MICRONETICS

Test Solutions Group

Carrier-to-Noise Generator Operating Manual

VOLUME 3:

Service and Field Calibration

MICRONETICS TEST SOLUTIONS GROUP

CNG Operating Manual

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Using this Manual

This manual provides details on the use of the Micronetics CNG-77xx series Carrier-to-Noise Generators (CNG). This manual is written to cover several CNG models furnished with the CNGOS operating system. As such, some functions and features discussed in this manual will not be available on certain product models. Every effort is made throughout this manual to denote these functions and features as being optional or not available on some models.

The CNG manual is partitioned into Volumes and organized into the following sections or chapters:

VOLUME 1: User's Guide

Quick Start Chapter 1 helps you get familiar with the most important functions and features of the CNG guiding you through a typical setup sequence.

General Information Chapter 2 contains a general description of the CNG including important information on Safety Considerations. This chapter also provides instructions for installation of your CNG and hardware connections.

Front Panel Operation Chapter 3 describes in detail how to operate the CNG through the front-panel keys. This chapter also describes the CNG calibration process and shows how to configure the CNG for remote operation.

Remote Interface Reference Chapter 4 contains reference information to help you in controlling the CNG through the remote interface.

VOLUME 2: Product Specifications and Tests

Theory of Operation Chapter 5 discusses the theory of operation behind the CNG. It is intended as a more technical reference for those interested in the calculations being performed by the CNG during its normal operation.

Specifications Chapter 6 lists the specifications for this specific CNG Model and configuration.

Performance Tests Chapter 7 contains details on the testing performed by the factory on this specific CNG to ensure it is meeting the performance specifications. Results of these tests are contained in an Appendix to this Volume of the Manual.

VOLUME 3: Servicing and Calibration

Service Information Chapter 8 contains procedures for CNG troubleshooting and guidelines on returning your CNG to Micronetics for servicing and factory calibration.

Field Calibration Chapter 9 provides details on the utilities included in the CNGOS that allow for partial calibration of the CNG at facilities outside of the Micronetics factory. These utilities are provided to verify the integrity of the CNG's performance at intervals interim to the Micronetics Factory Calibrations.

If you have questions relating to the operation of the Carrier-to-Noise Generator, call 1-603-883-2900 in the United States, or contact your nearest Micronetics Sales Representative.

If your CNG fails within one year of purchase, Micronetics will repair it free of charge. Call 1-603-883-2900 in the United States, or contact your nearest Micronetics Sales Representative.

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Chapter

8

Service Information

Information related to servicing and troubleshooting of the Carrier-to-Noise Generator.

This chapter provides information on performing routine maintenance on the CNG. Instructions for troubleshooting the CNG should you experience problems are also included in this chapter. Additional information is provided on how to return the CNG to the factory for service should the troubleshooting steps fail to resolve the problem or for the periodic factory calibration.

Routine Maintenance

This section highlights some of the actions that should be performed on a routine basis to ensure the best conditions for operation of the CNG. The actual time interval for each action will depend upon the environment in which the CNG is being used. For example, an area with high dust content will warrant more frequent cleanings of the cooling fan filter.

Cooling Fan Filter

Most CNG Models are configured with a single cooling fan on the rear panel. Air is drawn in through the cooling fan and then exits from a series of exhaust vents along the front underside of the CNG enclosure. Some CNG Models may provide for additional airflow through additional side venting and / or an additional cooling fan. Special cooling configurations also exist that reverse the airflow, drawing air in through the side and lower vents and then exhausting it out the rear panel.

The most important aspect of the CNG cooling is maintaining proper airflow. Standard CNG Models with rear-mounted inlet fans come equipped with a protective filter over the fan face. This filter should be removed and cleaned periodically to remove any particle build-up that could restrict airflow. The following is a list of steps for cleaning this filter.

- Turn off the CNG AC Power. Disconnect the CNG from the AC power source.

- Gently pull off the filter assembly cover that snaps over the fan shroud. Pay attention to the orientation of the smaller of the four retaining tabs on this cover.
- Remove the black mesh filter from the cover or the face of the fan shroud, which ever place it stayed attached to.
- Gently clean the filter by brushing of vacuuming using caution so as not to tear the filter. DO NOT use cleaning solvents as they may cause permanent damage to the filter material. If it is necessary to use water to clean the filter, ensure that it is thoroughly dry prior to re-installation.

> **WARNING**
> Use of cleaning solvents may cause permanent damage to the cooling fan filter material. Limit cleaning to dry methods or limited water ONLY.

- Re-install the cleaned filter into the filter assembly cover.
- Snap the cover back onto the fan shroud.
- Re-connect the CNG to AC power source.

Should this filter become damaged at any time, contact the Micronetics factory or local sales office for information on replacements.

Connector Care

The RF mating connectors of the CNG should be inspected periodically for any damage or contaminants. Any foreign debris can usually be removed by using a cotton swab and mild cleaning solvent such as isopropyl alcohol.

If any of the connectors show signs of physical damage, the CNG may need to be returned to the factory for repair. Care should be taken to inspect any cable, adapter or other connector for physical damage prior to mating with the CNG. This will help to prolong the life and integrity of the CNG's RF connectors.

> **WARNING**
> DO NOT spray liquid of any kind directly onto the CNG Display area. The liquid could penetrate into the CNG enclosure and cause permanent damage.

Front Panel Display

It may be necessary at some point in time to clean the CNG Front Panel Display area. The Display surface is covered by a protective bezel to limit any damage directly to the LCD display face. The protective bezel can be cleaned by wiping with a soft damp cloth. DO NOT spray liquid cleaner of any type directly onto the display area as there is risk that the liquid may penetrate into the CNG enclosure and cause damage to the electronic components.

Troubleshooting

The following is a list of problem symptoms and suggested actions that may be helpful in resolving a problem with your CNG. If the CNG continues to experience problems, please refer to the section on Factory Repair. In general, the CNG does not contain any user serviceable parts. Please be reminded that any unauthorized entry into the CNG enclosure will void all warranty of the product.

> **WARNING**
> DO NOT open the CNG Enclosure without prior authorization from Micronetics factory personnel. Doing so will immediately void all product warranty.

PROBLEM: CNG will not Power Up

- Verify that the AC line cord is properly connected to the AC power source.
- Verify that the AC Power Switch on the CNG Rear Panel is in the ON position.
- Verify the integrity of the CNG's AC Line Fuse. The fuse is located in the AC Power Input Module on the CNG Rear Panel.
  - Remove the AC line cord from the CNG.
  - Use a small flat blade screwdriver to pry out the fuse holder assembly from the AC Power module.
  - Use an ohmmeter to verify the fuse is not blown (open circuit).
  - If the fuse requires replacement, ensure that the replacement fuse is of the same type and rating.
- Check for movement of the Rear Panel cooling fan. If working, the CNG may be experiencing problems with the internal power supply or main processing unit. Refer to the section on Factory Repair to arrange for servicing.
- Check for illumination of the CPU status light. If working, the CNG may be experiencing problems with the internal power supply or front panel display. Refer to the section on Factory Repair to arrange for servicing.

PROBLEM: Front Panel Display is blank

- CNG appears to power up but front panel display remains blank. Refer to the section on Factory Repair to arrange for servicing.

PROBLEM: Repeated beeps during power up, blank display

- CNG may be experiencing a problem with the system CPU and its peripherals such as RAM, hard drive, floppy drive or keyboard. Refer to the section on Factory Repair to arrange for servicing.

PROBLEM: Keyboard Error during power up

- Remove the external keyboard if connected, cycle the CNG AC power. If the problem is resolved, the external keyboard may be experiencing a problem. Refer to the section on Factory Repair to arrange for a replacement keyboard.
- If problem exists without the external keyboard attached, ensure that all keys on the front panel keypad are free moving and not stuck in a depressed position. If a key was found to be stuck then correct and cycle the CNG AC power. If the problem persists, refer to the section on Factory Repair to arrange for servicing.

PROBLEM: CNG fails to complete Internal Calibration (Key 5)

- If the CNG appears to have completed the initial power meter zeroing and calibration steps, the CNG may require adjustment to the Noise Reference Level. Consult the Noise Level Calibration section of Chapter 9 Field Calibration.

Factory Service or Repair

If it is determined that the CNG must be returned to the Micronetics factory for service or repair, perform the following steps to ensure proper processing.

Request RMA Number

The first step is to contact the Micronetics factory, either directly or through your local sales representative, to obtain an RMA authorization number. This number will serve as the unique tracking number for this CNG during its time within the factory. Any and all work performed in the service or repair of this CNG will be cataloged under this RMA number.

Preparation for Shipment

The CNG must be properly packed for transport to the Micronetics factory. If available, use the original shipping carton and packing material that the CNG arrived in upon delivery to your facility. If unsure of the necessary packing requirements, contact the Micronetics factory for information. Micronetics cannot be held responsible for any damage incurred during transit to the factory for service or repair.

> **WARNING**
> Micronetics cannot be held responsible for any damage incurred to the CNG during shipment to the Micronetics repair center.

The following checklist is provided to assist in proper packaging:

- Cap all connector with protective covers.
- Ensure the front panel display is adequately protected to prevent damage.
- Seal the CNG in a protective plastic barrier prior to placing in the shipping carton.
- Use a shipping carton of adequate strength to support the weight of the CNG.
- Protect the CNG on ALL sides with high-impact foam or comparable material.
- Securely seal the carton to prevent any accidental opening.
- Mark the furnished RMA number on the outside shipping label.

Chapter

9

Field Calibration

Instructions for performing an annual calibration at a location outside of the Micronetics factory.

This chapter provides instructions for executing the CNG's internal calibration routines. This field calibration process provides for NIST traceability and should be performed on an annual basis. It is still recommended that the CNG be scheduled for factory re-initialization at the Micronetics factory or a factory trained calibration facility at intervals of five years (three years if operating continuously).

Equipment Required

The following equipment is required to perform the Field Calibration of the CNG. All equipment should be in good working order and show evidence of a valid calibration traceable to NIST standards.

- RF Power Meter – must be capable of measuring true RMS power in the full frequency range of the CNG being calibrated.
- RF Signal Generator – must be capable of providing a CW signal with an amplitude of approximately –10 dBm at various frequencies within the operating range of the CNG being calibrated.
- RF Cable – must be of adequate length to connect from the Signal Generator Output to the CNG's Carrier and/or Injector Input Port.
- RF Adapters – adapters as required to support the following connections:
    - RF Power Meter (Sensor) to the CNG's C+N Output Port
    - Signal Generator Output to RF Cable
    - RF Cable to CNG's Carrier or Injector Input Port

Calibration Menu

The CNG Field Calibration process is completely coordinated by the CNG's internal operating software. The CNG's Calibration Menu is disabled at initial power up. This prevents accidental or unauthorized access to the calibration routines while the CNG is being used in a normal measurement system. In order to access the internal Calibration Menu the external keyboard must be attached to the CNG. The Calibration Menu is then enabled by pressing the following series of keys:

CTRL + ALT + C

The *Calibration* menu header should now appear in the Main Menu bar. Pressing CTRL + ALT + C again will toggle the Calibration Menu off again. Each repeat of this key series will toggle the Calibration Menu state again from OFF to ON or ON to OFF.

The Field Calibration process is divided into four (4) separate sections as indicated by the following Calibration Menu sub-items:

- Noise Level – focuses on the portions of the CNG that provide the Additive White Gaussian Noise (AWGN) spectrum. Performing this calibration step will measure and adjust, if required, the Noise Reference factor used to verify the AWGN spectrum output level.
- Carrier Level – focuses on the portions of the CNG that involve the Carrier Signal as it travels from the CNG's Carrier Input Port to the CNG's C+N Output Port. Performing this calibration step will measure and adjust, if required, the Carrier Path loss factors.
- Injector Level (Injector Option required) – focuses on the portions of the CNG that involve the optional Injector Signal as it travels from the CNG's Injector Input Port to the CNG's C+N Output Port. Performing this calibration step will measure and adjust, if required, the Injector Path loss factors.
- Power Mtr Cal – focuses on the aspects associated with the Cal Monitor feature available on CNG Models equipped with the 3200A internal power meter. The amount of allowed drift in the measurement of the reference source and the measurement interval are set from within the portion.

Each of these Field Calibration steps are detailed in the sections that follow. CNG models not equipped with the Injector Option will not display the Injector Path menu item. While the CNG allows for any individual calibration step to be performed at any time, it is recommended that all the three (3) Level steps be performed together as a group to ensure that all portions of the CNG are evaluated at equal intervals in time.

Noise Level Calibration

This section of the Field Calibration process deals with the CNG's internal noise source. This noise source is fully characterized at the factory to determine the noise source's output profile over the CNG's operating frequency range. Over time and / or wide variations in operating temperature, the noise source may experience a shift in its output level. This level shift occurs in a uniform fashion across the entire operating frequency range with the relative spectral profile remaining unchanged.

Each time the routine CNG System Calibration is performed (Key 5) from the front panel or remote interface, the CNG measures the aggregate output level of the noise source and compares it to a specified level known as the Noise Reference Level. Any error in this measurement is an indication that the noise source level has shifted. The CNG then makes a real time adjustment in the Noise Density data that is used to set the desired noise output level. The CNG will consider that the System Calibration has failed if it detects an error in Noise Reference Level in excess of 1.0 dB. This failure will be denoted by the System Cal Button (Key 5) continuing to flash after the calibration process concludes.

The Noise Level Calibration process allows for adjustment of the Noise Reference Level value based on a power measurement made by an independent NIST traceable instrument. The following is a list of steps required to complete the Noise Level Calibration portion of the Field Calibration process.

STEP 1: CNG Warm-up

In order to perform any of the portions of the Field Calibration process, the CNG must have been operating for the minimum time required to clear the "REFERENCE COLD" message displayed in the lower left corner of the CNG display. This is typically a minimum of 15 minutes. Any attempt to perform the Noise Level Calibration prior to this warm-up period will result in the CNG displaying the following message:

> CNG Reference Cold
> Process will terminate

Simply allow the CNG to complete the warm-up period as indicated by the automatic clearing of the REFERENCE COLD message and then initiate the Noise Level Calibration process again.

STEP 2: External Equipment Preparation

Ensure that the external power meter exhibits a valid calibration traceable to NIST standards. Apply AC power to this meter and allow it to warm-up in accordance with the manufacturer's recommendations. Once the warm-up period is complete, perform a zeroing and calibration of the meter per the manufacturer's recommendations.

STEP 3: Menu Selection

Access the Field Calibration Menu by pressing the C key on the external keyboard. If the Calibration Menu header does not appear in the CNG Menu Bar, see the section above entitled Calibration Menu for instructions on activating the menu. Once the Calibration drop down list appears, use the UP / DOWN arrow keys to select the Noise Level menu item. The CNG will check to ensure that the minimum warm-up period has been met (see Step 1).

The CNG will then search the Calibration Log for the last successful performance of the Noise Level Calibration. If one is found, the CNG will display a message box of the form shown below:

```
NOISE DENSITY CALIBRATION
Last Performed: MM/DD/YY HH:MM:SS
Proceed? ENTER = YES    ESC = NO
```

Press the ENTER key to continue with the current calibration or press the ESC key to terminate this process. The Calibration Log records all events associated with the Field Calibration process to provide factory personnel with information that may be helpful in the event that this CNG needs to be returned to the factory for servicing. Providing the timestamp of the last successful event helps the Field Calibration personnel confirm that the CNG is following their prescribed calibration plan.

If the above message does not appear, then the CNG has no history of a prior successful Noise Level Calibration being performed in the field.

STEP 4: Internal Meter Calibration

The CNG will begin the actual calibration process by first performing a zeroing and calibration of the internal power meter. The following message will be displayed:

```
Step 1of 6: Internal Meter Zero & Cal
Proceed? ENTER = YES   ESC = NO
```

The operator may choose to terminate the process at this point by pressing the ESC key or press ENTER to continue. If ENTER is selected, the CNG will then perform a zeroing and calibration of the internal power meter. The status of this process will be indicated by the messages presented in the lower right corner of the CNG display. If the CNG is unable to complete the internal power meter calibration, the following message will be displayed:

```
POWER METER CAL FAILURE
Process will terminate.  Press ENTER Key.
```

Pressing the ENTER key will end the calibration process and return the CNG to its main operation. Consult Chapter 8 Service Information of this manual for additional information. It may be necessary for this CNG to be returned to the factory for repair.

STEP 5: Carrier Input Termination

If this CNG Model is not equipped with a Carrier Path Attenuator, the operator will be prompted to terminate the Carrier Input Port with the proper impedance load. The following message will be displayed:

> Terminate the XX Ohm Carrier Input
> Proceed? ENTER = YES ESC = NO

The XX in the message refers to the System Impedance, 50 or 75 Ohms, depending upon the CNG Model. Once the Input has been terminated, pressing the ENTER key will prompt the CNG to continue the process. Again, the process can be terminated by pressing the ESC key.

STEP 6: External Meter Connection

At this point, the CNG will prompt for the connection of the external Power Meter to the appropriate CNG C+N Output Port. Ensure that this meter has been allowed to warm-up and has completed the proper zeroing and calibration according to the manufacturer's instructions. The power meter's frequency of operation should be set to the center of the CNG's operating frequency range. The following message is displayed by the CNG:

> Step 2 of 6: Connect an External
> Power Meter to the xx Ohm C+N Output
> Proceed? ENTER = YES ESC = NO

For best results, the power meter's sensor should be connected directly to the CNG Port using the minimum amount of adapters and interconnects. This will ensure the most accurate measurement of signal levels at the C+N Output interface. Press the ENTER key once the connection is complete or the ESC key if you wish to terminate the calibration process at this point in time.

The CNG will now set up the exact conditions used during the normal System Calibration's measurement of the Noise Reference Level with the exception that this signal will be routed to the C+N Output Port.

STEP 7: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 3 of 6: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 8: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 4 of 6: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point.

STEP 9: Adjusting Noise Density

The CNG will now take the entry provided in the previous steps, adjust it to reflect the level that would be seen by the internal power meter, and compare this to the current setting for the Noise Reference Level.

If the CNG detects a difference of more than 2.0 dB between the current Noise Reference Level and the "to be" value just calculated, the CNG will present the following warning message:

> Excessive Noise Error of X.XX dB
> detected. Return to Factory recommended.
> Press ENTER Key

The CNG will continue with the Noise Level Calibration process, but provides this warning to indicate that the CNG may need servicing or that the entry provided may be in error.

The CNG will then automatically update the Noise Reference Level entry in the calibration data files to reflect the measurement just performed. During this time, the CNG will display the following message:

> Step 5 of 6: Adjusting Noise Density
> Reference Data, Standby…

STEP 10: Updating Noise Density

The final step in the Noise Level Calibration process is for the CNG to now perform the Noise Reference portion of the System Calibration and then calculate the average density for the currently specified CNG Center Frequency and DUT Bandwidth. The CNG will display the following message while performing this step:

> Step 6 of 6: Updating Noise Density
> data. Standby…

The Noise Level portion of the Field Calibration is now completed. It is strongly recommended that the Carrier Level and Injector Level (if the CNG is equipped with

the Injector Option) portions of the Field Calibration now be performed as well. Once completed, the CNG will return to normal operation in the same mode and settings that it was in prior to starting the Noise Level Calibration Process.

STEP 11: Calibration Completed

The CNG will then display the following message to indicate that this portion of the Field Calibration is completed and the event has been added to the Calibration Log File:

```
Calibration Process Completed
Press ENTER to continue
```

Carrier Level Calibration

This section of the Field Calibration process deals with the CNG's Carrier Path. This path is fully characterized at the factory to determine path losses and coupling factors over the CNG's operating frequency range. An accurate reading of the Carrier Signal level present at the CNG's C+N Output Port is critical to establishing ratio measurements.

The Carrier Level Calibration process allows for adjustment of the Carrier Path calibration factors to enable the CNG to record the correct Carrier Signal level. A series of measurements will be made across the CNG's operating frequency range. The readings obtained from the external power meter will be compared to those taken by the internal power meter. The following is a list of steps required to complete the Carrier Level Calibration portion of the Field Calibration process.

STEP 1: CNG Warm-up

In order to perform any of the portions of the Field Calibration process, the CNG must have been operating for the minimum time required to clear the "REFERENCE COLD" message displayed in the lower left corner of the CNG display. This is typically a minimum of 15 minutes. Any attempt to perform the Carrier Level Calibration prior to this warm-up period will result in the CNG displaying the following message:

CNG Reference Cold Process will terminate

Simply allow the CNG to complete the warm-up period as indicated by the automatic clearing of the REFERENCE COLD message and then initiate the Injector Level Calibration process again.

STEP 2: External Equipment Preparation

Ensure that both the external power meter and signal generator exhibit valid calibrations traceable to NIST standards. Apply AC power to this signal generator and meter and allow them to warm-up in accordance with the manufacturer's recommendations. Once the warm-up period is complete, perform a zeroing and calibration of the meter per the manufacturer's recommendations.

STEP 3: Menu Selection

Access the Field Calibration Menu by pressing the C key on the external keyboard. If the Calibration Menu header does not appear in the CNG Menu Bar, see the section above entitled Calibration Menu for instructions on activating the menu. Once the Calibration drop down list appears, use the UP / DOWN arrow keys to select the Carrier Level menu item. The CNG will check to ensure that the minimum warm-up period has been met (see Step 1).

The CNG will then search the Calibration Log for the last successful performance of the Carrier Level Calibration. If one is found, the CNG will display a message box of the form shown below:

```
CARRIER PATH CALIBRATION
Last Performed: MM/DD/YY HH:MM:SS
Proceed? ENTER = YES    ESC = NO
```

Press the ENTER key to continue with the current calibration or press the ESC key to terminate this process. The Calibration Log records all events associated with the Field Calibration process to provide factory personnel with information that may be helpful in the event that this CNG needs to be returned to the factory for servicing. Providing the timestamp of the last successful event helps the Field Calibration personnel confirm that the CNG is following their prescribed calibration plan.

If the above message does not appear, then the CNG has no history of a prior successful Carrier Level Calibration being performed in the field.

STEP 4: Internal Meter Calibration

The CNG will begin the actual calibration process by first performing a zeroing and calibration of the internal power meter. The following message will be displayed:

```
Step 1of 16: Internal Meter Zero & Cal
Proceed? ENTER = YES   ESC = NO
```

The operator may choose to terminate the process at this point by pressing the ESC key or press ENTER to continue. If ENTER is selected, the CNG will then perform a zeroing and calibration of the internal power meter. The status of this process will be indicated by the messages presented in the lower right corner of the CNG display. If the CNG is unable to complete the internal power meter calibration, the following message will be displayed:

```
POWER METER CAL FAILURE
Process will terminate.  Press ENTER Key.
```

Pressing the ENTER key will end the calibration process and return the CNG to its main operation. Consult Chapter 8 Service Information of this manual for additional information. It may be necessary for this CNG to be returned to the factory for repair.

STEP 5: Signal Generator Connection

The CNG will now prompt for connection of the CW Signal Generator to the appropriate Carrier Input Port. The Signal Generator should be set for RF Output OFF. The port specified will depend upon the CNG Model and its System Impedance options. The following message will be displayed:

```
Step 2of 16: Connect a CW Signal
Generator to the XX ohm Carrier Input
Proceed? ENTER = YES   ESC = NO
```

The XX in the message refers to the System Impedance, 50 or 75 Ohms, depending upon the CNG Model. Once the Signal Generator has been connected, pressing the ENTER key will instruct the CNG to continue the process. Pressing the ESC key will signal that the calibration process should be terminated at this point.

If the CNG is equipped with a Carrier Path Attenuator, it will be set to its minimum attenuation state. The CNG will then apply the following parameter settings:

- DUT Bandwidth = 5 MHz
- Internal Power Meter = Measure Carrier Input
- Noise Output = OFF

STEP 6: External Meter Connection

At this point, the CNG will prompt for the connection of the external Power Meter to the appropriate CNG C+N Output Port. Ensure that this meter has been allowed to warm-up and has completed the proper zeroing and calibration according to the manufacturer's instructions. The power meter's frequency of operation should be set to the center of the CNG's operating frequency range. The following message is displayed by the CNG:

> Step 3 of 16: Connect an External
> Power Meter to the xx Ohm C+N Output
> Proceed? ENTER = YES ESC = NO

For best results, the power meter's sensor should be connected directly to the CNG Port using the minimum amount of adapters and interconnects. This will ensure the most accurate measurement of signal levels at the C+N Output interface. Press the ENTER key once the connection is complete or the ESC key if you wish to terminate the calibration process at this point in time.

STEP 7: Signal Generator Setup

The CNG will now prompt for the signal generator to be set to a specified frequency and amplitude representing the first of three (3) measurement points. The following message is displayed by the CNG:

> Step 4 of 16: Set Source to
> -10 dBm a Freq of XX.X MHz
> Proceed? ENTER = YES ESC = NO

The XX.X will be a value of frequency in MHz that is dependant upon the CNG Model. The Signal Generator (Source) RF Output should now be set to ON. Press the ENTER key to continue the calibration process or the ESC key to terminate the process at this point. The CNG will automatically set the Center Frequency (Key 7) to the value requested for the external signal source.

STEP 8: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 5 of 16: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 9: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 6 of 16: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. This value will be held until all other frequency points are measured.

STEP 10: Internal Meter Reading

The CNG will now perform its own measurement of the Carrier Signal using the internal power meter. The following message will be displayed during this step:

> Step 7 of 16: Internal Carrier Reading
> in progress. Standby…

The reading will then be adjusted by the calibration factor to obtain a reading of the level at the CNG's C+N Output Port. This value will be held until all other frequency points are measured.

STEP 11: Signal Generator Setup

The CNG will now prompt for the signal generator to be set to a specified frequency and amplitude representing the second of three (3) measurement points. The following message is displayed by the CNG:

> Step 8 of 16: Set Source to
> -10 dBm a Freq of XX.X MHz
> Proceed? ENTER = YES ESC = NO

The XX.X will be a value of frequency in MHz that is dependant upon the CNG Model. The Signal Generator (Source) RF Output should now be set to ON. Press the ENTER key to continue the calibration process or the ESC key to terminate the process at this point. The CNG will automatically set the Center Frequency (Key 7) to the value requested for the external signal source.

STEP 12: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 9 of 16: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 13: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 10 of 16: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. This value will be held until all other frequency points are measured.

STEP 14: Internal Meter Reading

The CNG will now perform its own measurement of the Carrier Signal using the internal power meter. The following message will be displayed during this step:

> Step 11 of 16: Internal Carrier Reading
> in progress. Standby…

The reading will then be adjusted by the calibration factor to obtain a reading of the level at the CNG's C+N Output Port. This value will be held until all other frequency points are measured.

STEP 15: Signal Generator Setup

The CNG will now prompt for the signal generator to be set to a specified frequency and amplitude representing the last of three (3) measurement points. The following message is displayed by the CNG:

> Step 12 of 16: Set Source to
> -10 dBm a Freq of XX.X MHz
> Proceed? ENTER = YES ESC = NO

The XX.X will be a value of frequency in MHz that is dependant upon the CNG Model. The Signal Generator (Source) RF Output should now be set to ON. Press the ENTER key to continue the calibration process or the ESC key to terminate the process at this point. The CNG will automatically set the Center Frequency (Key 7) to the value requested for the external signal source.

STEP 16: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 13 of 16: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 17: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 14 of 16: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point.

STEP 18: Internal Meter Reading

The CNG will now perform its own measurement of the Carrier Signal using the internal power meter. The following message will be displayed during this step:

> Step 15 of 16: Internal Carrier Reading
> in progress. Standby…

The reading will then be adjusted by the calibration factor to obtain a reading of the level at the CNG's C+N Output Port.

STEP 19: Compute Average Error

The CNG will now take the entries provided and measurements obtained in the previous steps and calculate the average difference between external and internal readings over the three (3) sets of measurements.

If the CNG detects a difference of more than 2.0 dB, the CNG will present the following warning message:

> Excessive Carrier Error of X.XX dB
> detected. Return to Factory recommended.
> Press ENTER Key

The CNG will continue with the Carrier Level Calibration process, but provides this warning to indicate that the CNG may need servicing or that the entry provided may be in error.

The CNG will then automatically update the Carrier Path Calibration data files to reflect the measurements just performed. During this time, the CNG will display the following message:

> Step 16 of 16: Adjusting Carrier Factor
> data file. Standby…

STEP 20: Updating Carrier Loss Factors

The final step in the Carrier Level Calibration process is for the CNG to now reload the Carrier Path calibration data and compute the average loss factors for the currently specified CNG Center Frequency and DUT Bandwidth. The Carrier Level portion of the Field Calibration is now completed. It is strongly recommended that the Noise Level and Injector Level (if the CNG is equipped with the Injector Option) portions of the Field Calibration now be performed as well (if not already completed). Once completed, the CNG will return to normal operation in the same mode and settings that it was in prior to starting the Carrier Level Calibration Process.

STEP 21: Calibration Completed

The CNG will then display the following message to indicate that this portion of the Field Calibration is completed and the event has been added to the Calibration Log File:

> Calibration Process Completed
> Press ENTER to continue

Injector Level Calibration

This section of the Field Calibration process deals with the CNG's Injector Path if the CNG Model is equipped with this option. This path is fully characterized at the factory to determine path losses and coupling factors over the CNG's operating frequency range. An accurate reading of the Injector Signal level present at the CNG's C+N Output Port is critical to establishing C/I ratio measurements.

The Injector Level Calibration process allows for adjustment of the Injector Path calibration factors to enable the CNG to record the correct Injector Signal level. A series of measurements will be made across the CNG's operating frequency range. The readings obtained from the external power meter will be compared to those taken by the internal power meter. The following is a list of steps required to complete the Injector Level Calibration portion of the Field Calibration process.

STEP 1: CNG Warm-up

In order to perform any of the portions of the Field Calibration process, the CNG must have been operating for the minimum time required to clear the "REFERENCE COLD" message displayed in the lower left corner of the CNG display. This is typically a minimum of 15 minutes. Any attempt to perform the Injector Level Calibration prior to this warm-up period will result in the CNG displaying the following message:

CNG Reference Cold Process will terminate

Simply allow the CNG to complete the warm-up period as indicated by the automatic clearing of the REFERENCE COLD message and then initiate the Injector Level Calibration process again.

STEP 2: External Equipment Preparation

Ensure that both the external power meter and signal generator exhibit valid calibrations traceable to NIST standards. Apply AC power to this signal generator and meter and allow them to warm-up in accordance with the manufacturer's recommendations. Once the warm-up period is complete, perform a zeroing and calibration of the meter per the manufacturer's recommendations.

STEP 3: Menu Selection

Access the Field Calibration Menu by pressing the C key on the external keyboard. If the Calibration Menu header does not appear in the CNG Menu Bar, see the section above entitled Calibration Menu for instructions on activating the menu. Once the Calibration drop down list appears, use the UP / DOWN arrow keys to select the Injector Level menu item. If this item is grayed out and not accessible, then this CNG Model does not have the Injector Input Option installed. The CNG will check to ensure that the minimum warm-up period has been met (see Step 1).

The CNG will then search the Calibration Log for the last successful performance of the Injector Level Calibration. If one is found, the CNG will display a message box of the form shown below:

```
INJECTOR PATH CALIBRATION
Last Performed: MM/DD/YY HH:MM:SS
Proceed? ENTER = YES   ESC = NO
```

Press the ENTER key to continue with the current calibration or press the ESC key to terminate this process. The Calibration Log records all events associated with the Field Calibration process to provide factory personnel with information that may be helpful in the event that this CNG needs to be returned to the factory for servicing. Providing the timestamp of the last successful event helps the Field Calibration personnel confirm that the CNG is following their prescribed calibration plan.

If the above message does not appear, then the CNG has no history of a prior successful Injector Level Calibration being performed in the field.

STEP 4: Internal Meter Calibration

The CNG will begin the actual calibration process by first performing a zeroing and calibration of the internal power meter. The following message will be displayed:

```
Step 1of 16: Internal Meter Zero & Cal
Proceed? ENTER = YES   ESC = NO
```

The operator may choose to terminate the process at this point by pressing the ESC key or press ENTER to continue. If ENTER is selected, the CNG will then perform a zeroing and calibration of the internal power meter. The status of this process will be indicated by the messages presented in the lower right corner of the CNG display. If the CNG is unable to complete the internal power meter calibration, the following message will be displayed:

```
POWER METER CAL FAILURE
Process will terminate.  Press ENTER Key.
```

Pressing the ENTER key will end the calibration process and return the CNG to its main operation. Consult Chapter 8 Service Information of this manual for additional information. It may be necessary for this CNG to be returned to the factory for repair.

STEP 5: Signal Generator Connection

The CNG will now prompt for connection of the CW Signal Generator to the appropriate Carrier Input Port. The Signal Generator should be set for RF Output OFF. The port specified will depend upon the CNG Model and its System Impedance options. The following message will be displayed:

```
Step 2of 16: Connect a CW Signal
Generator to the XX ohm Carrier Input
Proceed? ENTER = YES   ESC = NO
```

The XX in the message refers to the System Impedance, 50 or 75 Ohms, depending upon the CNG Model. Once the Signal Generator has been connected, pressing the ENTER key will instruct the CNG to continue the process. Pressing the ESC key will signal that the calibration process should be terminated at this point.

If the CNG is equipped with a Carrier Path Attenuator, it will be set to its maximum attenuation state. If this CNG Model is not equipped with a Carrier Path Attenuator, the operator will be prompted to terminate the Carrier Input Port with the proper impedance load. The following message will be displayed:

```
Terminate the XX Ohm Carrier Input
Proceed? ENTER = YES  ESC = NO
```

The XX in the message refers to the System Impedance, 50 or 75 Ohms, depending upon the CNG Model. Once the Input has been terminated, pressing the ENTER key will prompt the CNG to continue the process. Again, the process can be terminated by pressing the ESC key.

The CNG will then apply the following parameter settings:

- Noise (Injector) Attenuator = minimum setting (0 dB)
- Noise Path Source = Injector Input
- Injector Bandwidth = 5 MHz
- Internal Power Meter = Measure Injector Input
- Injector Output = ON

STEP 6: External Meter Connection

At this point, the CNG will prompt for the connection of the external Power Meter to the appropriate CNG C+N Output Port. Ensure that this meter has been allowed to warm-up and has completed the proper zeroing and calibration according to the manufacturer's instructions. The power meter's frequency of operation should be set to the center of the CNG's operating frequency range. The following message is displayed by the CNG:

```
Step 3 of 16: Connect an External
Power Meter to the xx Ohm C+N Output
Proceed? ENTER = YES  ESC = NO
```

For best results, the power meter's sensor should be connected directly to the CNG Port using the minimum amount of adapters and interconnects. This will ensure the most accurate measurement of signal levels at the C+N Output interface. Press the ENTER key once the connection is complete or the ESC key if you wish to terminate the calibration process at this point in time.

STEP 7: Signal Generator Setup

The CNG will now prompt for the signal generator to be set to a specified frequency and amplitude representing the first of three (3) measurement points. The following message is displayed by the CNG:

> Step 4 of 16: Set Source to
> -10 dBm a Freq of XX.X MHz
> Proceed? ENTER = YES ESC = NO

The XX.X will be a value of frequency in MHz that is dependant upon the CNG Model. The Signal Generator (Source) RF Output should now be set to ON. Press the ENTER key to continue the calibration process or the ESC key to terminate the process at this point. The CNG will automatically set the Injector Center Frequency (Key 3 in C/I Mode) to the value requested for the external signal source.

STEP 8: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 5 of 16: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 9: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 6 of 16: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. This value will be held until all other frequency points are measured.

STEP 10: Internal Meter Reading

The CNG will now perform its own measurement of the Injector Signal using the internal power meter. The following message will be displayed during this step:

> Step 7 of 16: Internal Injector Reading
> in progress. Standby…

The reading will then be adjusted by the calibration factor to obtain a reading of the level at the CNG's C+N Output Port. This value will be held until all other frequency points are measured.

STEP 11: Signal Generator Setup

The CNG will now prompt for the signal generator to be set to a specified frequency and amplitude representing the second of three (3) measurement points. The following message is displayed by the CNG:

> Step 8 of 16: Set Source to
> -10 dBm a Freq of XX.X MHz
> Proceed? ENTER = YES ESC = NO

The XX.X will be a value of frequency in MHz that is dependant upon the CNG Model. The Signal Generator (Source) RF Output should now be set to ON. Press the ENTER key to continue the calibration process or the ESC key to terminate the process at this point. The CNG will automatically set the Injector Center Frequency (Key 3 in C/I Mode) to the value requested for the external signal source.

STEP 12: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 9 of 16: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 13: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 10 of 16: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. This value will be held until all other frequency points are measured.

STEP 14: Internal Meter Reading

The CNG will now perform its own measurement of the Injector Signal using the internal power meter. The following message will be displayed during this step:

> Step 11 of 16: Internal Carrier Reading
> in progress. Standby…

The reading will then be adjusted by the calibration factor to obtain a reading of the level at the CNG's C+N Output Port. This value will be held until all other frequency points are measured.

STEP 15: Signal Generator Setup

The CNG will now prompt for the signal generator to be set to a specified frequency and amplitude representing the last of three (3) measurement points. The following message is displayed by the CNG:

> Step 12 of 16: Set Source to
> -10 dBm a Freq of XX.X MHz
> Proceed? ENTER = YES ESC = NO

The XX.X will be a value of frequency in MHz that is dependant upon the CNG Model. The Signal Generator (Source) RF Output should now be set to ON. Press the ENTER key to continue the calibration process or the ESC key to terminate the process at this point. The CNG will automatically set the Injector Center Frequency (Key 3 in C/I Mode) to the value requested for the external signal source.

STEP 16: External Reading Entry

The Operator is now prompted to provide the reading from the external power meter in dBm. The CNG will display the following message and present an Input Dialog box for data entry:

> Step 13 of 16: Provide the reading
> from the External Power Meter

Enter the data into the Input Dialog box and press ENTER to complete the entry. Pressing the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point. The CNG will ask the Operator to confirm this entry in the next step.

STEP 17: Confirm External Entry

The Operator is now prompted to confirm the entry just provided for the external power meter reading. The following message will be displayed and an Input Dialog box, preloaded with the entry provided in the prior step, is presented.

> Step 14 of 16: Confirm the reading
> from the External Power Meter

If the value displayed in the Input Dialog box is correct, simply press the ENTER key. Otherwise, use the backspace key to erase the entry to enter the correct value. Pressing

the ESC key while in the dialog box will signal to the CNG that the calibration process should be terminated at this point.

STEP 18: Internal Meter Reading

The CNG will now perform its own measurement of the Injector Signal using the internal power meter. The following message will be displayed during this step:

> Step 15 of 16: Internal Carrier Reading
> in progress. Standby…

The reading will then be adjusted by the calibration factor to obtain a reading of the level at the CNG's C+N Output Port.

STEP 19: Compute Average Error

The CNG will now take the entries provided and measurements obtained in the previous steps and calculate the average difference between external and internal readings over the three (3) sets of measurements.

If the CNG detects a difference of more than 2.0 dB, the CNG will present the following warning message:

> Excessive Injector Error of X.XX dB
> detected. Return to Factory recommended.
> Press ENTER Key

The CNG will continue with the Injector Level Calibration process, but provides this warning to indicate that the CNG may need servicing or that the entry provided may be in error.

The CNG will then automatically update the Injector Path Calibration data files to reflect the measurements just performed. During this time, the CNG will display the following message:

> Step 16 of 16: Adjusting Injector Factor
> data file. Standby…

STEP 20: Updating Injector Loss Factors

The final step in the Injector Level Calibration process is for the CNG to now reload the Injector Path calibration data and compute the average loss factors for the currently specified CNG Injector Center Frequency and Injector Bandwidth. The Injector Level portion of the Field Calibration is now completed. It is strongly recommended that the Noise Level and Carrier Level portions of the Field Calibration now be performed as well (if not already completed). Once completed, the CNG will return to normal operation in the same mode and settings that it was in prior to starting the Injector Level Calibration Process.

STEP 21: Calibration Completed

The CNG will then display the following message to indicate that this portion of the Field Calibration is completed and the event has been added to the Calibration Log File:

> Calibration Process Completed
> Press ENTER to continue

Power Meter Calibration

For CNG Models equipped with the 3200A internal power meter, the CNG is able to perform a periodic measurement of the 50 MHz reference source to verify that the power meter is still calibrated and functioning correctly. This feature, call Cal Monitor, is enabled or disabled from within the Option Menu of the CNG Main Menu bar.

The Power Meter Calibration portion of the Field Calibration allows for selection of the measurement interval and acceptable drift factor associated with this reference source measurement.

STEP 1: Menu Selection

Access the Field Calibration Menu by pressing the C key on the external keyboard. If the Calibration Menu header does not appear in the CNG Menu Bar, see the section above entitled Calibration Menu for instructions on activating the menu. Once the Calibration drop down list appears, use the UP / DOWN arrow keys to select the Power Mtr Cal menu item. This will then activate the lower tier menu displaying Drift Level and Interval.

Drift Level

Selecting Drift Level from within the Power Mtr Cal lower tier will present the operator with an Input Dialog box to enter in the desired allowable drift in dB. The current setting will be displayed in the data entry window. The Drift Level is the amount of error in dB that, if exceeded during a background reference source measurement, will cause the System Calibration Key to begin flashing. This indicates that the CNG system Calibration should be performed to maintain acceptable system accuracy.

The factory setting for this value is 0.2 dB. Choosing a smaller value may result in a System Calibration being required more frequently.

Interval

Selecting Interval from within the Power Mtr Cal lower tier will present the operator with an Input Dialog box to enter in the desired Cal Monitor measurement interval in minutes with a maximum of 1440 minutes (24 hours). The current setting will be displayed in the data entry window. This value will determine how often the reference source is measured if the Cal Monitor feature is currently enabled.

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