



# **Hardware Installation Guide**

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Mobile Data Computer (Version 3&4)



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## INTRODUCTION

This document provides instructions and guidelines that should be followed for the successful installation of Mentor Engineering's Mobile Data Computer (MDC).

### 1 FCC Compliance Statement (USA)

#### 1.1 FCC Class A Part 15

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

- a) This device may not cause harmful interference
- b) This device must accept any interference received, including interference that may cause undesired operation.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

### 2 What You Need

For a typical installation in a vehicle, you will need the following:

- MDC
- MDC installation cables (vehicle/power cable and communications adapter cable)
- Mounting bracket
- Cable tie-downs

To assist with the installation, it is often necessary to have the following available:

- PC Laptop
- MDC programming cable
- Multimeter
- Radio service monitor (for systems using mobile radios for communications)
- Radio service monitor (for systems using mobile radios for communications)

## INSTALLATION

### 1 General

The MDCs are shipped pre-programmed with the appropriate communications and application software. In some cases, however, it is necessary to re-program the units with updated files prior to installing them. Please refer to the MDC Programming application note for details on re-programming the units.

## 2 MDC Mounting Bracket

The type of MDC mounting bracket will vary depending on the type of vehicle that the MDC is being installed in. It will also depend on whether or not an Express QWERTY keyboard is to be mounted with the MDC. The mounting brackets may be ordered through Mentor, or through a third party supplier. The following information provides the details necessary for ordering a mounting bracket along with an adapter plate for the MDC.

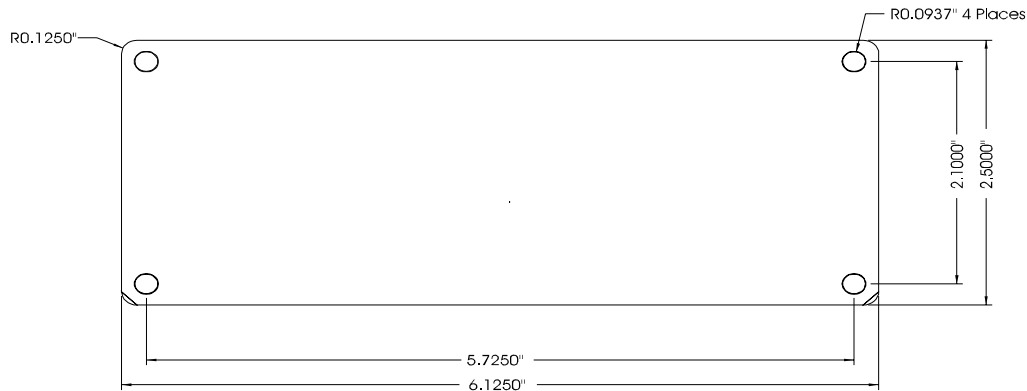


Figure 1 Mounting Bracket Adapter Plate

- MDC Mounting screws: 3/8" (10mm) #8 thumb screws
- Adapter Plate Material: 1/8" (3.2mm) aluminum

## 3 MDC Placement

The placement of the MDC should be carefully considered. It is important that the unit is mounted so that the driver of the vehicle can easily view and operate the MDC. Attention should be given to the placement to make sure the MDC does not interfere with regular driving functions. To avoid damage due to overheating, the MDC should not be mounted where it will be in direct sunlight.

## 4 MDC Connections

The interface points available on the MDC are grouped on six separate connectors according to their function.



Figure 2 MDC Rear View – MDC Connectors

#### 4.1 Connector Summary

- a) Vehicle connector:  
MDC power, general use I/O, odometer input and RS485 interface.
- b) Communications connector:  
General use I/O, covert microphone, internal modem to mobile radio connection points and an RS232 interface for external data modems.
- c) Auxilliary port 1:  
RS232 serial interface port used for MDC programming and for connection to external peripheral devices.
- d) Auxilliary port 2:  
RS232 serial interface port for connection to external peripheral devices.
- e) Auxilliary port 3:  
RS232 serial interface port for connection to external peripheral devices.
- f) Keyboard port:  
Interface port for connection to the Express Mini QWERTY keyboard.

In the most basic MDC installation, only the vehicle and communications connectors will to be required.

#### 4.2 Communications Interface

The installation cable provided will bring the appropriate interface pins from the communications connector to an appropriate adapter for the communications device. Details for specific interfaces are available as application notes from Mentor Engineering, Inc.

#### 4.3 Peripherals Interface

Details regarding the cabling interface for external MDC peripheral devices, odometers, and additional I/O are available as application notes specific to these functions. These notes are provided as required by Mentor Engineering, Inc.

#### 4.4 MDC Cables

In general, there will be one cable from the MDC connected to power (see Power Connections section) and one cable connected to the communications device (radio, modem, etc.). It is

common practice to route the cabling through the vehicle so it is not visible to the driver and is more protected from the environment. Mentor Engineering recommends that this practice be followed in installations.

In some installations that use GPS, there will also be a GPS antenna that will have to be mounted on the roof or the trunk of the vehicle and connected to the MDC via the GPS connector (located at the rear of the MDC underneath the fuse). Note: Mentor strongly recommends mounting the GPS antenna in the center of the roof for maximum sky view.

#### **4.5 Power Connections**

The MDC receives power via the vehicle connector. The installation cable that is provided for the vehicle connector will have pigtailed for connection to power and ground.

**Refer to the cabling diagram provided by your Mentor Systems Engineer before making any power connections. Normally, the RED lead will indicate POWER and the BLACK lead will indicate GROUND.**

The MDC power leads should be crimped onto the power leads at the power input to the communications device. Installing the power leads in this way will avoid the possibility of the ground potential at the MDC differing from the ground potential of the communications device (due to current draw during a transmit cycle).

If the MDC is connected to switched ignition power the unit's manifest will be lost every time the engine is turned off. In some systems, the MDC will be connected to ignition power and will be powered on and off automatically. If the ignition is off the MDC can be powered using the power switch.

The MDC has a 3-amp fuse on its power input. The fuse is easily accessible via the back of the unit if it needs to be replaced (port 3A in Figure 2). Note, however, that a blown fuse will often indicate that there is either a problem with a connection to the MDC or with the MDC itself. Check all connections before replacing the fuse.

Please refer to the Technical Data section of this manual for details on the voltage and current requirements of the MDC.

### **5 Communications Device**

There will also be a communications device that will have to be installed in the vehicle. In radio systems, this will be a mobile radio with its accompanying antenna. If a data system such as CDPD, DataTAC, iDEN, EDACS or Mobitex is being used, then the communications device will be a modem (which may be internal in the MDC). The size and location of the communications device should be taken into account during the installation process to ensure that there is enough space to mount and install all components of the system in the vehicle.

### **6 Antenna Installation**

Among all installation variables, antenna location has the greatest impact on the performance of the radio modem. Mentor Engineering recommends using a roof top antenna installed in the center of the vehicle roof for best coverage and to meet SAF/MPE radiation specifications.(See Following section: RF Radiation Specifications)

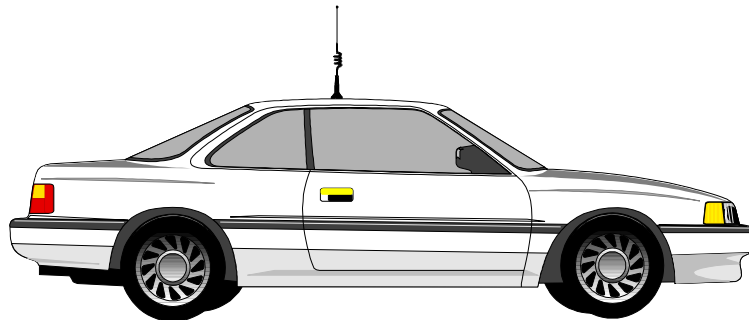
### **7 Installing Roof Top Antennas**

These antennas are permanently mounted to the vehicle through a 3/4-inch hole in the roof. Roof top antennas require a ground plane to achieve maximum gain. To be effective, the ground plane should have a radius of 6 inches or more. These antennas are available in different gain radiation patterns. The most common is the 3dB gain variety. A typical 3dB gain antenna is shown below in Figure 3. For CDPD systems Novatel recommends the use of a Half-Wave Dipole antenna with a 50-ohm nominal impedance. The VSWR should be 1.5:1 nominal with a maximum of 2.0:1. They assume a 1.2 dB antenna gain. They also specify the module is limited to operate with an antenna with maximum of 2.15 dBi nominal gain or not to exceed 1.5 Watts ERP for any type of remotely mounted outdoor external antenna.



Figure 3 3dB Gain Antenna

During the installation, never use a drill bit or hole saw. First, drill a pilot hole. Then, use a hole cutting punch to make the 3/4-inch hole. This prevents rough edges in the roof of the car that could result in water leaks. A silicon sealant can also be used, but avoid unnecessary contact with the vehicle's paint. Because this type of antenna cannot be moved, careful attention to aesthetics and location are critical. Figure 4 shows the preferred location of the 3dB rooftop antenna.



cntrant.cdr

Figure 4 Location of Roof Mount Antenna

## 8 General Antenna Guidelines

- Position the antenna as high as possible on the body of the vehicle.



- Keep the RF cable as short as possible. Cut the excess cable during an installation. Do not wrap it up. Excess cable adds unnecessary loss to the transmitted power.
- Ensure the antenna is in a vertical position during operation.
- Use proper RF connectors. The preferred type of connector is a SMA connector. (See the "SMA Connector Assembly" section above.)
- Avoid sharp bends and moving objects in the coaxial cable path.
- Position the antenna away from fuel caps.
- Position the antenna on the opposite side of the vehicle, away from the vehicle's AM/FM radio antenna.
- Follow the antenna manufacturer's guidelines exactly when installing antennas.
- Do not substitute any antenna for the one supplied by the manufacturer. You may be exposing person(s) to harmful radiation. Contact the supplier or manufacturer for further instruction

## 9 RF Radiation Specifications

### 9.1 FCC Radio Frequency Exposure Rules

Based on FCC rules 2.1091 and 2.1093 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin 65 and its Supplement C, all integrations of the MobiConnect 902 unit are subject to routine environmental evaluation for radio-frequency (RF) exposure prior to equipment authorization or use.

For mobile devices, defined as a transmitting device designed to be generally used such that a separation distance of at least 20 cm is maintained between the body of the user and the transmitting radiated structure, the human exposure to RF radiation can be evaluated in terms of Maximum Permissible Exposure (MPE) limits for field strength or power density in mW/cm<sup>2</sup>.

### 9.2 How to Comply With FCC SAR/MPE Guidelines

In order to comply with FCC SAR/MPE Guidelines the antenna must be placed a minimum of 20 cm from the vehicles edge. To accomplish this, and to ensure optimum antenna performance Mentor Engineering recommends that antenna be installed in the center of the vehicle rooftop.

**WARNING:** The user should be instructed to maintain the minimum distance from the antenna.

## 10 SAR and MPE Limits

SAR limits for General Population/Uncontrolled exposure is 1.6W/kg for partial body exposure, averaged over 1 g of tissue and 4 W/kg for hands, wrists and feet averaged over 10 g of tissue. The limits for Occupational/Controlled exposure are more relaxed, i.e., 8 W/kg for partial body and 20 W/kg for hands, wrists and feet. The 1.6 W/kg limit applies for most users of the MobiConnect.

The limit for MPE is 0.6mW/cm<sup>2</sup> at 900 MHz.

RF exposure distance is based on normal operating proximity to the user's or nearby persons' body. This distance is measured from any part of a radiating structure, generally the antenna, to the closest part of the body.

## 11 Labelling

If the antenna is installed at least 20 cm from the vehicle’s edge no warning label is required.

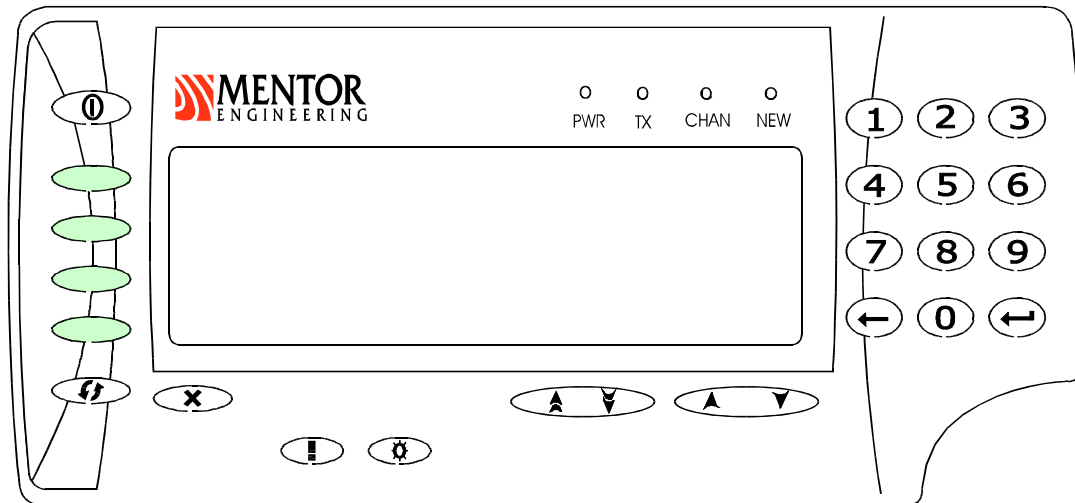
If the antenna is not at least 20 cm from any vehicle edge, an additional RF radiation hazard label that warns the user or nearby persons to keep away from the antenna by the specified distance is required. This is because the minimum separation distance of the final device configuration cannot be met due to occasional non-essential operating conditions or requirements.

An example statement is shown below.

“Warning: To meet the FCC RF exposure requirement for mobile transmitter end products, ensure that the antenna is at least 20 cm away from the user, or nearby persons, when transmitting.”

## BASIC OPERATION AND CONFIGURATION

The following figure should be used as reference while following the instructions in this section.













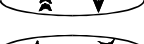


- |   |                        |   |               |
|---|------------------------|---|---------------|
|  | ON/OFF KEY             |  | BACKSPACE KEY |
|  | FUNCTION KEY           |  | ENTER KEY     |
|  | MORE KEY               |  | NUMBER KEY    |
|  | EXIT KEY               |  | POWER LED     |
|  | EMERGENCY KEY          |  | CHANNEL LED   |
|  | BACKLIGHT KEY          |  | NEW INFO LED  |
|  | PAGE UP/ PAGE DOWN KEY |  | TRANSMIT LED  |
|  | UP/DOWN KEY            |   |               |

Figure 5 MDC Front View with Key Definitions

### 1 Turning the MDC On

The MDC is powered on and off with the ON/Off Key. In some systems, the MDC is powered on and off with the vehicle ignition.

The MDC will display the Mentor logo along with software revision information. The first screen of the customer's application file should appear after approximately 2 seconds.

## 2 Adjusting the Backlight

The backlight for the keypad and LCD display is adjusted by pressing the BACKLIGHT key. Each time the key is pressed, the backlighting will switch to the next of eight different levels of intensity.

## 3 Accessing the MDC Maintenance Menus

Many MDC parameters (unit ID, communications parameters, time/date) may be modified through the MDC maintenance menus. These menus are only intended for use by qualified technicians and, therefore, they are protected by a special access sequence.

To access the menus, press the key \*CONFIDENTIAL\* in order within a 2 second time frame. The screen display that should appear is shown in the figure below. (If you are having problems entering the maintenance menus, it is likely that you are not pressing the coded keypad sequence fast enough).

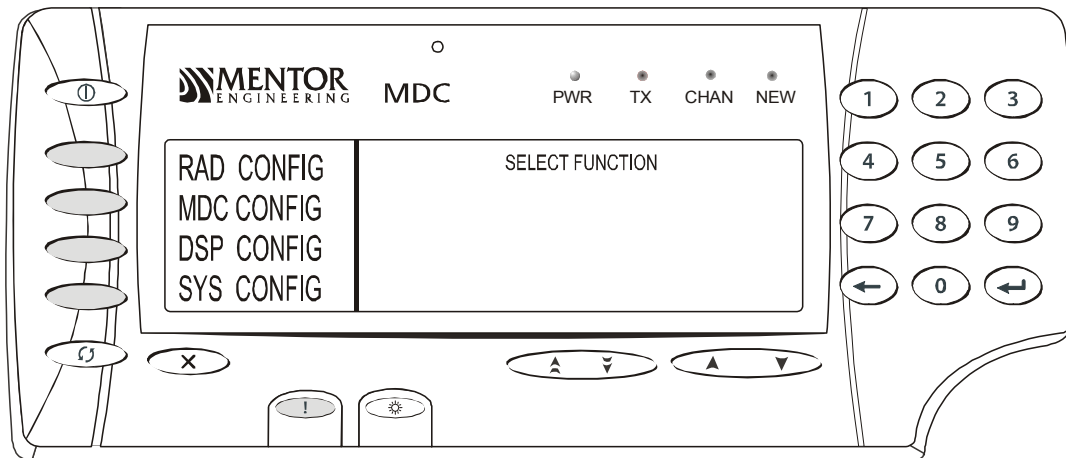


Figure 6 MDC Maintenance Menu (Radio System)– Page 1

## 4 Setting the MDC Time and Date

From the MDC maintenance menu, select the user utilities function by pressing the function key next to the USR UTL text. In the subsequent screen, press the function key next to the CHANGE TIME text, enter the current time at the prompt and press ENTER. Next, press the function key next to the CHANGE DATE text, enter the current date and press ENTER.

In systems with GPS, the time and date will be updated when the MDC is powered on and the antenna gets a lock. It will also be updated at 2am if the MDC is powered on and the GPS antenna has a lock.

**IMPORTANT:** In systems with taximeter, changing the date and time can only be done through the taxi seal.

Press EXIT once to leave the USR UTL menu.

## 5 Adjusting the LCD Contrast

From the MDC maintenance menu, select the user utilities function by pressing the function key next to the USR UTL text. From the user utilities menu, press the function key next to the LCD CONTRAST text. Use the PAGE UP / PAGE DOWN keys to adjust the contrast up or down as required.

Press EXIT once to leave the USR UTL menu.

## 6 Setting the MDC ID

In most systems, it is necessary to set a unique ID for each MDC that is installed. (NOTE: In an EDACS Data Network the MDC ID has to be the same as the LID of the mobile radio it is connected to). When the MDC is being installed for use on a data network such as CDPD, DataTAC, iDEN or Mobitex, the external or internal modem has a unique ID and the MDC ID does not need to be configured. For these systems, please refer to the appropriate applications note for the necessary set-up parameters.

From the MDC maintenance menu, select the MDC configuration screens by pressing the function key next to the MDC CONFIG text. From the MDC configuration screen, press the MDC ID function key, enter the MDC ID at the prompt and press ENTER. Press EXIT to leave the MDC configuration screen

**IMPORTANT:** Before exiting from the MDC Maintenance screen, the newly entered values must be saved. To save modified parameters, select the SYS CONFIG function key. There is a save function associated with the bottom function key (even though the key has no label). Press this key and you will be prompted to save the changed values. Press ENTER and the values will be saved.

Finally, press EXIT to leave the SYS CONFIG menu and EXIT again to leave the maintenance menus.

## 7 Setting Communications Parameters

The communications parameters for the various communications systems are set via the MDC maintenance menus. Usually Mentor personnel will pre-configure these values. Please refer to the applicable application notes from Mentor Engineering to configure these values if required.

# CONFIGURING AND TESTING IN THE VEHICLE

When the MDC has been installed in the vehicle, there are some configuration and testing procedures that Mentor Engineering recommends following. These procedures can verify that the unit is ready for fleet operation when it leaves the installation site.

## 1 Setting the DSP Gain Level (Conventional Radio Systems Only)

The MDC Version 3&4 comes equipped with a high speed Digital Signal Processor (DSP) modem for use with radio systems. The DSP is responsible for receiving and processing the incoming and outgoing data to/from the MDC.

Note: Setting the DSP level is not required on any data network (EDACS, CDPD, Mobitex, DataTAC, iDEN, etc.). If your system uses a data network, then the DSP Configuration menus will not be accessible.

If the MDC is being used in a radio system, then the MDC DSP Gain Level should be set while installing. The MDC can transmit a modem synchronization pattern that can be viewed on a radio

service monitor. If the transmit level is too high the data will over-deviate the channel and will not be successfully decoded by the receiving device. If the transmit level is too low, then the transmission will be under-deviated and not be received either.

Follow this procedure to correctly set the MDC DSP Gain Level. A radio service monitor will be required.

- a) Press \*CONFIDENTIAL\* to get back into the MDC maintenance menus.
- b) Press the function key next to the DSP CONFIG text to go into the DSP configuration menus.
- c) Press MORE and you will see the label SEND MPAT next to the second from the top function key.
- d) Set up your service monitor to monitor the frequency that the mobile radio will be transmitting on.
- e) To send the MDC modem pattern, press the function key that corresponds to the SEND MPAT text. On the main MDC screen, you will see square brackets appear around the SENDING MODEM PATTERN message and the TX LED should go on. To stop sending the pattern press the SEND MPAT function key again. On the main MDC screen, you will see square brackets appear around the MODEM PATTERN OFF message and the TX LED should go off.
- f) Using the service monitor, determine the amount of deviation in kHz of the channel when sending the modem pattern as described in step 5. We want approximately 2.5 kHz deviation.
- g) Note: Since the MDC does not control the PL Inhibit leads during this test, any deviation due to PL (private line) Tones on your system must be added to the 2.5 kHz. For example, if PL Tone deviation is 0.5 kHz, then you must have a total of 3.0 kHz of deviation on the channel.
- h) If the channel deviation on the service monitor is not 2.5 kHz, then the CGAIN (Coarse Gain setting) and the FGAIN (Fine Gain Setting) will have to be adjusted until 2.5 kHz deviation is reached. The Coarse Gain settings range from 0 to 31 which represents -34.5 dB to 12 dB in steps of 1.5 dB. The Fine Gain settings range from 0 to 24 which represents 0 dB to 3 dB in steps of 0.125 dB. The total gain can be determined by adding the Coarse Gain setting to the Fine Gain setting. For example, if CGAIN=10 (-19.5 dB) and FGAIN=8 (1 dB) the total gain is  $-19.5 \text{ dB} + 1 \text{ dB} = -18.5 \text{ dB}$ .

**NOTE:** The Coarse Gain should be adjusted first to get within the range of 2.5 kHz. Then the Fine Gain can be adjusted as you get closer to 2.5 kHz deviation. These values should be recorded for future reference.

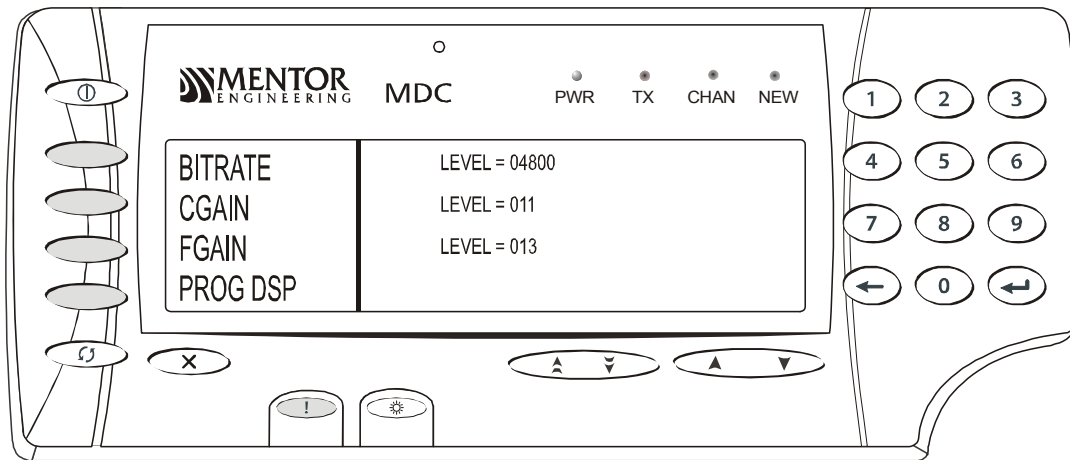


Figure 7 MDC DSP Configuration Screen Page 1

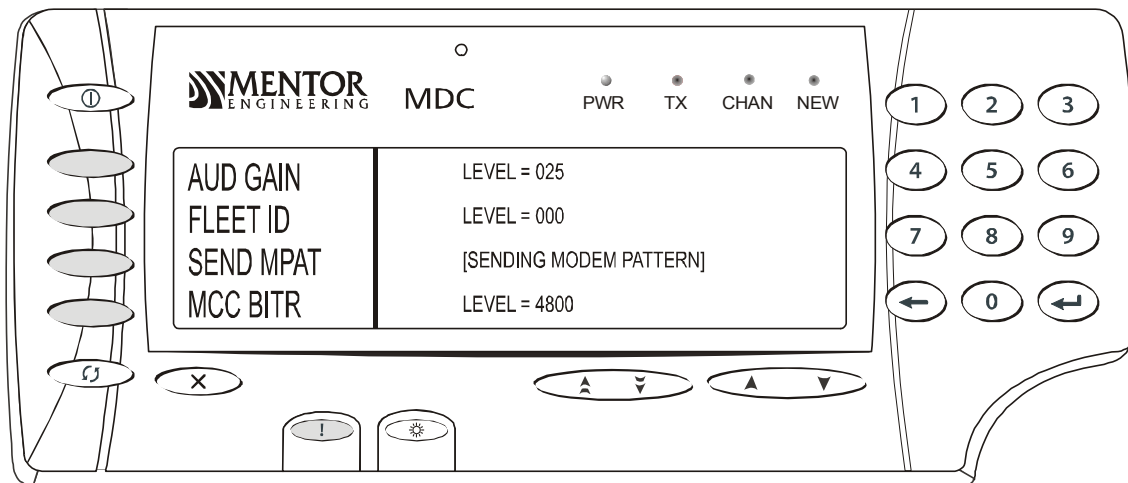


Figure 8 MDC DSP Configuration Screen Page 2

**Important Note:** The BITRATE, AUD GAIN, FLEET ID and MCC BITR variables should not be changed unless instructed to do so by a Mentor System Engineer. They are system-specific parameters, and if set incorrectly will make the system inoperative!

- i) Any change in the gain levels (Coarse or Fine) requires that you program the DSP. Do this by pressing the PROG DSP function key. You will be prompted as to whether you are sure you want to program the DSP. Press the enter key for yes and the exit key for no. The new DSP GAIN levels are now set in the MDC.
- j) Increasing the number in the brackets (by using the numeric keypad) will increase the deviation measured on your service monitor. Decreasing the number (by using the numeric keypad) will decrease the deviation.

**Note:** The deviation cannot be changed live over the air. It is an iterative process i.e. set a level, program the DSP, send the modem pattern, measure it with the service monitor, then repeat the process until the desired level of approximately 2.5kHz is reached.

- k) Once the deviation is approximately 2.5 kHz on the service monitor, press EXIT to leave the DSP CONFIG menus and go back to the main menu.
- l) Before exiting from the MDC Maintenance screen, the newly entered values must be saved. To save modified parameters, select the SYS CONFIG function key. There is a save function associated with the bottom function key (even though the key has no label). Press this key and you will be prompted to save the changed values. Press ENTER and the values will be saved.
- m) Finally, press EXIT to leave the SYS CONFIG menu and EXIT again to leave the maintenance menus.

## 2 Setting the MDC ID

As previously mentioned, in most systems, it is necessary to set a unique ID for each MDC that is installed. (NOTE: For an EDACS Data Network the MDC ID must be the same as the LID ID of the mobile radio it is connected to. When the MDC is being installed for use on a data network such as CDPD, DataTAC, iDEN, EDACS or Mobitex, the external or internal modem has a unique ID and the MDC ID does not need to be configured. For these systems, please refer to the appropriate applications note for the necessary set-up parameters.)

From the MDC maintenance menu, select the MDC configuration screens by pressing the function key next to the MDC CONFIG text. From the MDC configuration screen, press the MDC ID function key, enter the MDC ID at the prompt and press ENTER. Press EXIT to leave the MDC configuration screen

Before exiting from the MDC Maintenance screen, the newly entered values must be saved. To save modified parameters, select the SYS CONFIG function key. There is a save function associated with the bottom function key (even though the key has no label). Press this key and you will be prompted to save the changed values. Press ENTER and the values will be saved.

Finally, press EXIT to leave the SYS CONFIG menu and EXIT again to leave the maintenance menus.

## 3 Testing the Communications

As a final test, a message can be sent by the MDC to the receiving device, if one is available. If an acknowledgement is received by the MDC, then it can be assumed that the message made it to the receiving device, and the MDC is operating properly.

When the MDC is powered on, it usually defaults to some sort of sign-on screen. This screen will usually have a function key labeled SIGNON. This key can be used to test communications.

First make sure that the communications device (ie: - radio, external modem) is on and set to the correct data channel. Also verify the cabling and antenna connections. If you are using mobile radios on a conventional radio system, then the channel LED on the MDC should be illuminated.

Press the function key next to the SIGNON text. Enter any information prompted for using the numeric keypad or keyboard and press ENTER. There may be several fields that need to be entered.

After the last field has been entered and ENTER is pressed, the MDC will display the message "SENDING..."

After a few seconds the message "SENDING...DONE" will appear on the MDC screen. If this happens, then the test was successful and installation is complete.

If the message “Could Not Deliver Message. Try Again?” appears then the test failed. Check the connections and equipment again to try to isolate the problem. It might be necessary to re-check the MDC DSP Gain again.



## TECHNICAL DATA

**Supply voltage**

9 - 18 volts

**Current consumption**

Typical (LCD heater off, medium backlight): 0.38 A

Maximum (LCD heater on, full backlight): 1.06 A

**Temperature range**

Operating: -30 to +60°C (-22 to +140°F)

**Note: Operation at temperatures outside this range is not recommended.**

Storage: -30 to +80°C (-22 to +176°F)

**Approximate Size (W x D x H)**

8.5 x 2 x 3.5 in. (216 x 51 x 89 mm.)

**Weight**

1 lb. (0.6 kg)