INSTRUCTION MANUAL

for the

CGO-Series

Comb Generators

Models: CGO-501, CGO-505 & CGO-515

1 & 5 MHz step

Table of Contents

Introduction

This manual provides on how maintain and use the Comb Generator.

Product Specifications

Models covered:	CGO-501, CGO-505, CGO-515
Frequency step size:	1 or 5 MHz
Number of antennas included:	Two
Antenna 1 Freq. range / height:	1 to 425 MHz / 12 inches (30.4 cm)
Antenna 2 Freq. range / height:	425 to 1500 MHz / 5 inches (12.7 cm)
Frequency Stability:	20 ppm
Amplitude Stability:	< ± 0.1 dB
Frequency Range:	1 MHz to 1.5 GHz
Internal Battery Type:	6 V Rechargeable NimH
Battery Charger Specifications:	
- Input:	115 / 230 VAC, 60 / 50 Hz
- Output:	6 VDC, 500 mA (unregulated)
- Plug type:	2.5 ID x 5.5 OD mm (center pin positive)
Output Connector:	BNC (female)
Circular base dimensions (W x H) :	7 x 1.2 inches / 17.8 x 3 cm
Weight (lbs / kg):	1.5 lbs / 0.7 kg

Other Comb Generator models available from Com-Power

- CGO-520 Comb Generator, 20 MHz step
- CGO-5100B Comb Generator, 100 MHz step
- CGO-51000 Comb Generator, 1 GHz step
- CGC-510E Conducted Comb Generator, 100 / 500 KHz step
- CGC-255E Conducted Comb Generator, 50 / 250 kHz step

Important precautions and Maintenance

Precautions:

A Comb Generator is an intentional radiator designed to produces signals over a wide frequency range. It was designed for use in EMI test laboratories to verify operation of EMI test sites and measurement equipment. These radiated signals may cause unwanted radio frequency interference to other equipment operating in the vicinity. If you detect any interference, increase the separation between Comb Generator and the other equipment.

Maintenance:

There are no user serviceable parts inside the unit. User modifications to the Comb Generator will void warranty. The Comb Generator uses rechargeable NimH batteries. Call the factory if the battery needs replacement. Send Comb Generator to authorized Com-Power service center if needs repair. Please visit our website at www.com-power.com to request a return merchandise authorization number (RMA) before sending the unit in for service.

Battery care and instructions

To avoid any risk of explosion

- Replace batteries with the size and type specified in this manual.
- Do not dispose of batteries in a fire or trash incinerator; or leave batteries in direct sunlight.
- Do not immerse batteries in water or otherwise get them wet.
- Do not charge batteries, that appear to be leaking, discolored, rusty, deformed, or emitting an odor
- Use only battery charger supplied with the Comb Generator to charge the batteries.

Environmental Conditions

This equipment is designed for indoor and outdoor use and is safe under the following environmental Conditions:

- Temperature: 5° C to 40° C
- Maximum relative humidity: 80%

Warranty

Com-Power warrants to its Customers that the products it manufactures will be free from defects in materials and workmanship for a ***period of 3 years***. This warranty shall not apply to:

a) Transport damages during shipment from your plant.
b) Damages due to poor packaging.
c) Product operated outside their specification.
d) Improperly maintained or modified.
e) Consumable items, fuses, power cords, cables, etc.
f) Normal wear
g) Calibration
h) Product is shipped outside the United States without the prior knowlege of Com-Power.

In addition, Com-Power shall not be obliged to provide service under this warranty to repair damage resulting from attempts to install, repair, service or modify the instrument by personnel other than Com-Power service representative.

Under no circumstances does Com-Power recognize or assume liability for any loss, damage or expense arising either directly or indirectly from the use or handling of this product, or any inability to use this product seperately or in combination with other equipment.

When requesting warranty services, it is recommended that the original packaging material be used for shipping. Damage due to improper packaging will void warranty.

In the case of a complaint, a label should be attached to the housing of the instrument which describes briefly the faults observed. If at the same time the name and telephone number (dialing code and telephone or direct number or department designation) is stated for possible queries, this helps towards speeding up the processing of warranty claims. In order to obtain service under this warranty, Customers must contact the Com-Power.

Product Description

Overview

The CGO series Comb Generators are reference signal sources. They were designed for EMC laboratories use. It is ideal for quickly detecting malfunctioning equipment in the radiated emissions test setup in between full calibration intervals. These malfunctions may go undetected, unless it they are checked often. Full site calibration, although more accurate, is time consuming is not practical for a quick test. By comparing Comb Generator data taken regularly, the EMI lab can ensure that all the test equipment and accessories are operating within the expected range. If any abnormality is detected, it can be quickly investigated and rectified before it causes measurement errors.

The Comb Generators can also be used for comparing two or more sites with similar setup. They can also be utilized as conducted signal sources for testing Line Impedance Stabilization Network (LISN), filters and cables.

Items included with Comb Generators

Equipment, accessories, and documents supplied with the models CGO-501, CGO-505 and CGO-515 Comb Generators are as follows:

- User's guide
- Custom storage box
- Battery Charger adapter
- Two antennas
- Test data (optional reference data at extra cost)

Controls and indicators

Power on Switch

This is located on the side of the Comb Generator, and is for powering the Comb Generator on and off. The RF output of the generator is active whenever the generator is on, except during a low battery condition.

Output connector

The comb generator output is available at the BNC connector located on the top of the unit. This output can be used for radiated or conducted emissions testing. For radiated measurements, the monopole antenna is attached to this connector. There are two antennas with BNC male connectors provided to cover the Comb Generator radiated frequency range. Please refer to page 3 to determine the approximate frequency range of each antenna. The antenna can be disconnected for conducted emissions measurements. **Do not connect the Comb Generator output to a Line Impedance Stabilization Network (LISN) that is connected to AC power. We also do not recommend connecting the Comb Generator output directly to a preamplifier input.**

Frequency selection switch (1 / 5 MHz)

This switch is only available on the model CGO-515. It allows the user to select between 1 or 5 MHz frequency step size.

Power On indicator

The green power on LED is lit, the Comb Generator is powered on and output is available for measurement.

Battery Low indicator

When the red 'battery low' LED is lit, the internal battery needs recharging. The output may not be reliable. Turn off Comb Generator and charge the battery with the supplied adapter. The approximate time to fully charge the battery is 8 hours. The Comb Generator can operate approximately 18 hours when fully charged. Please note however, that the operating time given in this manual is approximate and depends on the condition of battery, storage period and the number times it has been charged and discharged. If the operating time keeps decreasing, you may need to replace the battery pack.

Theory

The Comb Generator uses an impulse to generate its step frequency output. It uses a stable power supply and signal shaping circuit to obtain relatively stable signal output with frequency components extending beyond 1 GHz.

The Comb Generator operates on battery power. The battery output is controlled by a voltage regulator circuit to provide stable power output to the signal generating circuit. The signal generating circuit consists of a clock generator, impulse generator, wave shaping circuit and output matching. The signal frequency is generated by a crystal oscillator.

An impulse in time domain corresponds to a flat output across the entire frequency spectrum in frequency domain. An ideal impulse, by definition is an infinite magnitude pulse with zero rise and fall time with zero duration. Such a pulse is not practical; however, the Model CGO-501,505 and 515 Comb Generators use this principle to get an output across a wide band. The highly stable frequency output from the oscillator is used to generate an impulse with very short duration and sharp rise and fall times. The shaping circuit was designed for improved stability, extended frequency response, and output impedance matching to 50 ohms. Since the circuit cannot generate an ideal impulse with zero rise and fall times, the comb generator conducted output reduces at the approximate rate of 20 dB per decade.

The radiated reference signal is transmitted by the antenna affixed to the top of the unit. An electrically short monopole antenna is an antenna that is short compared to the wavelength of the frequency it radiates. Such an antenna generates a radiated field proportional to its length. The radiated field, therefore, compensates for decreasing signal up to a frequency, where the antenna cannot be called electrically short. This theory describes the general behavior of the field, but each Comb Generator may behave slightly different than the other due to circuit variation. Since the Comb Generators were designed to provide a reference reading at a given frequency, this limitation is not a problem.

Application

Radiated Emissions

EMI test sites such as Open Area Test Site (OATS) or Anechoic chambers are constructed with specific requirements and are calibrated in a precise manner to optimize the reliability of the emissions measurements. The time and expense incurred is considered essential to increase the repeatability of the data.

The data taken on the above sites are generally reliable. However, in some instances, discrepancies do occur, and the reliability of data is questionable. Such discrepancies could be discovered when either (a) data from two sites for the same equipment do not match, or (b) the data from two different occasions for the same equipment at the same OATS are not consistent. It is important to find the cause for such inconsistency. This is generally a very time consuming and difficult process because the reason could be one of four complex factors.

(1) Equipment under test (EUT),
(2) The Test Site
(3) Instrumentation
(4) Test personnel.

Each of these factors may have many possible causes. The EUT, for example, may have changed due to component variation, temperature, operating mode, wear and tear, design, etc. The test site may be a cause due to a reflective object near the site, variation of ground saturation or ambient signal presence. It also could be due to malfunctioning test instrumentation.

By establishing a simple measurement procedure similar to the one described below, the test lab can reduce the occurrences of such problems; thereby increasing the reliability of measurements taken on the site. The procedure described is just a guide and can varied according to your needs.

Measurement Procedure

As mentioned before, taking measurements frequently is important. Create a log with frequency and levels that you would like to record. This can be a daily, weekly or monthly log. We recommend taking Comb Generator measurements before starting a radiated emissions test. Set up the Comb Generator with the appropriate antenna (see frequency range on page 3). Put the Comb Generator where the equipment under test (EUT) is normally placed during the test.

Make a measurement like you would on a EUT. We recommend using discrete frequency points rather than a wide frequency sweep. Such as 30 MHz, 40 MHz, 100 Hz, 900 MHz, etc. Record the level for each frequency.

Compare these levels with subsequent measurements to make sure that the pattern does not have abrupt change from the established daily log at any frequency.
This log is used to detect any test equipment or test site related problems, as described below.

Problems Related to Test Equipment

Variation on the log of the Comb Generator output data is dependent on the test equipment as well as site. The Comb Generator replaces the EUT. The Comb Generator not only generates the output simultaneously at all the harmonics, but it minimizes any variation of its output. This is achieved by utilizing a stabilized signal circuit as well as geometry of the radiator. The circuit stability is maximized by design, whereas the geometry of the radiated source is optimized by eliminating all cables during the Radiated Emission Mode. The typical variation of Comb Generator output at any frequency is less than ± 1 dB.

With the variations due to the EUT practically eliminated, only variations remaining are due to other factors, mainly the test instrumentation and the site. The variation due to test instrumentation is limited to the sum total of the tolerance on all test equipment used (spectrum analyzer, antenna, preamplifier, cables). A few days of data will establish the range of variation to be expected at a site. This is generally less than ± 3 dB. Any variation in the readings above normal variation indicates a potential problem.

After the daily log is established for a few days, any problem is easily detected as a larger variation. This procedure allows immediate detection of a major problem with the test equipment.

Problems Related to site

The above procedure cannot distinguish between problems related to the test site. The Comb Generator can be used in two ways to detect any problem with a test site. One method is to start the daily log immediately after the test site is calibrated. This way, one is certain about the validity of the data taken on the test site. The second method is to calibrate the Comb Generator radiated output as absolute emission level. Such calibration is provided as an option with the Comb Generators.

In addition, when difficulty arises with any EUT data taken at two different sites, the Comb Generator can be used to determine if both sites give reliable results, just by comparing the data at the two sites with the Comb Generator. In this case, if the two sites do not produce comparable results, a Comb Generator with calibrated data is certainly required to determine the faulty site.

Problems Related to Test Personnel

The Comb Generator cannot directly help to eliminate the test personnel related problems. However, by increasing the confidence level and establishing definite procedures for eliminating site and equipment related problems it helps tremendously to reduce the problems related to EMI measurements.

The following graphs show the typical radiated and conducted output levels for the respective comb generators:

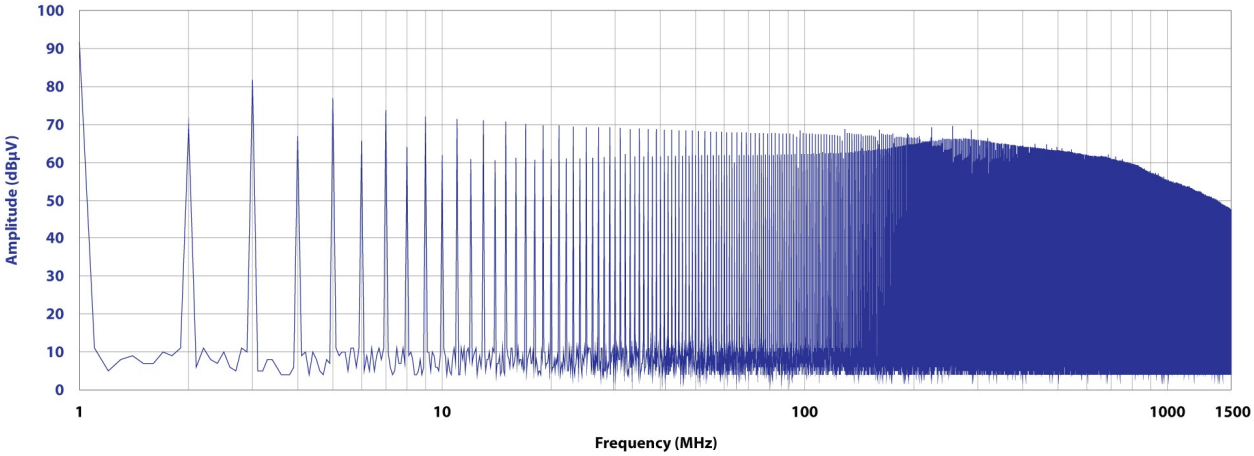

Figure 1: CGO-501 – Conducted Output

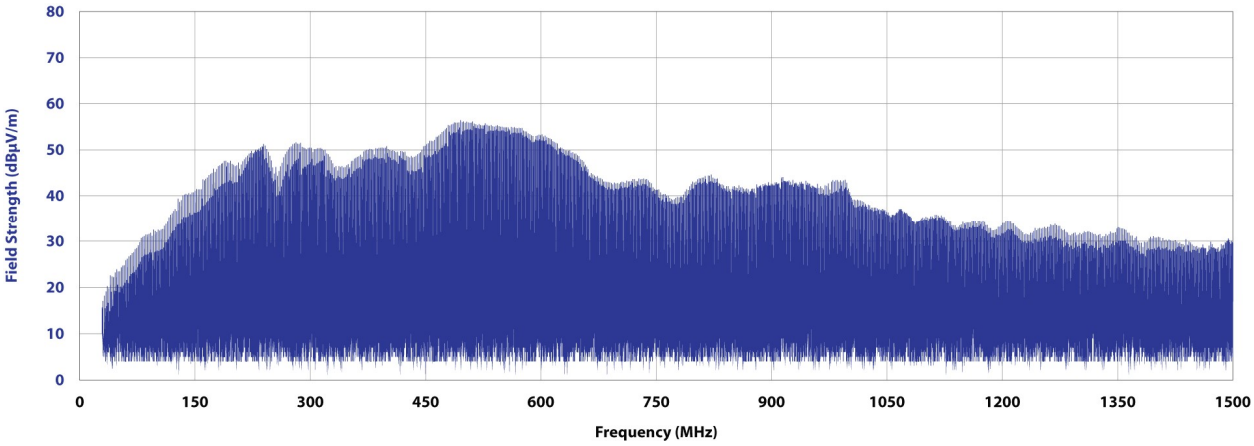

Figure 2: CGO-501 – Radiated Output at 3-meters distance (antenna height fixed @ 1 meter)

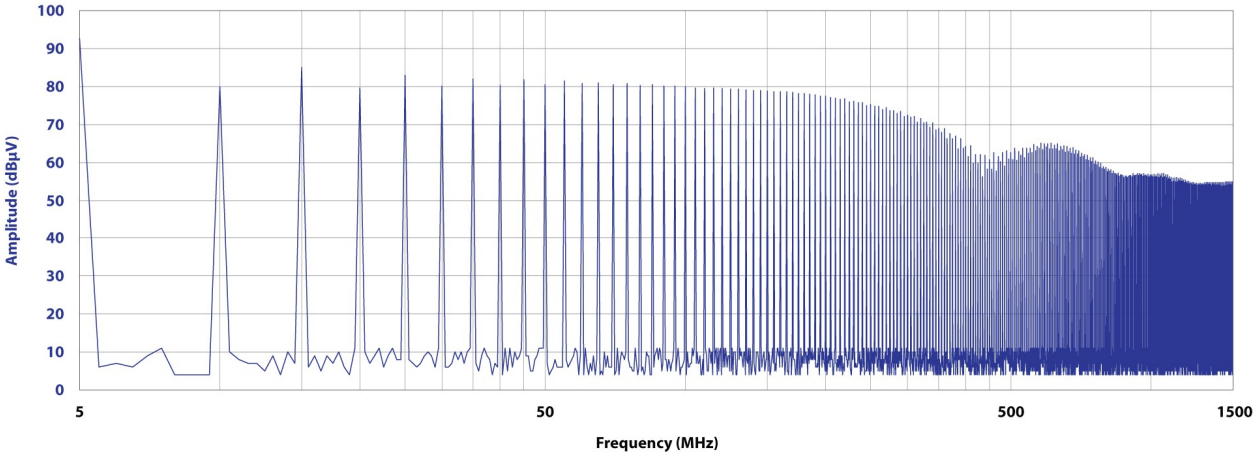

Figure 3: CGO-505 – Conducted Output

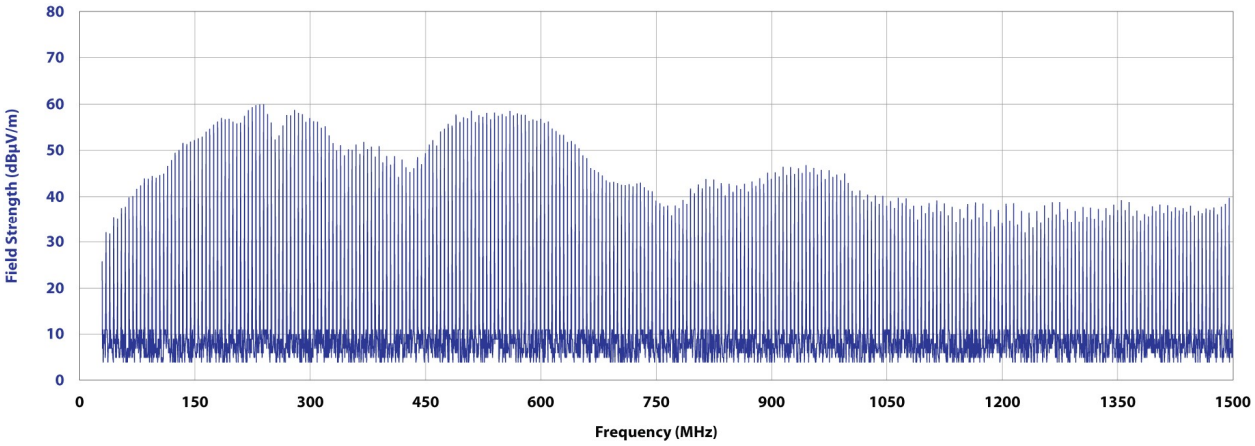

Figure 4: CGO-505 – Radiated Output at 3-meters distance (antenna height fixed @ 1 meter)

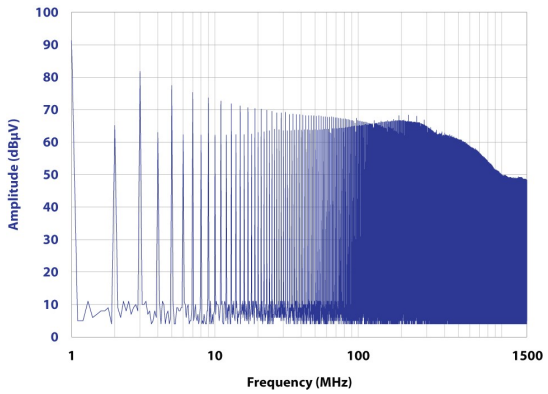

Figure 5: CGO-515 (1 MHz step) - Conducted

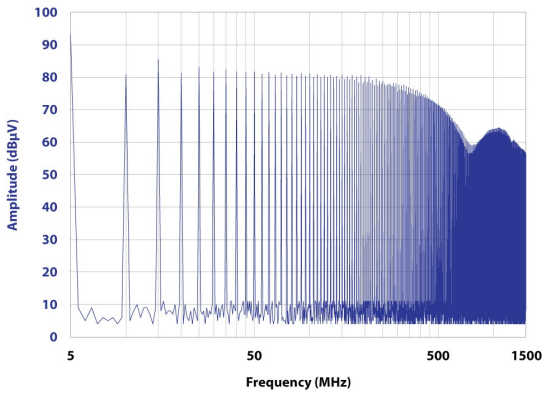

Figure 6: CGO-515 (5 MHz step) - Conducted

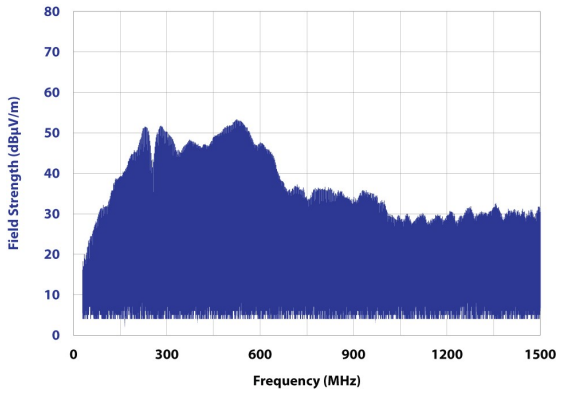

Figure 7: CGO-515 (1 MHz step) - Radiated

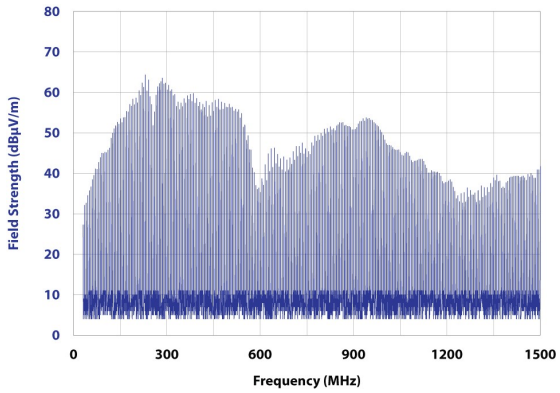

Figure 8: CGO-515 (5 MHz step) – Radiated