hours.

The controls--indicators--connectors located on the front and rear panel of the EM-6106 include:

- a. Power Switch,
- b. Power On Indicator (green LED),
- c. Battery Charge Indicator (red LED),
- d. Type "N" (male) Antenna Input Connector,
- e. Type "N" (female) RF Output Connector,
- f. DC Power Accessory Connector,
- g. AC Input Connector (RP),

- h. Fuse Holder (RP).

6.3 Description Front/Rear Panel

6.3.1 Front Panel

- a. **ON/OFF (Power) Switch**

Type: Two cycle rocker switch.

Function: Turns on DC regulator circuit to supply +15 VDC for antenna active circuitry.

- b. **Power On Indicator**

Type: LED.

Color: Green.

Function: To indicate that the DC regulator circuit is activated and functional.

Whenever the battery voltage has decreased to the point that recharging is required, the LED will be extinguished. At this point the DC regulator circuitry is disabled and is non-operational until the battery is recharged.

Battery recharging should be initiated as soon as possible after the Power On Indicator LED is extinguished. Failure to do so could compromise the useful life of the battery.

NOTE: Whenever the EM-6106 is connected to the AC power source, the Power On Indicator is extinguished and the DC regulator disabled.

- c. **Battery Charge Indicator**

Type: LED.

Color: Red

Function: To indicate that the EM-6106 is connected to the selected AC power source and the battery is being recharged. The DC regulator is disabled during battery recharging.

- d. **Input Connector**

Type: "N" (male).

Function: The connector has two functions:

1) To receive the RF Output of the antenna being used (EM-6877, EM-6105).

2) To supply the DC power required to operate the active circuitry of the antenna being used. The center conductor feeds the +15 VDC while the shield is the DC ground return.

e. **Output Connector**

Type: "N" (female).

Function: Connects the RF input from the Input Connector to the spectrum analyzer or receiver being used.

f. **DC Power Accessory Connector**

Type: 4-pin

Function: Provides a +15 VDC output.

6.3.2 Rear Panel

a. **AC Power Connector**

Type: IEC, male, grounded.

Function: Connects the EM-6106 to the selected AC power source for use by the charging circuit.

b. **Fuse Holder**

Type: Panel mount for subminiature fuse, screw-driver slot knob.

Function: Self-explanatory.

6.4 Description Battery/Charger/Regulator Circuitry

The battery supplies the operating voltage for the regulator circuitry of the EM-6106.

When the Power Switch is in the ON position, the output of the battery is connected to the Cutoff/Monitor and Regulator circuits. If the battery voltage is a minimum of +15.5 VDC, a sensor network will supply battery voltage to the DC regulator circuit.

The DC regulator supplies the +15 VDC for the antenna circuitry and to activate the Power "ON" LED. The conduction of a series pass transistor is controlled by a feedback network. A potentiometer is adjusted for a regulated +15 VDC output to the INPUT Connector and the Accessory Connector.

Whenever the battery voltage goes below +15.5 VDC, the sensor network turns off the regulator circuit which extinguishes the Power "ON" LED.

To recharge the internal battery, the EM-6106 is connected to the selected AC power source which automatically disconnects the battery power from the regulator circuit and activates the "CHARGE" LED. This is accomplished by a relay within the charger circuitry.

- NOTE:**
- 1) The position of the power switch has NO EFFECT on the operation of the charger circuit.**
 - 2) The EM-6106 will not operate when connected to an AC power source.**

A constant voltage charge circuit is used to supply a constant voltage for charging the battery. The series-pass transistor is current-limited, while additional resistors and diodes serve as a feedback network. A potentiometer is used to adjust the level of the charge voltage.

6.5 Operating Procedure

6.5.1 Recharging Battery

6.5.1.1 AC Power Source

The EM-6106 uses an AC power source of:

90-265 VAC, 47-440 Hz

6.5.1.2 Fuse Specifications

The EM-6106 uses the following fuse:

0.50 AMP 2AG FAST-ACTING, subminiature.

6.5.1.3 Battery Recharging Procedure

- a. Connect the EM-6106 to the selected AC power source.
- b. Leave the unit connected to the AC power source for a minimum of 12 hours before operating the EM-6106.

- NOTE:** *The internal DC power supply of the EM-6106 is designed to operate only with the internal battery. The EM-6106 will not operate connected to an AC Power Source.*

6.5.2 EM-6106 Operation

- a.** Connect the 2 meter (6') coaxial cable (CNC-6--N FEMALE-TO-N FEMALE) from the RF Output Connector (Type "N" Male) on the antenna being use to the "Input" Connector (Type "N" Male) on the EM-6106 front panel.
- b.** Connect a 3 meter (10') low loss coaxial cable (N MALE-TO-N MALE) from the Output Connector (Type "N" Female) on the EM-6106 front panel to the spectrum analyzer or receiver being used.
- c.** Activate the EM-6106 by turning on front panel "Power On" Switch. This activates the +15 VDC regulator circuit within the EM-6106 and the front panel "POWER ON" LED.

Figure 1
Antenna Factor Graph
Model EM-6105
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ELECTRO-METRICS
MODEL EM-6105 SERIAL NO: TYPICAL
ANTENNA FACTOR VS FREQUENCY

(EM6105-11)

Frequency (MHz)	Antenna Factor (dB/m)
0.01	25.61
0.02	25.13
0.05	24.41
0.10	24.37
0.20	24.38
0.50	24.40
1.0	24.45
2.0	24.43
5.0	24.61
10.0	24.74
20.0	24.87
30.0	24.80
40.0	25.13
50.0	25.57
60.0	26.18
70.0	26.82
80.0	36.65
100.0	24.30
140.0	15.34
160.0	14.55
180.0	16.11
200.0	17.02
300.0	17.44
400.0	18.44
500.0	18.69
600.0	23.52
700.0	23.63
800.0	24.76
900.0	27.79
1000.0	30.24
1200.0	35.03
1400.0	34.63
1600.0	36.23
1800.0	38.73
2000.0	39.23

