EAC-2000 MANUAL ADDENDUM FOR DIGITAL OPERATION

D R A F T

15 July, 1999

1.1 Introduction

This section of the manual describes EAC-2000 operation when it has TIA-136 digital-channel sets installed. An EAC-2000 may be ordered directly from the factory with digital channel sets installed, or upgrade kits may be ordered to add digital channel-set capability to an existing EAC-2000 installation.

In general the installation issues (isolation needs, channel selection, etc.) are identical for either type of system and are covered in detail in the AMPS EAC-2000 manual. The differences between a TIA-136 equipped system and a standard AMPS-only system will be covered in this section.

The hardware differences for a digital-equipped EAC-2000 are:

1.1.1 Controller Module

Controller Module 19-20001-1 is required for TIA-136 digital operation. If an existing EAC-2000 installation has the older (analog only) 19-5598-1 Controller Module installed, it must be replaced with the dual-mode 19-20001-1 Controller Module. The 19-20001-1 module will process both analog and digital calls.

1.1.2 RF Module

The 19-20000-1 IS-136 RF Module is required for TIA-136 operation. It may be placed in any card cage slot in place of the analog 19-5599-1 Cellular I.F. module within the following constraints:

- A 19-20000-1 module must be placed in slot 5 for DCCH operation.
- A 19-20000-1 module must be placed in slot 6 if dual-mode hand-in operation is desired. If DCCH-only operation is implemented or if hand-in of DTC calls is not required, then the analog 19-5599-1 Cellular I.F. module may be left in slot 6.
- If dual-mode (analog control channel as well as a DCCH channel) operation is desired, then an analog 19-5599-1 module must be installed in slot 1 for the analog control channel.

- Any combination of 19-2000-1 IS-136 RF modules and 19-5599-1 Cellular I.F. modules may be placed in the remaining slots in the card cage.

1.1.3 45W PA Module

The 1819.G1 class AB linear PA must be used with the 19-20000-1 module. The class C PAs (21-117-1, 21-396-1, etc.) are usable only with the analog 19-5599-1 Cellular I.F. modules. Note also that the 1819.G1 linear PA cannot be used in place of a class C PA. No power output will be provided in either case if the PA is mismatched with its corresponding RF module.

Note that the 1819.G1 PA, the 19-20000-1 and the 19-20001-1 modules have reverse-colored labels (white on blue instead of blue on white) to provide a quick visual aid in identifying the modules required for TIA-136 operation. The 1819.G1 PA also has a label on its handle stating that it is an “IS-136 Linear PA”. It is also white-on-blue to match the corresponding controller and RF module labels.

1.2 Kit Contents

To allow field conversion of EAC-2000 installations to digital operation, two kits are available:

If the EAC-2000 has a 19-5598-1 Controller module installed, then a EK2000DCCH kit must be ordered. The EK2000ACCH kit consists of:

- One 19-20001-1 Controller Module
- One 19-20000-1 IS-136 RF Module
- One 1819.G1 IS-136 Linear PA

If the EAC-2000 has a 19-20001-1 Controller module installed, then an EK2000DTC kit must be ordered. EK2000DTC kit consists of:

- One 19-20000-1 IS-136 RF Module
- One 1819.G1 IS-136 Linear PA

The EK2000DTC kit may be used for the DCCH channel if the EAC-2000 already has the 19-20001-1 Controller Module installed. Otherwise, any number of EK2000DTC kits may be ordered to add or increase DTC capacity in the EAC-2000. Any shortage or apparent damage should be resolved before beginning the installation.

1.3 Saving the existing System Configuration

If the Controller in an existing EAC-2000 installation is being upgraded to the 19-20001-1 version, then many of the parameters programmed into the existing system will also need to be copied to the new controller. To assist in this operation a blank Parameter Worksheet is included in the appendix. This provides a place to list the current setup parameters so that they can be entered as the new digital-capable Controller is installed. **The highlighted entries on the Parameter Worksheet are digital-specific and will entered later.**

Information on connecting a local terminal to the EAC-2000D is contained in Section 4.4 of Volume 1 of the EAC-2000 Manual.

1.4 Determining the Digital-specific Parameters

1.4.1 Identifying the Digital Donor Control Channel

The digital donor control channel is the IS-136 control channel of the primary cell site with which the EAC-2000 will communicate. It can be used in conjunction with an Analog Donor Control channel where both analog only and IS-136 mobiles are to be served in the boosted coverage area.

• **When the booster is adjacent to a single cell sit**e, the control channel(s) of that cell site is(are) the donor control channel(s).

• **When the booster is adjacent to several cell site**s, the control channel(s) of the cell site with the most unused channels should be chosen. (This cell is then referred to as the primary donor cell.) More than one cell site being received by a donor antenna can result in unwanted hand-offs by the cellular system, causing dropped calls. Therefore the donor antenna should be positioned to favor the desired donor cell site. As in the analog case, the reverse-path signal level received from the EAC-2000 by the adjacent cell sites **must be** less than the signal level received by the selected donor site. Usually a 10 dB margin is sufficient.

• **When both analog and digital donor channels are selecte**d, it is best if they are both from the same donor cell site as that makes positioning of the donor antenna easier.

1.4.2 Selecting a Boosted Digital Control Channel

The boosted digital control channel (selection X) is the control channel that will be used in the EAC-2000 coverage area. Select a channel that meets the following requirements:

• At least a 3 channel separation from any donor channel (both control and voice)

• At least a 21 channel separation from any boosted channel (both control and voice). (Closer spacing is possible with higher losses, consult the factory)

• Conforms to the local system configuration. (Since IS-136 mobiles are assisted in finding a DCCH, the system must be configured to add the boosted Digital Control Channel to those information broadcasts). There are several strategies in the cellular system setup that can assist mobile DCCH selection. These are described in the appendix *System Integration Issues and Strategie*s.

1.4.3 Recording the digital parameters on the Parameter Worksheet

To make it easier to program the digital parameters into the system, they may be entered onto the parameter worksheet. The digital parameters are highlighted so they can be easily found.

2.0 Installing the new Hardware

This section of the manual details the installation of the hardware contained in the DCCH kit. By convention the DCCH hardware is installed in slot 5, so any AMPS hardware (PA and RF Module) currently installed in slot 5 must be removed or relocated to another unused slot. The analog 19-5598-1 Controller will be removed so it can be replaced with the 19-20001-1 IS-136 controller included in the DCCH kit.

This upgrade will require the system be removed from service for a period of time and should be scheduled to reduce impact on service.

2.1 Removing the AMPS hardware

Be sure that all current set-up information from the system has been recorded as described in section 1.3 of this manual.

Slot 5 is the fifth position from the left in the RF/IF module card cage. The corresponding PA position is the upper right slot in the lower (for a 10-channel

EAC-2000) PA cage. For a 5-channel EAC-2000, it is in the upper right slot of the PA cage.
When no traffic is currently being handled by the booster shut off the booster.
Remove the Controller, RF module and PA that are currently in slot 5.

2.2 Installing the DCCH hardware

Install the 1819.G1 IS-136 PA into PA Slot 5
Install the 19-20000-1 IS-136 RF Module into IF slot 5
Install the IS-136 Controller into the controller slot
Connect the jumper cable from the IS-136 Controller to the IS-136 RF module as shown in the detail Figure 1.
Verify all modules are fully seated, the retaining screws on the Controller and RF Module are finger-tight, and the front-panel data cable is correctly installed between the 19-20001-1 Controller and the 19-20000-1 IS-136 RF Module in slot 5.
If DTC kits are being installed, place the 19-20000-1 I.F. modules in the desired slots. For DTC hand-in, a 19-20000-1 module must be placed in card cage slot 6. 19-20000-1 modules may be placed in any other available slot for DTC operation.
If analog control channel operation is to be provided, then an analog 19-5599-1 Cellular I.F. module must be left in card cage slot 1. If necessary, existing 19-5599-1 analog modules may be removed to make room for the new 19-20000-1 digital modules.
Note: The IS-136 PA(s) will be installed as part of the following procedure.

2.3 Preparing the AMPS hardware

Since the Controller contains all of the channel assignment information, when the system is initially powered up with the 19-20001-1 Controller the system will attempt to run with the factory defaults, causing a mismatch with the combiner tuning. Therefore it is recommended that all the analog PA’s be pulled so that they remain in their slot but do not make contact with the backplane connector. This will effectively take them out of the system until the channels are correctly programmed.

2.4 Connecting a Local Terminal

The IS-136 Controller uses the same RS-232 parameters and same style cable as the original controller. Connect the terminal as follows.

1. Using the data cable that was provided with the EAC-2000, connect the terminal to the 25-pin D-sub connector located on the front of the controller module.

2.6 Changes to the SET Menus for DCCH and DTC Operation

The following changes have been made to the SET menus to accommodate DCCH and DTC operation:

1) In the RF Boards / Position X menu, STATUS parameter, the following choices are now available (for all boards except board 6):

```
(0) DISABLED
(1) ENABLED AMPS Control
(2) ENABLED AMPS Voice
(3) ENABLED TDMA DCCH
(4) ENABLED TDMA DTC
```

For board 6, the choices are:

```
(0) DISABLED
(1) ENABLED Scan
```

Note that only one position Status may be set to ENABLED AMPS Control.
Also, only one position Status may be set to ENABLED TDMA DCCH

2) The Boosted Channel (whether it is voice, analog control or DCCH) is now set in the RF Boards / Position X menu. For example, if you have the "Status" of a board set to ENABLED TDMA DCCH, the position menu for that board will display as follows:

```
Position 5
A Status ..............................ENABLED TDMA DCCH
B Boosted DCCH Channel ..................... 169
C Diversity ...........................ON
```

3) On the PA Menu, Selection K, "Key Forward PA" has been changed as follows. If you select a PA number for which the associated Board STATUS is ENABLED TDMA DCCH or ENABLED TDMA DTC, then you will be prompted to enter the desired PA output power. The allowable range is 33 to 48 dBm in one dB increments. In the case of the digital PA, there is no power adjustment screw. Rather, the power out is controlled by software to be in a range of the PA power set point - 0 to +0.5 dB.

Once you have entered the desired power out, the PA will be keyed, and the PA power out reading will be displayed as usual. During this display, the PA power out setting may be adjusted up or down by entering "U" or "D". This allows the power out to be adjusted to compensate for the varying losses in the combiner and the duplexer such that the desired power out at the antenna connector can be achieved.

Following is the display that occurs when a TDMA PA is keyed.

```
Enter your selection ...k
NOTE: Keying PA may cause calls to drop
and will disrupt service in the EAC coverage area.
Enter RETURN to exit or number of PA to key : 5
PA 5 is DTC or DCCH; PA Output is software controlled to a
target range of PA Power Setting +/- .3 dB ...
Current PA Power Setting is : +46.5 dBm
Enter new value (or RETURN if no change) ...
While keyed, Enter "U" or "D" to adjust the PA Power Setting ...
Current PA Power Setting is : +46.5 dBm
PA Position 5 Channel Number 169 PA Power +46.6 dBm
```

4) On the PA Menu, if any board has Status set to Enabled TDMA DCCH or Enabled TDMA Voice, additional power settings appear. Following is the full PA Menu.

```
Power Amplifiers
A Forward PA Power Step - Voice ..................0
B Forward PA Power Step - Control ................0
C Forward PA Power Step - Hand-off................0
D Forward PA Power Low Alarm Point - Voice........+40.0 dBm
E Forward PA Power Low Alarm Point - Control......+40.0 dBm
F Forward PA Power Low Alarm Point - Hand-off.....+40.0 dBm
G Reverse PA Power Set - Voice ...................+20 dBm
H Reverse PA Power Set - Control .................+20 dBm
I Reverse PA Power Low Alarm Point - Voice........+15 dBm
J Reverse PA Power Low Alarm Point - Control......+15 dBm
K Key Forward PA ................................POWER ADJ / COMBINER TUNING
L Key Reverse PA .................................POWER MEASUREMENT
M Forward PA Power Low Alarm Point - DCCH ........+40.0 dBm
N Reverse PA Power Set - DCCH ....................+20 dBm
O Forward PA Power Low Alarm Point - DTC .........+40.0 dBm
P Reverse PA Power Set - DTC .....................+20 dBm
X Done with this menu
```

Note that selections M through P are new. They allow setting of the Forward PA Power Low Alarm Point and Reverse PA Power Set for DCCH and DTC boards and PAs. These settings correspond in functionality to their counterparts for the analog voice and control channels.

Note that there is no "Reverse PA Power Low Alarm Point" setting for the DTC or DCCH reverse PAs. The TDMA boards perform closed loop power control and reverse PA power out checking. There is still an alarm generated if the Reverse PA power output is low, however, the threshold at which the alarm occurs is not operator settable.

5) The Control Channels menu (under the System Parameters menu) has been changed to accommodate extra settings for DCCH. The following additional menu items will appear if a board Status is set to Enabled TDMA DCCH.

```
I Donor DCCH Channel ............................... 400
J DCCH Channel State During "All Channels Busy" ...... DIRECTED RETRY
```

The Donor DCCH Channel setting has obvious functionality.

The DCCH Channel State During "All Channels Busy" paramater has function that controls the Boosted DCCH operation when all channels are busy (or, if there is no Donor DCCH being received).

The available choices are as follows.

```
(1) Off
```

```
(2) DENY ACCESS, BUT COUNT
(3) BOOST ACCESSES
(4) DIRECTED RETRY
```

These selections are identical to the selections for the analog "Control Channel State when All Channels Busy" parameter.

6) The Control Channels Menu no longer has a "Boosted Control Channel" selection. This channel is now entered in the RF Board menu.

7) The Voice Channels Menu no longer has a "Boosted Voice Channels" selection. These channels are now entered in the RF Board menu.

8) The RSSI Alarm Points menu under the Alarms menu has two new settings to accommodate the DCCH. The new RSSI Alarm Points menu is as follows:

```
RSSI Alarm Points
A Donor Control Channel RSSI - High Alarm Point ........DISABLED
B Donor Control Channel RSSI - Low Alarm Point .........-80 dBm
C Donor Voice Channel RSSI - High Alarm Point ..........DISABLED
D Donor DCCH Channel RSSI - High Alarm Point ...........DISABLED
E Donor DCCH Channel RSSI - Low Alarm Point ............-80 dBm
```

Note that selections D and E are new. They allow the setting of the RSSI levels that cause alarms for the Donor DCCH.

9) The PA power settings for the forward PA for DCCH and DTC have a resolution of 0.1 dBm. Also, the settings for the analog PA's have been changed to have a resolution of 0.1 dBm. The associated powers reported with the "SSS" command and the "PWR" command will read with resolution of 0.1 dBm.

Note that the accuracy of this reading ultimately depends upon the calibration of the sensor in the PA or or the M1 antenna power sensor. Typically, this accuracy is +/- .75 dB.

The reason power out is reported with a resolution of 0.1 dB even though the accuracy is no better than 0.75 dB is to allow small changes in output power to be resolved and displayed. For example, if a reported power out changes from +46.7 dBm to +46.2 dBm in a short term, the appropriate conclusion to draw is that (1) the power out initially was 46.7 +/- 0.75 dBm and (2) the power out dropped by about 0.5 dB.

3.0 Tuning the Transmitter Combiner and Setting Output Power

The combiner must be tuned and the output power levels set whenever the boosted channels are entered or changed. For the upgrade to DCCH at least the boosted DCCH will be new and will require adjustment. Any other channel changes will also require retuning.

Even if the DCCH is only new channel to be tuned, it is preferable to repeak the combiner and verify the output power for the other channels.

3.1 Tuning the DCCH Combiner PA 5

1. With the system power **OF**F, connect power-measuring equipment to the M1 antenna port (see Figure XX). **Be sure that PA 5 (the IS-136 PA) is fully seated**). Remove the cover plates from the forward combiner(s) to reveal the combiner tuning screws. Then turn the power back on. Output power may be monitored using a through-line wattmeter (or a wattmeter with a built-in load) to monitor output power.

2. From the SET Main Menu, type **B <CR>** to display the Power Amplifiers Menu.

```
A Forward PA Power Step - Voice ..................0
B Forward PA Power Step - Control ................0
C Forward PA Power Step - Hand-off................0
D Forward PA Power Low Alarm Point - Voice........+40.0 dBm
E Forward PA Power Low Alarm Point - Control......+40.0 dBm
F Forward PA Power Low Alarm Point - Hand-off.....+40.0 dBm
G Reverse PA Power Set - Voice ...................+20 dBm
H Reverse PA Power Set - Control .................+20 dBm
I Reverse PA Power Low Alarm Point - Voice........+15 dBm
J Reverse PA Power Low Alarm Point - Control......+15 dBm
K Key Forward PA ................................POWER ADJ / COMBINER TUNING
L Key Reverse PA ................................POWER MEASUREMENT
M Forward PA Power Low Alarm Point - DCCH ........+40.0 dBm
N Reverse PA Power Set - DCCH ....................+20 dBm
O Forward PA Power Low Alarm Point - DTC .........+40.0 dBm
P Reverse PA Power Set - DTC .....................+20 dBm
X Done with this menu
```

3. Type **K <CR>** to key a forward PA.

4. Type **5 <CR>** to key PA 5 and display the forward power output as measured at the sensor.

5. Refer to the illustration affixed to the inside of the front door of the EAC-2000 cabinet to determine which combiner cavities coordinate with which PAs. Loosen the lock nut and adjust combiner cavity 5 using a screwdriver.

• If using a wattmeter, adjust for **maximum power output** as indicated by the wattmeter.

• Retighten the lock nut.

NOTE: The power reading displayed on the terminal will not vary as the combiner is tuned.

Combiner Cavity

6. Adjust the power output for PA 5 from the laptop computer as described in paragraph 3) in section 2.6.

☞ **NOTE:** The PA power level displayed on the terminal is 3 to 4 dB higher than the power level at the antenna port because of internal cable and combiner losses. The displayed PA power ranges from +38 to +47 dBm (7–45 watts), which corresponds to a range at the M1 antenna connector of +34 to +43 dBm (3–20 watts). If the displayed power level is used instead of a wattmeter, take these differences into consideration.

Always use a wattmeter if an accurate power level reading at the M1 antenna connector is desired.

3.2 Adjusting Combiners and Power levels for PAs 1-4, and 7-11

In a like manner the combiner can be tuned for the remaining analog channels by selecting a new PA each time. **Each PA should be fully seated in its slot before proceedin**g. The power level is set differently on the analog PA's as follows:

1. Adjust the power output for each PA using a small screwdriver or adjustment tool to turn the PA power potentiometer on the front of the PA (Figure 4-9). Use a wattmeter, if available, to measure the power output. Adjust to the level necessary to meet the authorized ERP level from the antenna.

☞ **NOTE:** The PA power level displayed on the terminal is 3 to 4 dB higher than the power level at the antenna port because of internal cable and combiner losses. The displayed PA power ranges from +38 to +47 dBm (7–45 watts), which corresponds to a range at the M1 antenna connector of +34 to +43 dBm (3–20 watts). If the displayed power level is used instead of a wattmeter, take these differences into consideration. Always use a wattmeter if an accurate power level reading at the M1

2. Note that the PA power potentiometer has a 7–10 dB turn down range. If the power out cannot be adjusted low enough, hit **ESC** to return to the Power Amplifiers Menu.
Select B, Forward PA Power Step - Control. This allows entry of a setting between 0 and 3. Increasing the step by 1 causes the maximum power out to be reduced by 4 dB (2®8 dB, 3®12 dB). Adjust this parameter in conjunction with the potentiometer to achieve the desired output power.
3. Repeat steps 3 (selecting a new PA each time) through 7 to adjust the remaining analog PAs (if installed).
If low power out is desired, use selection A, Forward PA Power Step - Voice, for PAs 2–5 and 7–11.
4. When all PAs have been adjusted, make a second pass through the PAs to check tuning and power levels, and make further adjustments as needed. This step is needed because one of the cavities might have been close to the point to which a second cavity was being tuned. This would cause erroneous power readings and adjustment during the initial pass.

3.3 Adjusting the PA 6 Power Level

PA 6 output power does not pass through the combiner. (For a description of PA 6 function, see Section 2 of Volume 3, Technical Information.) To adjust its power level—
1. Turn the power off, move the power measuring equipment to the M2 antenna port, and turn the power back on.
If low power out of PA 6 is desired, use selection C, Forward PA Power Step -Hand-off, to reduce the maximum power out.
NOTE: If a digital module is installed in slot 6, then use the procedure described in paragraph 3) in section 2.6 for setting the power output level.

2. Note that the PA power potentiometer has a 7–10 dB turn down range. If the power out cannot be adjusted low enough, hit **ESC** to return to the Power Amplifiers Menu.
Select B, Forward PA Power Step - Control. This allows entry of a setting between 0 and 3. Increasing the step by 1 causes the maximum power out to be reduced by 4 dB (2®8 dB, 3®12 dB). Adjust this parameter in conjunction with the potentiometer to achieve the desired output power.
3. Repeat steps 3 (selecting a new PA each time) through 7 to adjust the remaining analog PAs (if installed).
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