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FLEX SERIES UNIVERSAL CONTROLLER

FLEX IV DSP DISPATCH CONTROLLER

User's Programming Manual

Made in U.S.A.

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INTRODUCTION

Congratulations! If you are reading this manual you have either purchased or are considering purchasing the revolutionary FLEX IV-DSP-D or FLEX IV-DSP-P communication controller. This system will allow multiple repeater sites to speak to each other either individually or in a conference call.

Programming the FLEX IV is a two or three step process, depending on the needs as will be described below. This approach allows maximum flexibility with a minimum learning curve for the installer.

STEP 1: The first step is to enter the various parameters that is needed for your applications in the Windows based program as shown in the first part of this manual. This program generates a file with an “ini” extension.

STEP 2: This step is only used if there is an error in the program used in STEP 1 or we added some features which might not be supported in the program from STEP 1.

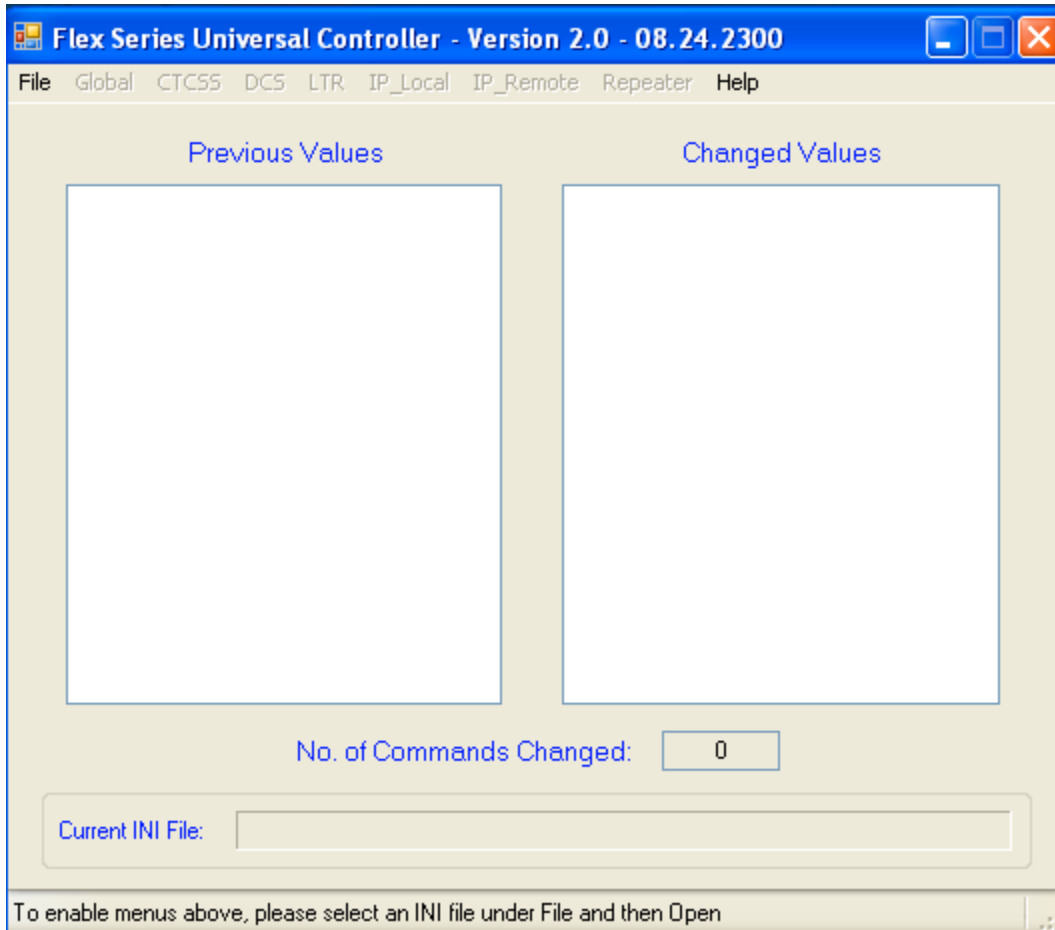
STEP 3: This step is used for transferring the “ini” file created in STEP 1 and STEP 2 and transferring it to the FLEX IV-DSP over the IP network.

This manual also includes the method that allows the user to update the firmware on all the different FLEX IV-DSP Controllers from a single location using the IP Network. In the dark ages, the radio dealer had to go to each site and change a microprocessor or an EPROM anytime there was an error in the firmware of the product or a new feature was added. Now it is possible to change the firmware of all the FLEX IV-DSP Controllers from the comfort of your office!

THE COMPUTER PROGRAMS USED ARE WRITTEN IN C# AND MUST HAVE A P.C. WITH THE XP WINDOWS OPERATING SYSTEM UPDATED TO SERVICE PACK 2. WE WILL SUPPORT FUTURE MICROSOFT OPERATING SYSTEMS.

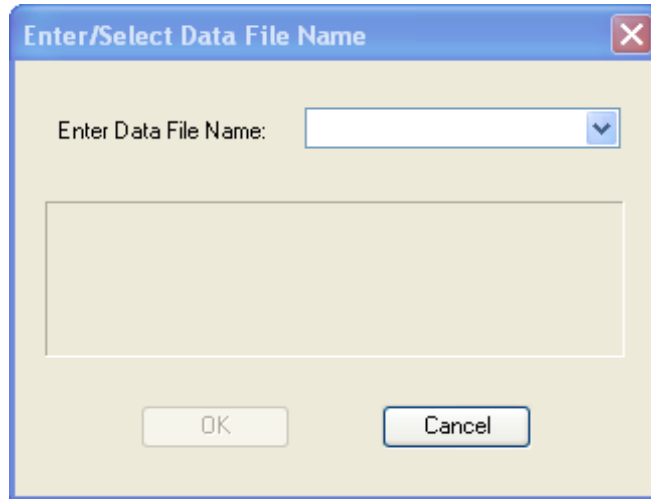
ENTERING THE PARAMETER DATA

After starting the Window data entry program for the FLEX IV, the first screen that will appear is as follows:

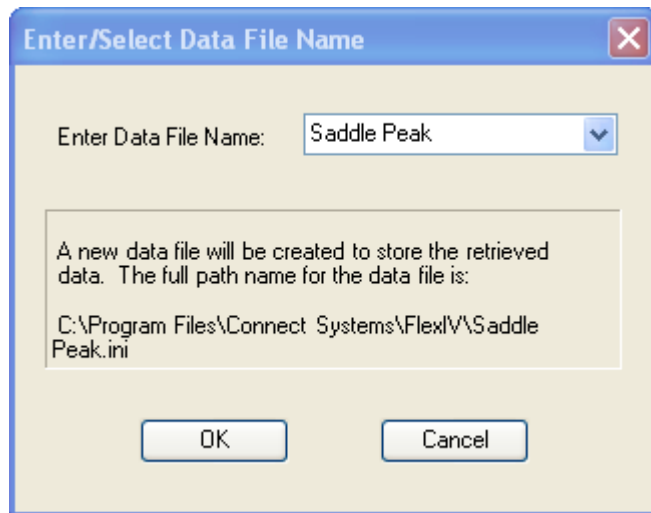


The user should either select "OPEN" and select an existing "INI" file they have worked with in the past or select "NEW" and create a new file from the pull down menu.

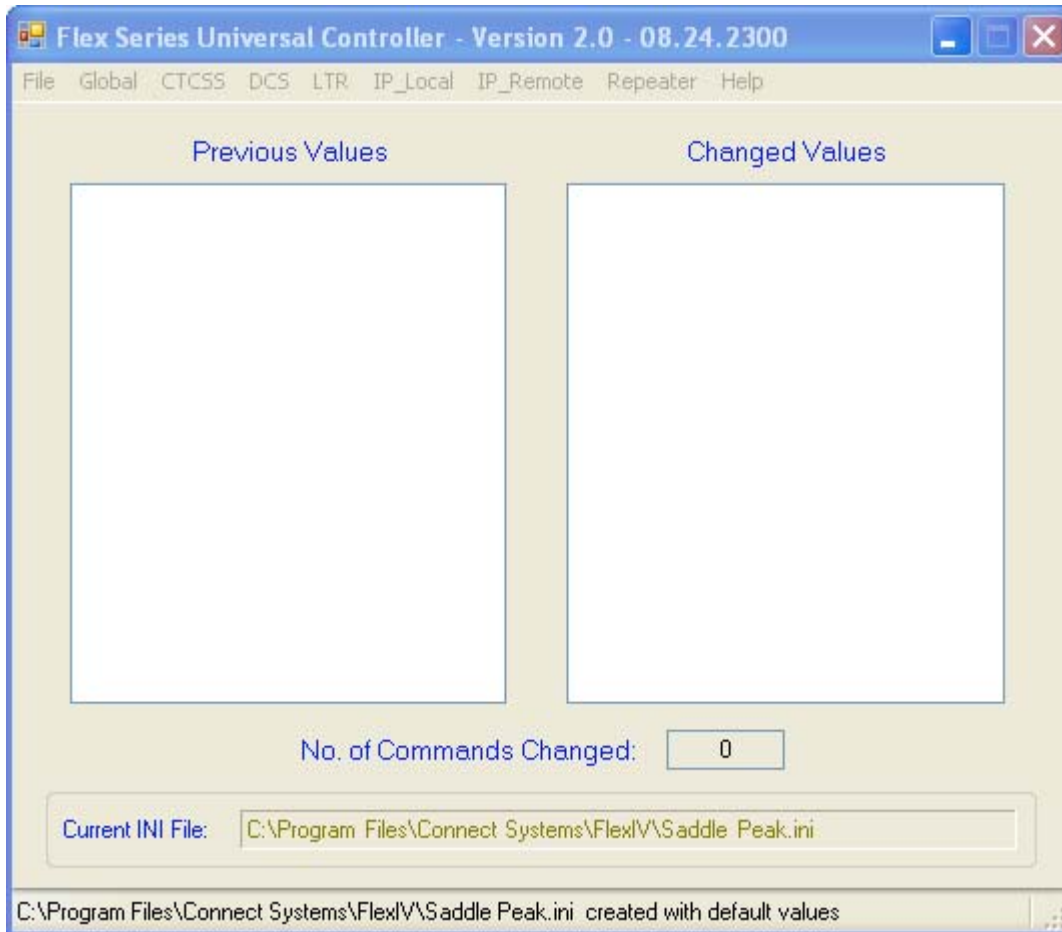
If “NEW” is selected, then the following appears on the computer screen:



You now should enter the name of the file. While you are entering the name of the file, the screen shows you the name of the file you are entering and the location it is being stored as shown below:



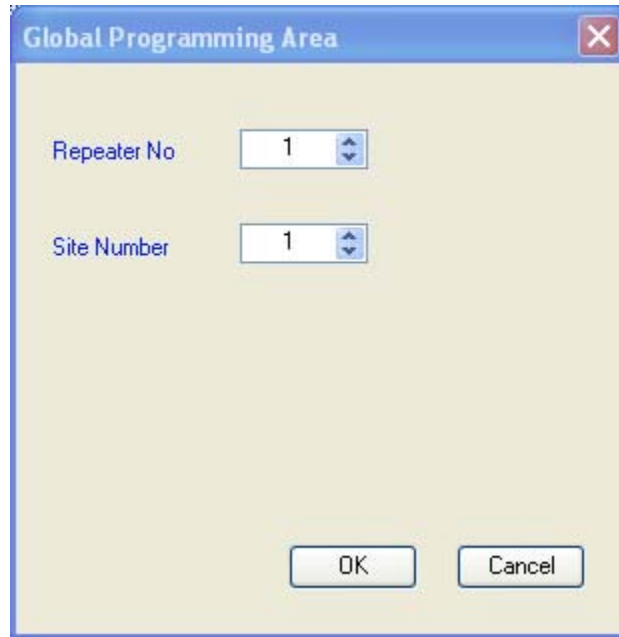
After the name is entered, click on “OK”. In a few seconds the file will be created and the following screen will appear:



Note the file name you have created is shown in the “Current INI File” and the program on the bottom indicates the file is created with the default values. Later, after the user has entered in all the values as necessary to program the system, the user must save the file using the “SAVE AS” command in the “File” pull down menu. The “SAVE AS” command allows you to save the file in the same location and with the same name as it was when it was created, or you can change the name and location as desired.

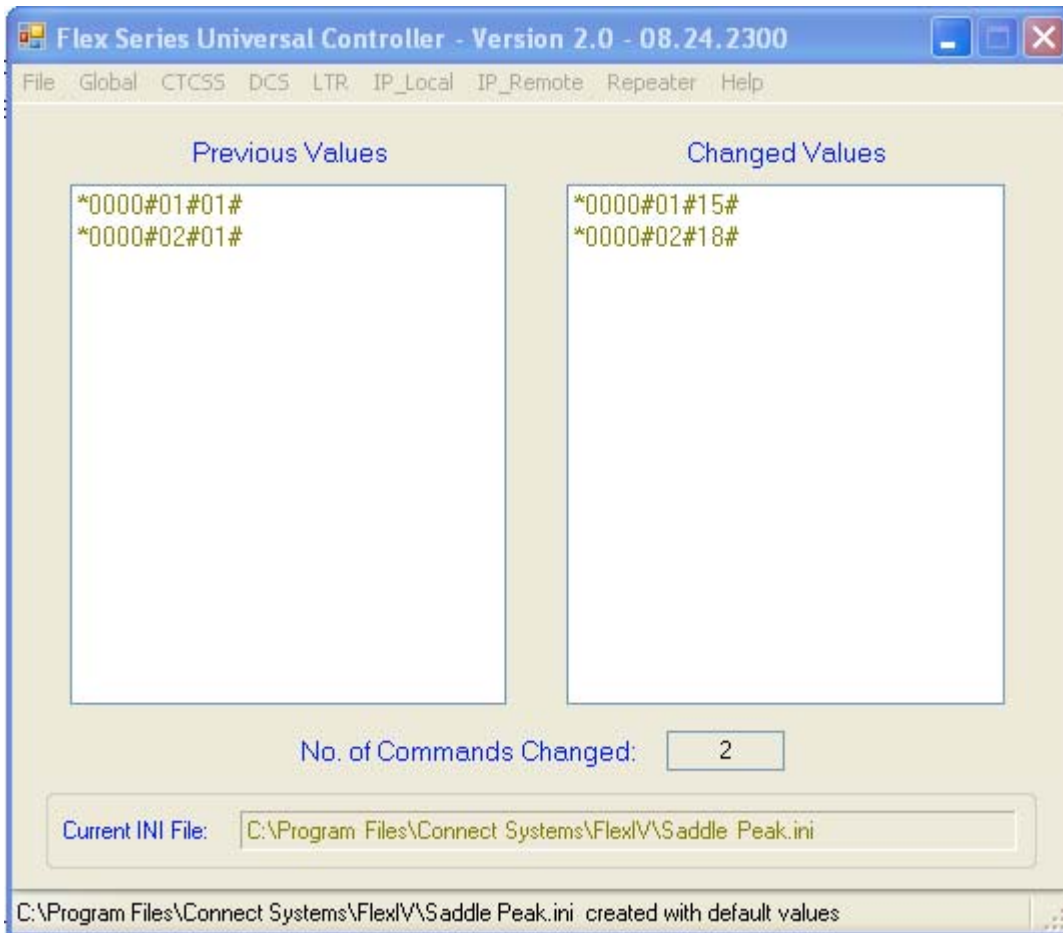
PROGRAMING THE GLOBAL PARAMETERS

From the global pull down menu, select Repeater Number and the following screen will appear:



The image shows a dialog box titled "Global Programming Area" with a close button (X) in the top right corner. The dialog box has a light beige background and a blue border. It contains two input fields: "Repeater No" and "Site Number". Both fields are currently set to the value "1" and have small up/down arrow buttons to their right. At the bottom of the dialog box, there are two buttons: "OK" and "Cancel".

Change the parameters to meet your need and then press the "OK" button. In the following example the repeater number WAS changed to 15 and the site number to 18. The following screen appears AFTER the "OK" button is pressed:



Notice that the original defaults are shown in the Previous Values column and the new values are shown in the “Changed Values” column. If the user did not press the “OK” button, then the display would not shown the changes.

PROGRAMING THE CTCSS PARAMETERS

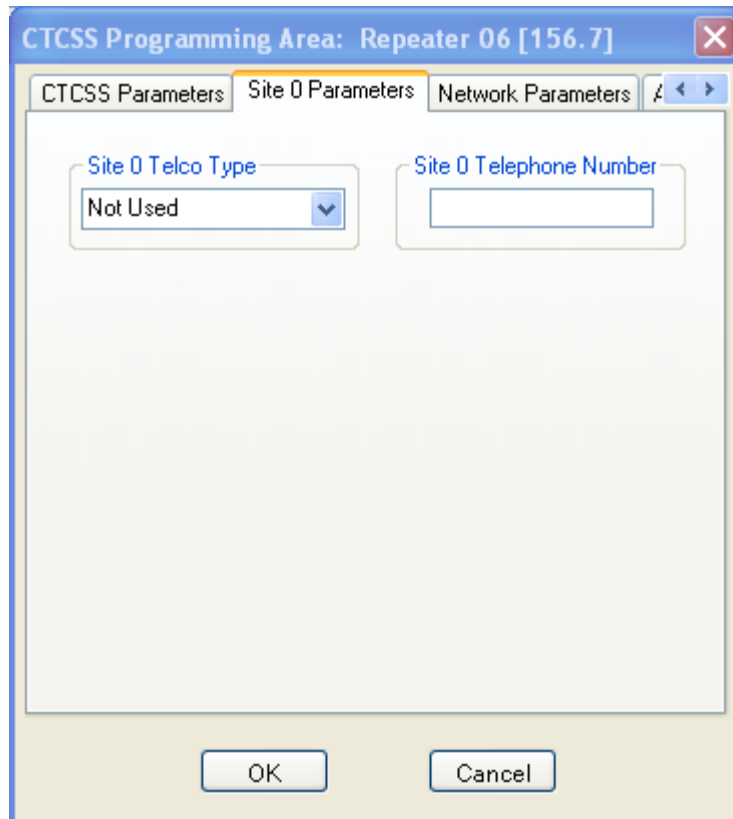
From the CTCSS pull down menu, first select one of the possible 20 repeaters at the site followed by one of the 51 possible CTCSS tones. After the repeater number and tone is selected, the following appears:

The screenshot shows a dialog box titled "CTCSS Programming Area: Repeater 06 [156.7]". It has three tabs: "CTCSS Parameters" (selected), "Site 0 Parameters", and "Network Parameters". The "CTCSS Parameters" tab contains the following settings:

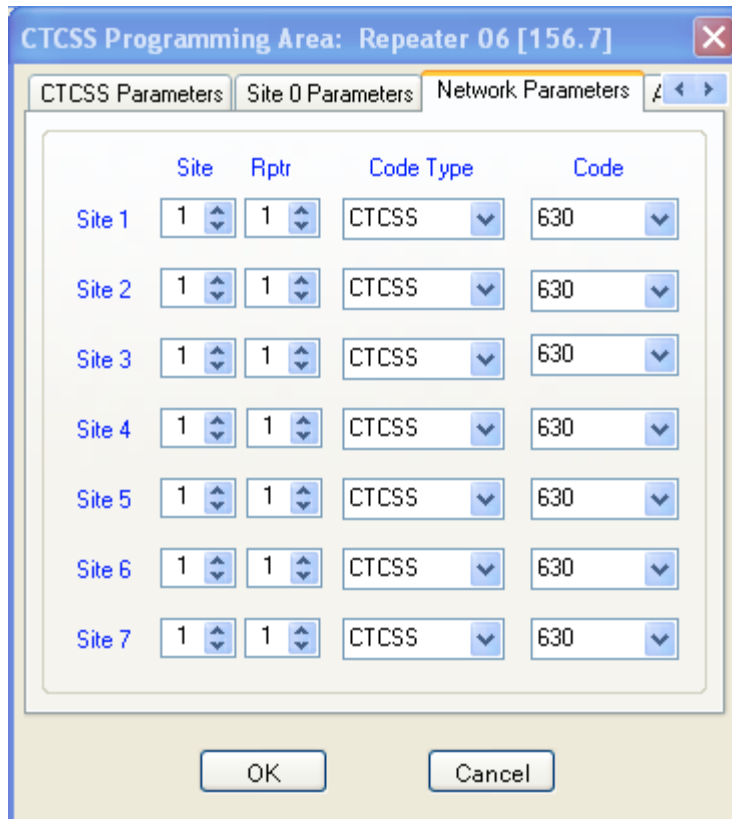
- Courtesy Beep:** Disabled, Enabled
- Reserve Tone:** Disabled, Enabled
- CTCSS/DCS-Hang Time:** Disabled, Enabled
- Network Mode:** Disabled, Enabled
- Subscriber:** Disabled, Enabled
- Priority Level:** Standard (dropdown menu)

At the bottom of the dialog are "OK" and "Cancel" buttons.

This is the first of the four possible screens. The other screens are as follows:



This screen should only be used if this repeater controller is of the public safety version.



This screen and its corresponding screen in the DCS and LTR parameters is the key to using the network. Whenever a CTCSS code is received, the system looks at this page and determines:

1. Which of the possible seven sites it should communicate with. The site is defined by the Site Number and the Repeater Number. There is another table which cross references the Site Number and Repeater Number to an absolute IP address.
2. Which communication format the destination repeater is using is determined as follows. The Code Type, which could be CTCSS, DCS, LTR or None and the corresponding code determines what format the destination repeater should use. This allows interoperability between sites.

If you need to only go between two different sites, then you use site 1 for that purpose and set the Code Type in site 2 – site 7 to None.

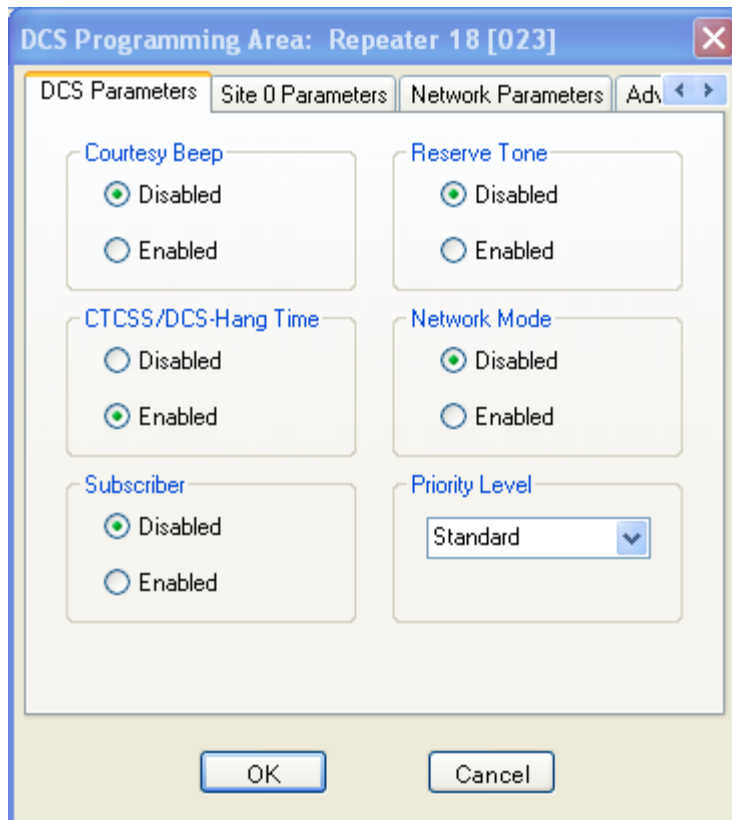
The image shows a software dialog box titled "CTCSS Programming Area: Repeater 06 [156.7]". It has two tabs: "Network Parameters" and "Advanced Parameters", with the latter being the active tab. The dialog contains a table with two columns: "Telco Type" and "Telephone Number". There are seven rows, labeled "Site 1" through "Site 7". Each row has a dropdown menu in the "Telco Type" column, all of which are currently set to "Not Used". The "Telephone Number" column contains empty text input fields for each site. At the bottom of the dialog are "OK" and "Cancel" buttons.

	Telco Type	Telephone Number
Site 1	Not Used	
Site 2	Not Used	
Site 3	Not Used	
Site 4	Not Used	
Site 5	Not Used	
Site 6	Not Used	
Site 7	Not Used	

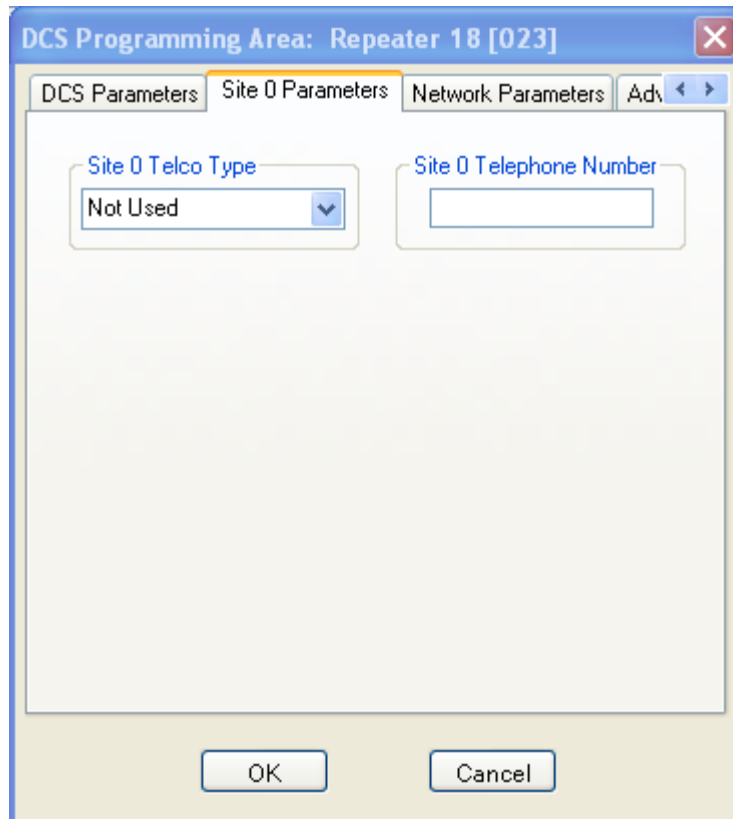
This screen should only be used if the destination repeater controller is of the public safety version.

PROGRAMING THE DCS PARAMETERS

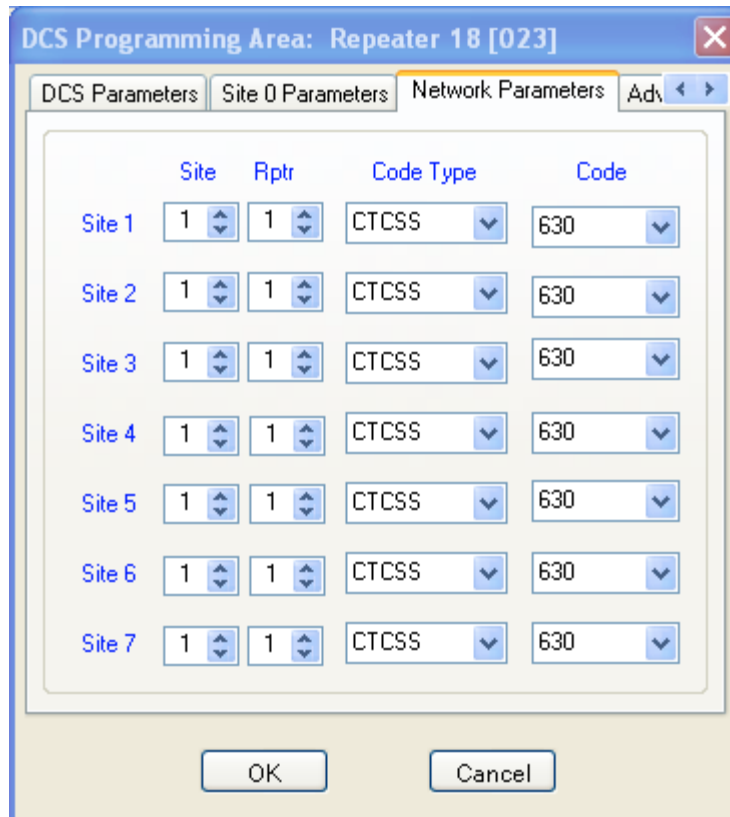
From the DCS pull down menu, first select one of the possible 20 repeaters at the site followed by one of the 112 possible DCS codes. After the repeater number and code is selected, the following appears:



This is the first of the four possible screens. The other screens are as follows:



This screen should only be used if this repeater controller is of the public safety version.



This screen and its corresponding screen in the CTCSS and LTR parameters is the key to using the network. Whenever a DCS code is received, the system looks at this page and determines:

3. Which of the possible seven sites it should communicate with. The site is defined by the Site Number and the Repeater Number. There is another table which cross references the Site Number and Repeater Number to an absolute IP address.
4. Which communication format the destination repeater is using. The Code Type, which could be CTCSS, DCS, LTR or None and the corresponding code determines what format the destination repeater should use. This allows interoperability between sites.

If you need to only go between two different sites, then you use site 1 for that purpose and set the Code Type in site 2 – site 7 to None.

	Telco Type	Telephone Number
Site 1	Not Used	
Site 2	Not Used	
Site 3	Not Used	
Site 4	Not Used	
Site 5	Not Used	
Site 6	Not Used	
Site 7	Not Used	

This screen should only be used if the destination repeater controller is of the public safety version.

PROGRAMING THE LTR PARAMETERS

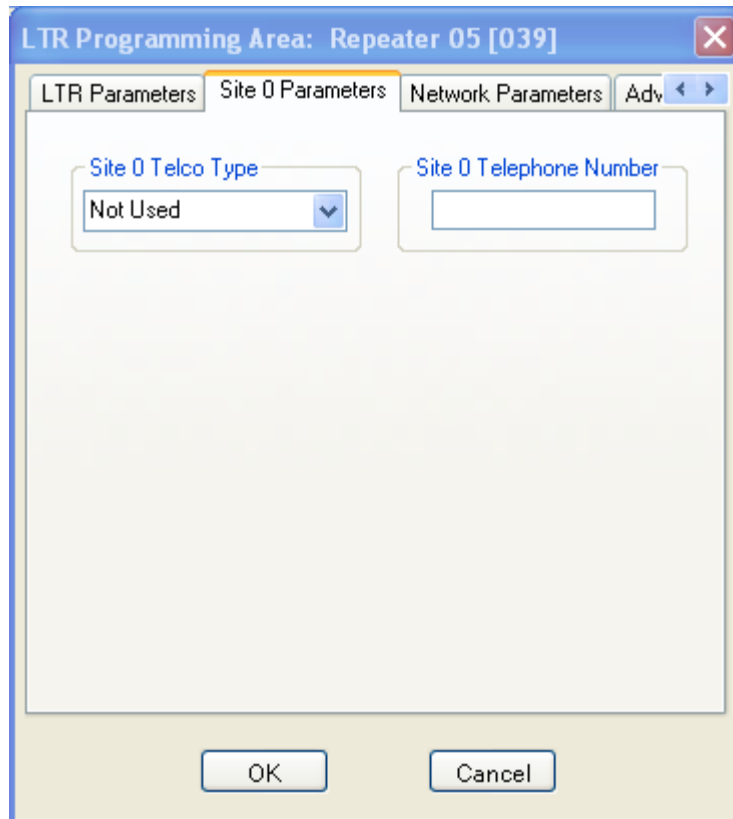
From the LTR pull down menu, first select one of the possible 20 repeaters at the site followed by one of the 250 possible LTR codes. After the repeater number and code is selected, the following appears:

The screenshot shows a dialog box titled "LTR Programming Area: Repeater 05 [039]". It has four tabs: "LTR Parameters", "Site 0 Parameters", "Network Parameters", and "Adv". The "LTR Parameters" tab is selected. The dialog contains several settings:

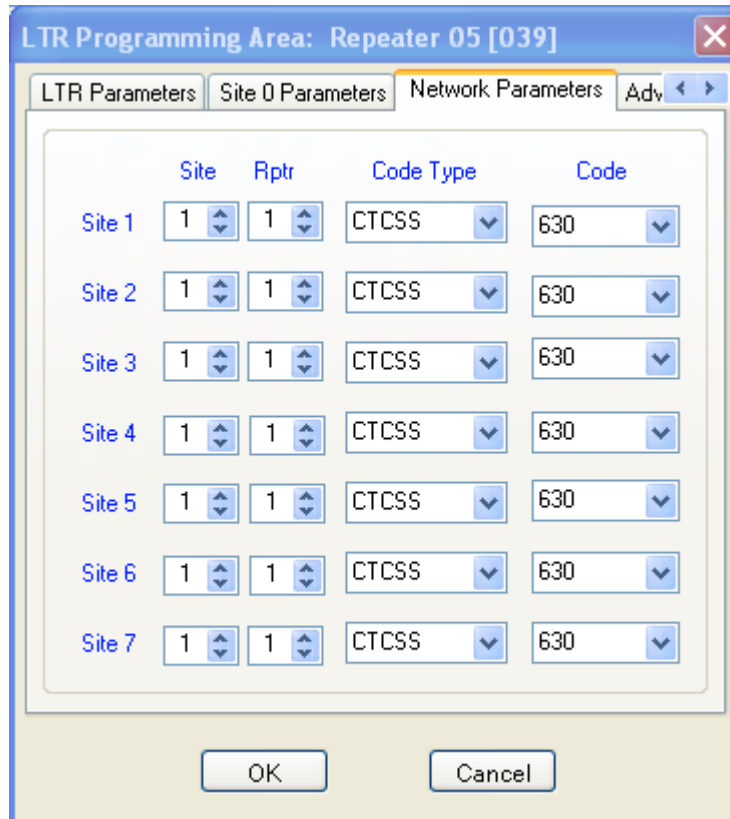
- Courtesy Beep:** Radio buttons for "Disabled" (selected) and "Enabled".
- Reserve Tone:** Radio buttons for "Disabled" and "Enabled".
- Reserved for Flex IV (left):** Radio buttons for "Disabled" and "Enabled".
- Reserved for Flex IV (right):** Radio buttons for "Disabled" (selected) and "Enabled".
- Subscriber:** Radio buttons for "Disabled" and "Enabled" (selected).
- Priority Level:** A dropdown menu currently showing "Standard".

At the bottom of the dialog are "OK" and "Cancel" buttons.

This is the first of the four possible screens. The other screens are as follows:



This screen should only be used if this repeater controller is of the public safety version.



This screen and its corresponding screen in the CTCSS and DCS parameters is the key to using the network. Whenever a LTR code is received, the system looks at this page and determines:

5. Which of the possible seven sites it should communicate with. The site is defined by the Site Number and the Repeater Number. There is another table which cross references the Site Number and Repeater Number to an absolute IP address.
6. Which communication format the destination repeater is using. The Code Type, which could be CTCSS, DCS, LTR or None and the corresponding code determines what format the destination repeater should use. This allows interoperability between sites.

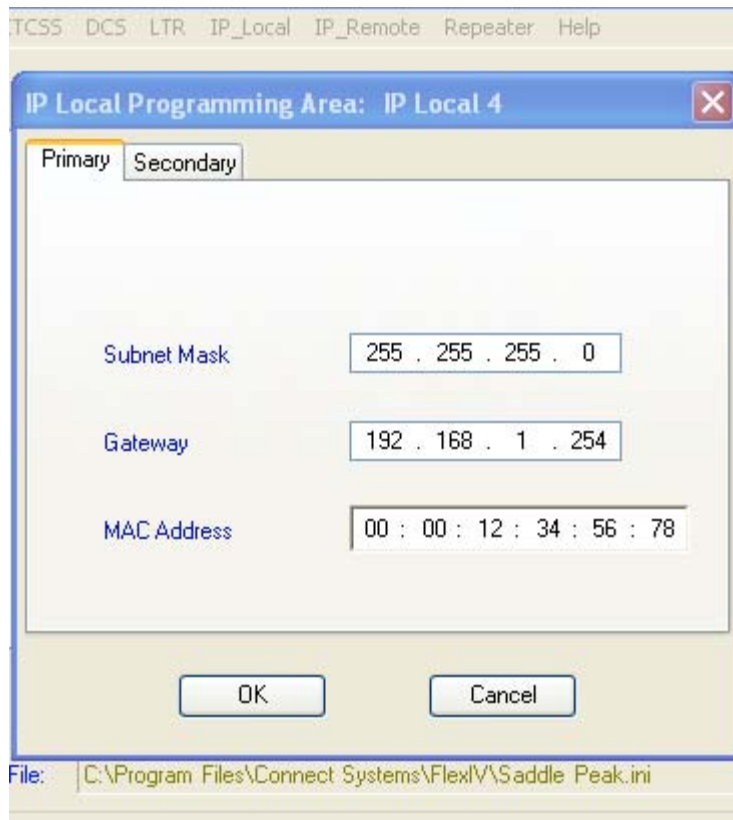
If you need to only go between two different sites, then you use site 1 for that purpose and set the Code Type in site 2 – site 7 to None.

	Telco Type	Telephone Number
Site 1	Not Used	
Site 2	Not Used	
Site 3	Not Used	
Site 4	Not Used	
Site 5	Not Used	
Site 6	Not Used	
Site 7	Not Used	

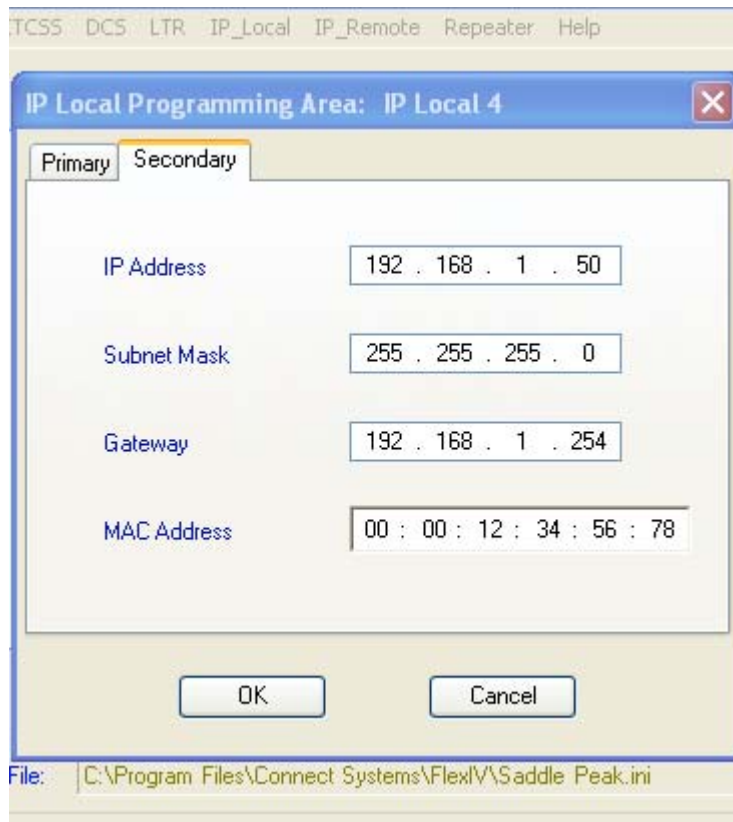
This screen should only be used if the destination repeater controller is of the public safety version.

PROGRAMING THE LOCAL IP PARAMETERS

From the Local IP pull down menu, first select one of the possible 20 repeaters. After the repeater is selected, the following appears:



This is one of the two possible screens. The other screen is as follows:



PROGRAMING THE REMOTE IP PARAMETERS

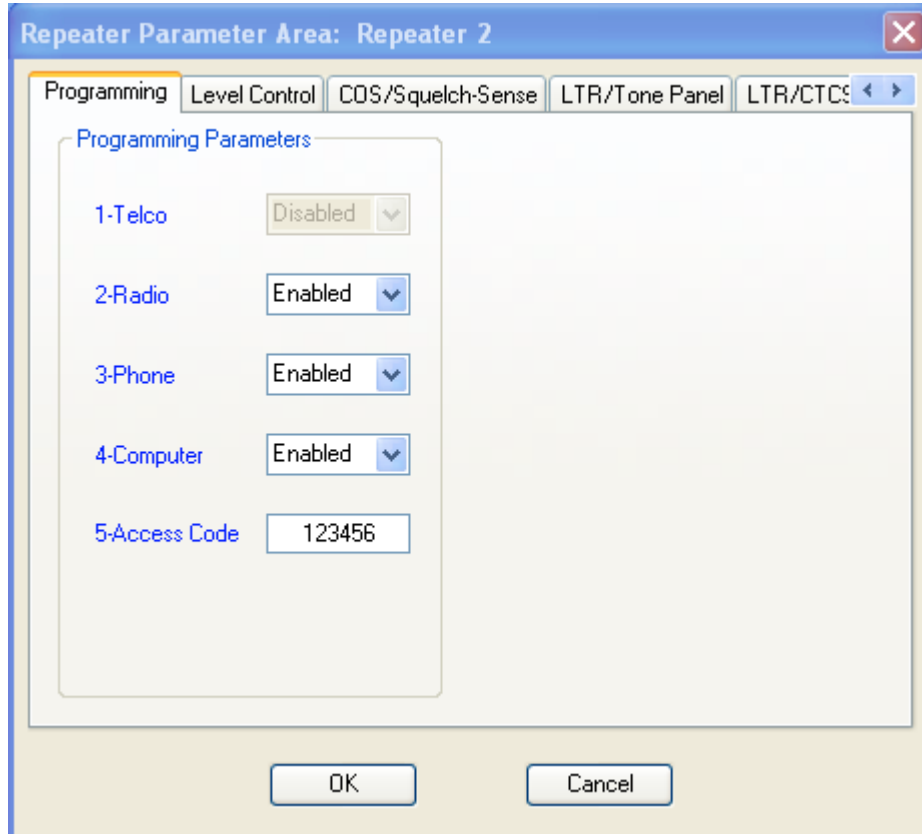
From the Remote IP pull down menu, first select one of the possible 99 sites. After the site is selected, the following appears:

	IP Address	Code	Mode	Index
Rptr 1	0 . 0 . 0 . 0	0	static	1
Rptr 2	0 . 0 . 0 . 0	0	static	1
Rptr 3	0 . 0 . 0 . 0	0	static	1
Rptr 4	0 . 0 . 0 . 0	0	static	1
Rptr 5	0 . 0 . 0 . 0	0	static	1
Rptr 6	0 . 0 . 0 . 0	0	static	1
Rptr 7	0 . 0 . 0 . 0	0	static	1
Rptr 8	0 . 0 . 0 . 0	0	static	1
Rptr 9	0 . 0 . 0 . 0	0	static	1
Rptr 10	0 . 0 . 0 . 0	0	static	1

This is the first of 2 identical screens that allow you to program the IP address of the remote repeaters at each site.

PROGRAMING THE REPEATER PARAMETERS

From the Repeater pull down menu, first select one of the possible 20 repeaters. After the repeater is selected, the following appears:

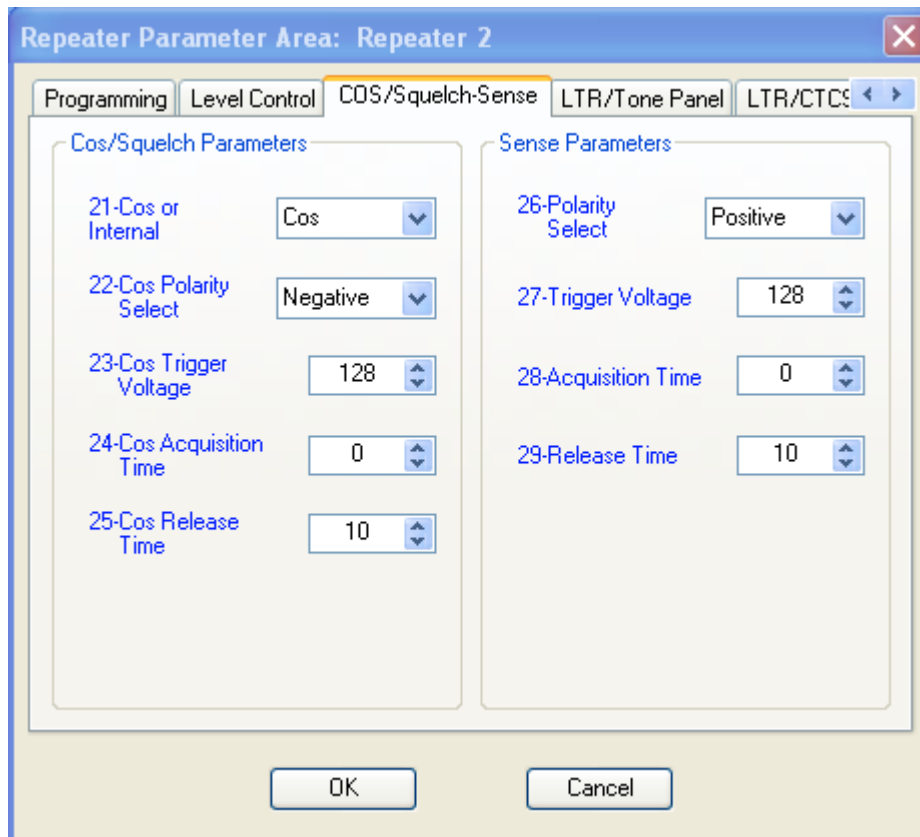


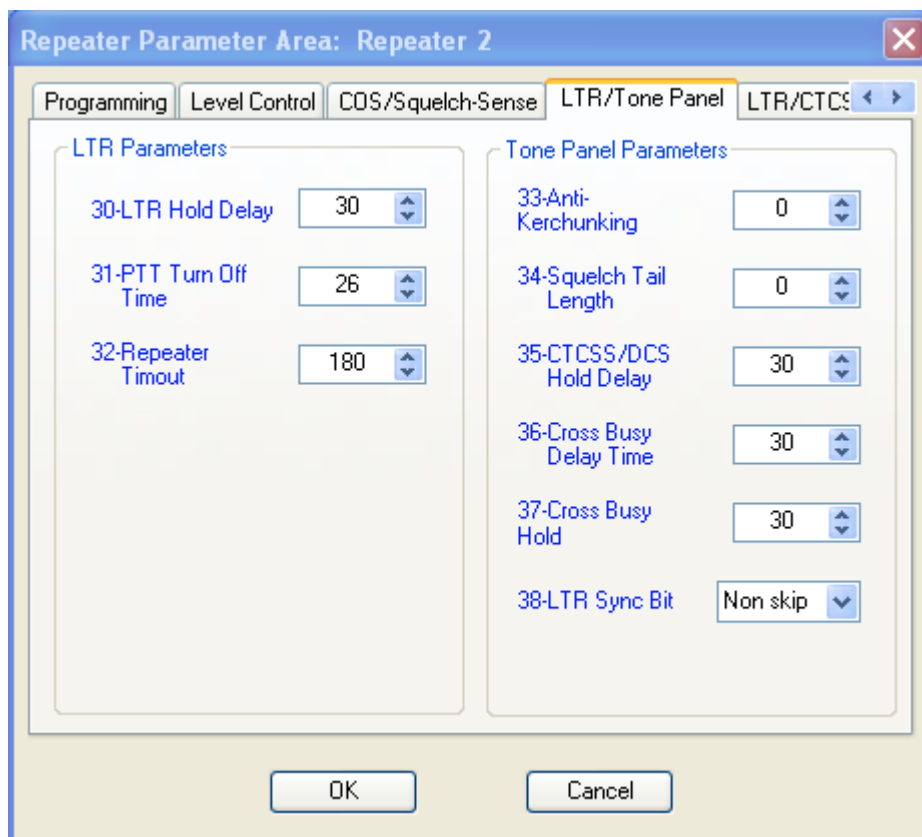
This is the first of eight screens. The other seven screens are shown on the following pages.

SOME OF THE PARAMETERS SHOWN ARE NOT SUPPORTED IN THE FIRST RELEASE OF THE SYSTEM. PLEASE SEE THE MANUAL THAT DESCRIBES THE PARAMATERS TO SEE IF THEY ARE SUPPORTED.

Repeater Parameter Area: Repeater 2

6-DTMF Telco	20	14-CTCSS Radio	25
7-DTMF Radio	50	15-DCS Radio	25
8-Beep Radio	50	16-LTR Radio	25
9-Beep Telco	5	17-Repeat Radio	100
10-CW ID Radio	50	18-Telco Radio	100
11-Voice Radio	255	19-Radio Telco	200
12-Voice Telco	255	20-Radio Limit	255
13-Paging Tone Radio	255		





Repeater Parameter Area: Repeater 2

Level Control CDS/Squelch-Sense LTR/Tone Panel LTR/CTCSS/DCS Comr < >

LTR		CTCSS/DCS	
39-Priority Level	1	46-DCS Encode Polarity	Normal
40-Encode Polarity	Normal	47-DCS Decode Polarity	Normal
41-Decode Polarity	Normal	48-Courtesy Tone Delay	10
42-Test ID Code	2	49-Subscriber Hang Time	30
43-Idle Message Timer	1	50-Carrier Drop Delay	99
44-Area Bit	Area 0		
45-Master or Slave	Slave		

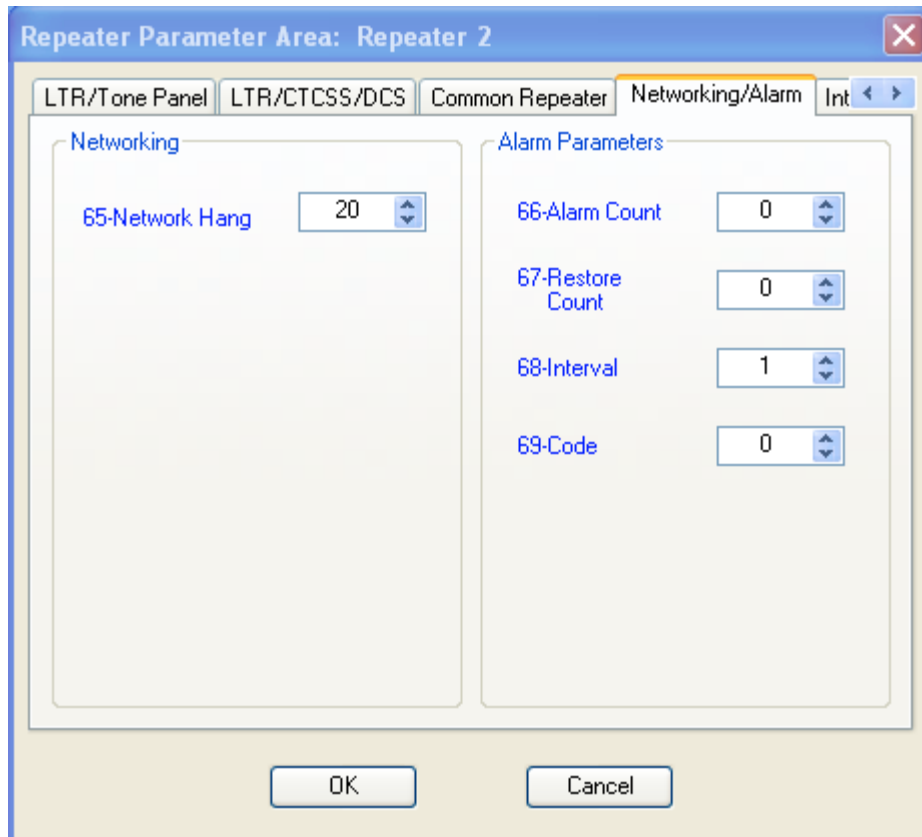
OK Cancel

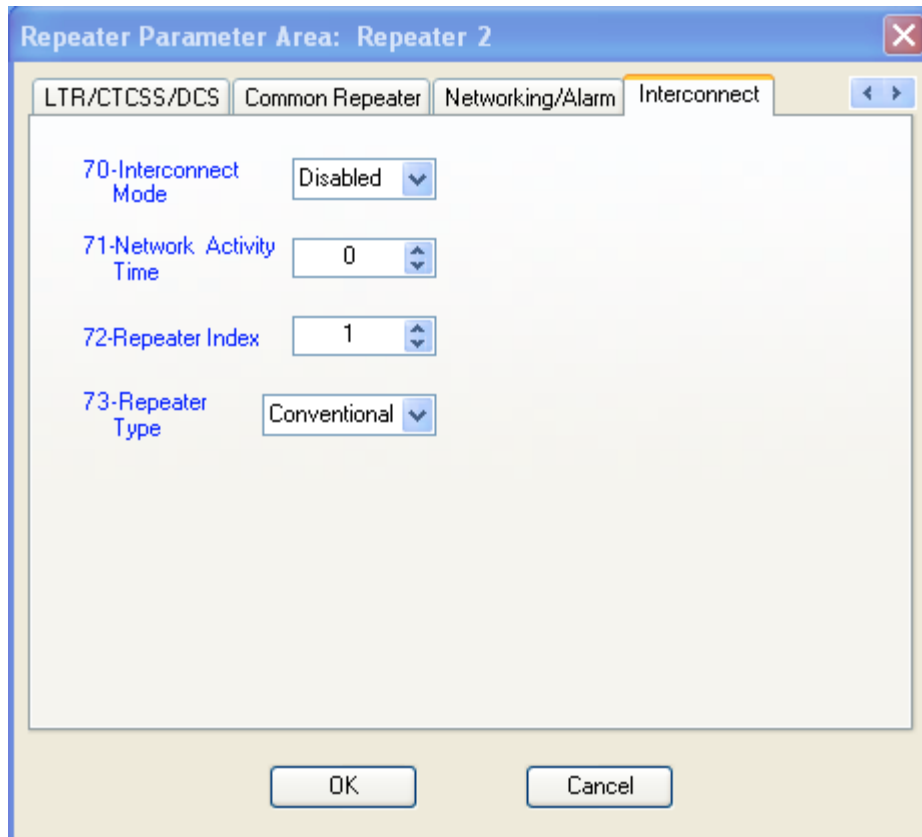
Repeater Parameter Area: Repeater 2

COS/Squelch-Sense | LTR/Tone Panel | LTR/CTCSS/DCS | **Common Repeater** < >

51-Access Delay	10	58-PTT Turn On Delay	10
52-Station Identification Mode	BEACON	59-Courtesy Beep Frequency	5
53-Voice or Morse Code	Morse Code	60-Repeater Transmit	Normal
54-Repeater CW ID Interval	0	61-Aux Relay	Not used
55-CW ID Speed	5	62-Cross Busy Mode	Not used
56-CWID Frequency	5	63-Radio Repeater Gain	1
57-CWID Sequence Characters		64-Telco Repeater Gain	1

OK Cancel





Now that you have programmed all the parameters, it is time to save the results. The next section will describe how to manually manipulate the “ini” file you have created.

MANUALLY MANIPULATING THE “INI” FILE

The “ini” file should be manipulated with the Windows NOTEPAD program. It is assumed that the user is familiar with the program and no effort will be made here to describe the features of NOTEPAD or how it works.

Manipulating the file should be done for only two reasons:

1. There is an error in our data entry program described above and the user has to manually fix the problem until Connect Systems Inc. updates the data entry program.
2. There is a new feature we want to include but have not put it in the data entry program yet or it's so special for a customer, we will not put it in the data entry program. An example of a feature we are going to have is gang programming. We will first have the user put it in manually and then later we will incorporate it into the data entry program.

When you first open the “ini” file you are going to get a screen that looks as shown below. It should be noted that this is only a small part of the file. Because the file is so large, it will take several seconds from the time you press the open command from NOTEPAD till the time you actually see anything on the computer screen.

[GLOBAL]

```
RepeaterNumber= *0000#01#01#
SiteNumber= *0000#02#01#
```

[CTCSS]

```
01_630_CourtesyBeep= *1001#630#01#0#
01_630_CTCSSDCSDuringHangTime= *1001#630#02#1#
01_630_Subscriber= *1001#630#03#0#
01_630_ReserveTone= *1001#630#04#0#
01_630_NetworkMode= *1001#630#05#0#
01_630_MappedNetworkUserNo= *1001#630#06#000#
01_630_PriorityLevel= *1001#630#07#0#
01_630_Site0_TelcoType= *1001#630#08#0#
01_630_Site0_TelephoneNumber= *1001#630#09# #
01_630_Site1_RepeaterIndex= *1001#630#10#0101#
01_630_Site1_CodeType= *1001#630#11#0#
01_630_Site1_Code= *1001#630#12#000630#
01_630_Site1_TelcoType= *1001#630#13#0#
01_630_Site1_TelephoneNumber= *1001#630#14# #
01_630_Site2_RepeaterIndex= *1001#630#15#0101#
01_630_Site2_CodeType= *1001#630#16#0#
01_630_Site2_Code= *1001#630#17#000630#
```

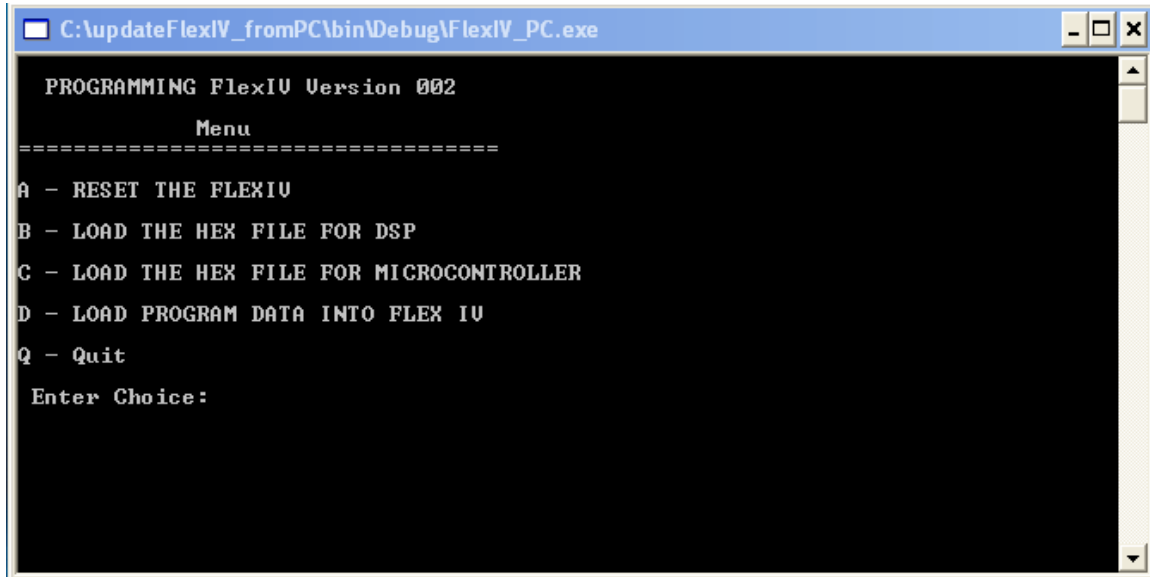
01_630_Site2_TelcoType=	*1001#630#18#0#	
01_630_Site2_TelephoneNumber=	*1001#630#19#	#
01_630_Site3_RepeaterIndex=	*1001#630#20#0101#	
01_630_Site3_CodeType=	*1001#630#21#0#	
01_630_Site3_Code=	*1001#630#22#000630#	
01_630_Site3_TelcoType=	*1001#630#23#0#	
01_630_Site3_TelephoneNumber=	*1001#630#24#	#
01_630_Site4_RepeaterIndex=	*1001#630#25#0101#	
01_630_Site4_CodeType=	*1001#630#26#0#	
01_630_Site4_Code=	*1001#630#27#000630#	
01_630_Site4_TelcoType=	*1001#630#28#0#	
01_630_Site4_TelephoneNumber=	*1001#630#29#	#
01_630_Site5_RepeaterIndex=	*1001#630#30#0101#	
01_630_Site5_CodeType=	*1001#630#31#0#	
01_630_Site5_Code=	*1001#630#32#000630#	
01_630_Site5_TelcoType=	*1001#630#33#0#	
01_630_Site5_TelephoneNumber=	*1001#630#34#	#
01_630_Site6_RepeaterIndex=	*1001#630#35#0101#	
01_630_Site6_CodeType=	*1001#630#36#0#	
01_630_Site6_Code=	*1001#630#37#000630#	
01_630_Site6_TelcoType=	*1001#630#38#0#	
01_630_Site6_TelephoneNumber=	*1001#630#39#	#
01_630_Site7_RepeaterIndex=	*1001#630#40#0101#	
01_630_Site7_CodeType=	*1001#630#41#0#	
01_630_Site7_Code=	*1001#630#42#000630#	
01_630_Site7_TelcoType=	*1001#630#43#0#	
01_630_Site7_TelephoneNumber=	*1001#630#44#	#
01_670_CourtesyBeep=	*1001#670#01#0#	

Because we do not currently have a reason for the user to directly change these files, we will only quickly describe what might have to be done.

Let's assume Courtesy Beep does not work and you want to change it from a zero to a one. You would change *1001#670#01#0# to *1001#670#01#1#. However, courtesy beep is a feature that is dependent on the CTCSS, DCS, or LTR number. That means it might have to be changed in 51 locations for the CTCSS, 112 locations for the DCS and 5000 locations for the LTR.

TRANSFERING DATA TO THE FLEX IV DSP

When the program first turns on, the following screen appears:



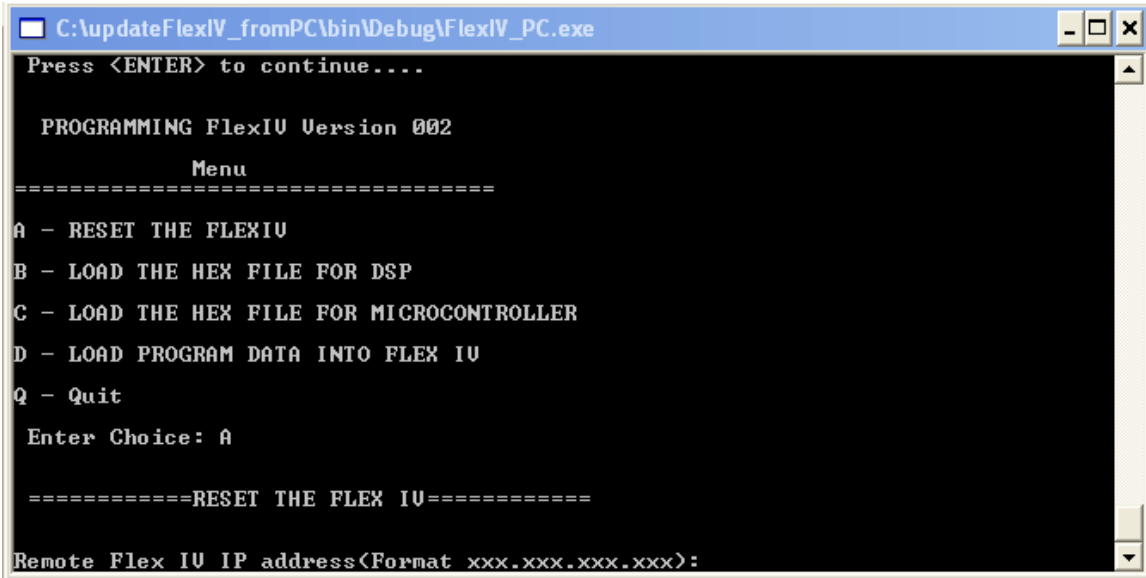
```
C:\updateFlexIV_fromPC\bin\Debug\FlexIV_PC.exe
PROGRAMMING FlexIU Version 002
Menu
=====
A - RESET THE FLEXIU
B - LOAD THE HEX FILE FOR DSP
C - LOAD THE HEX FILE FOR MICROCONTROLLER
D - LOAD PROGRAM DATA INTO FLEX IU
Q - Quit
Enter Choice:
```

To select one of the functions, press the appropriate key on your computer keyboard followed by the enter key. The meaning of the different choices is as follows:

- A. RESET THE FLEXIV:** When the program data is loaded into the system the data is stored in a temporary location. It is not until the operator gives a reset command, is the data actually used. When the HEX data is loaded into the DSP, the program is not used until a reset command is given. When the HEX data is loaded into the microcontroller, an automatic reset is generated and thus not necessary for the user to issue a reset command.
- B. LOAD THE HEX FILE FOR DSP:** This is the firmware for updating the DSP. Connect Systems Inc. must supply this HEX file. It is not changeable by the user.
- C. LOAD THE HEX FILE FOR MICROCONTROLLER:** This is the firmware for updating the microcontroller. Connect Systems Inc. must supply this HEX file. It is not changeable by the user.
- D. LOAD PROGRAM DATA INTO FLEX IV:** This is the parameter data you changed in section one of this manual. This program updated both the parameters for the DSP as well as the parameters for the microcontroller.
- Q. Quit:** Entering this key exits you from the program.

RESET THE FLEX IV DSP

After the “A” key is pressed followed by the “Enter” key, the following is displayed:



```
C:\updateFlexIV_fromPC\bin\Debug\FlexIV_PC.exe
Press <ENTER> to continue....

PROGRAMMING FlexIU Version 002

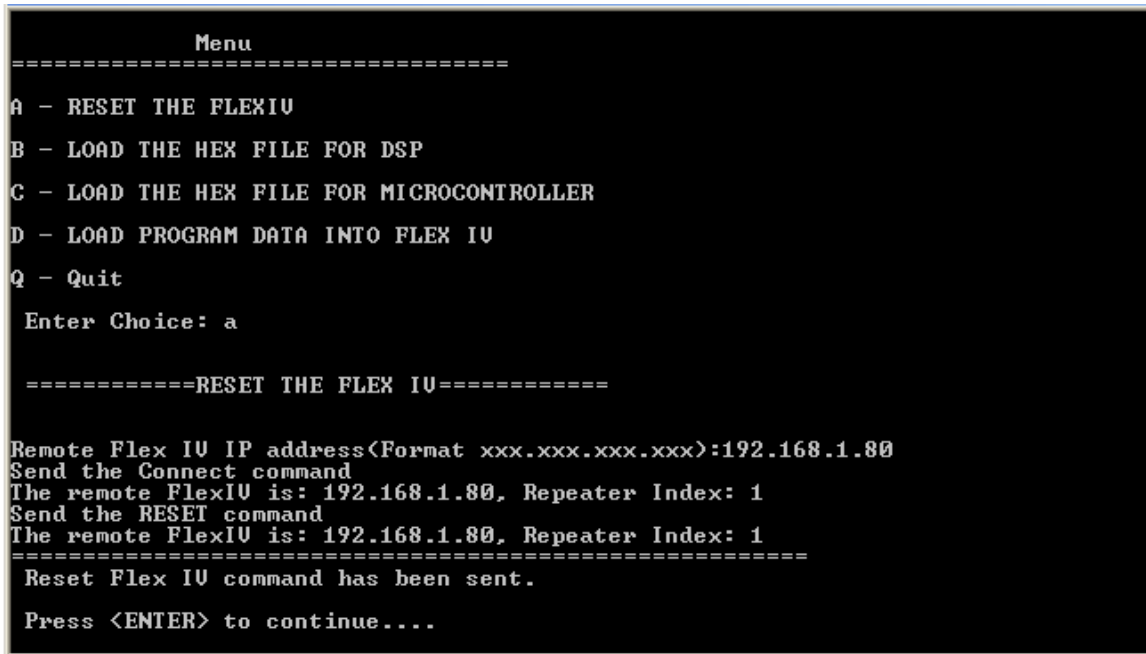
Menu
=====
A - RESET THE FLEXIU
B - LOAD THE HEX FILE FOR DSP
C - LOAD THE HEX FILE FOR MICROCONTROLLER
D - LOAD PROGRAM DATA INTO FLEX IU
Q - Quit

Enter Choice: A

=====RESET THE FLEX IU=====

Remote Flex IU IP address<Format xxx.xxx.xxx.xxx>:
```

The user now enters the IP address of the FLEX IV DSP Controller they want to Reset. followed by the “Enter” key. The P.C. will then send the reset command and display the following:



```
Menu
=====
A - RESET THE FLEXIU
B - LOAD THE HEX FILE FOR DSP
C - LOAD THE HEX FILE FOR MICROCONTROLLER
D - LOAD PROGRAM DATA INTO FLEX IU
Q - Quit

Enter Choice: a

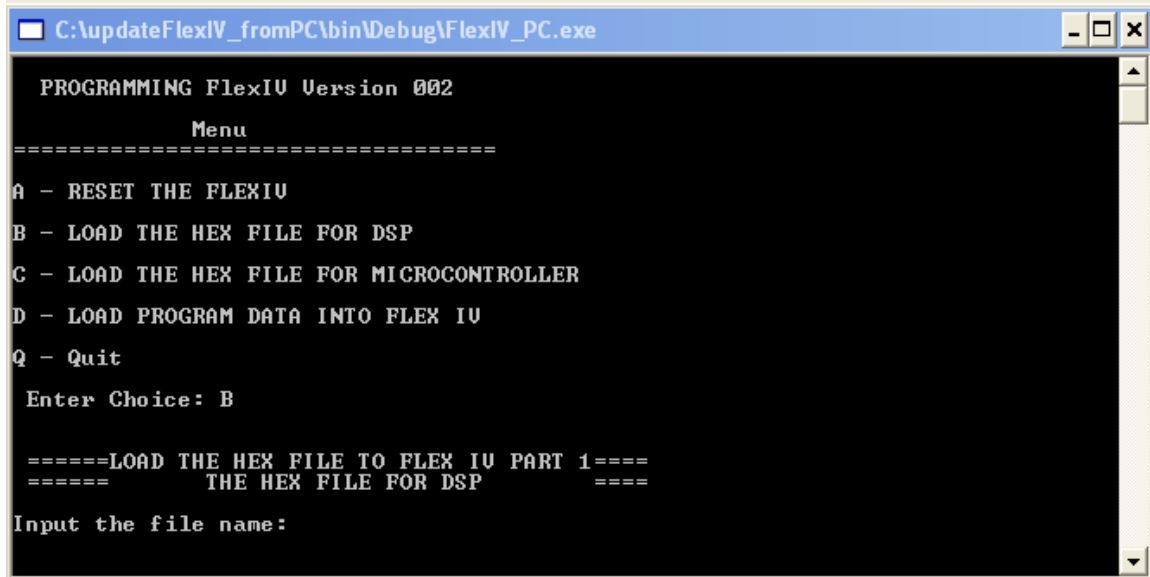
=====RESET THE FLEX IU=====

Remote Flex IU IP address<Format xxx.xxx.xxx.xxx>:192.168.1.80
Send the Connect command
The remote FlexIU is: 192.168.1.80, Repeater Index: 1
Send the RESET command
The remote FlexIU is: 192.168.1.80, Repeater Index: 1
=====
Reset Flex IU command has been sent.

Press <ENTER> to continue....
```

LOAD THE HEX FILE FOR DSP

After the “B” key is pressed followed by the “Enter” key, the following is displayed:



```
C:\updateFlexIV_fromPC\bin\Debug\FlexIV_PC.exe

PROGRAMMING FlexIU Version 002

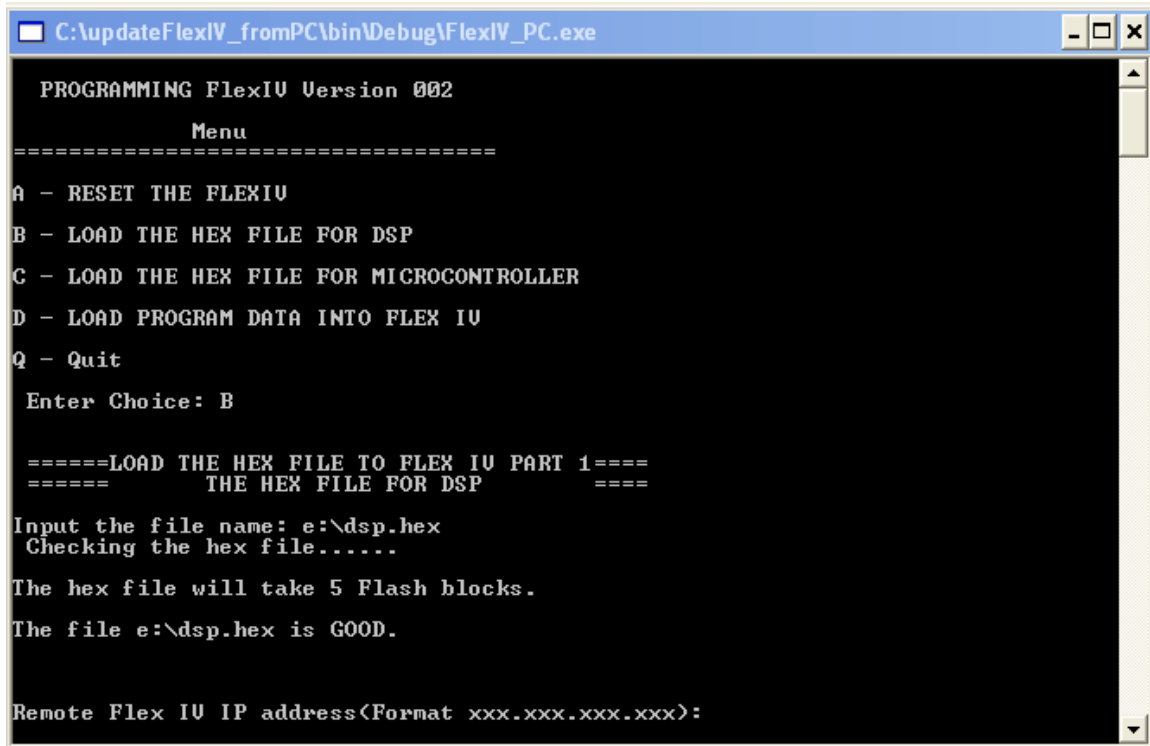
Menu
=====
A - RESET THE FLEXIU
B - LOAD THE HEX FILE FOR DSP
C - LOAD THE HEX FILE FOR MICROCONTROLLER
D - LOAD PROGRAM DATA INTO FLEX IU
Q - Quit

Enter Choice: B

=====LOAD THE HEX FILE TO FLEX IU PART 1=====
=====THE HEX FILE FOR DSP=====

Input the file name:
```

The user now has to enter the file name as E:\dsp.hex. It should be noted that in this test the file is being obtained from a flash disk. It is possible to have a more complicated file name such as c:\csi\dsp_hex_file\dsp.hex. The actual location of the file and the name of the file is determined by the user. After the file name is entered, the display will now show:



```
C:\updateFlexIV_fromPC\bin\Debug\FlexIV_PC.exe

PROGRAMMING FlexIU Version 002

Menu
=====
A - RESET THE FLEXIU
B - LOAD THE HEX FILE FOR DSP
C - LOAD THE HEX FILE FOR MICROCONTROLLER
D - LOAD PROGRAM DATA INTO FLEX IU
Q - Quit

Enter Choice: B

=====LOAD THE HEX FILE TO FLEX IU PART 1=====
=====THE HEX FILE FOR DSP=====

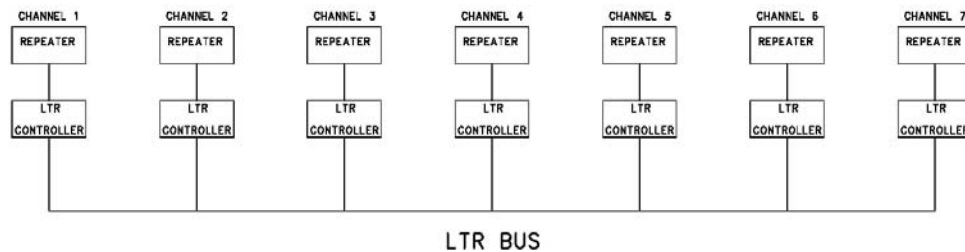
Input the file name: e:\dsp.hex
Checking the hex file.....

The hex file will take 5 Flash blocks.
The file e:\dsp.hex is GOOD.

Remote Flex IU IP address<Format xxx.xxx.xxx.xxx>:
```

The user now enters the IP address of the FLEX IV DSP Controller they want to reprogram. After the IP address followed by the “Enter” key is pressed, the screen will show the data is being transferred from the P.C. to the FLEX IV DSP.

SETTING UP THE LTR SYSTEM



This section is going to explain how to optimize an LTR system in conjunction with a wide area network. First it is necessary to briefly review how an LTR system works.

How Trunking Works

In an LTR system, all mobiles are homed to the home channel. If the home channel is not in use and the mobile keys up, then that radio will use that home channel. If the home channel is busy, the home channel will send out a special code to indicate which channel is not busy. The mobile will then trunk to the channel that is not busy.

The LTR BUS

Whenever a radio is transmitting, the information associated with that channel is put on the LTR BUS. The information on the bus is outputted on the Home Channel to indicate where all the radios that are currently active are.

LTR Timing

LTR subcode data is transmitted over the air at 300 baud. Each LTR word is 40 bits long. This gives a timing of an LTR word of 133 milliseconds. The LTR BUS goes through a complete cycle in 150 milliseconds.

If there are "N" active radios on the home channel, then the information for all "N" radios will be transmitted over the air sequentially one channel at a time. Therefore the time to send all "N" channels for is $N * 133$ Milliseconds.

The radios in a particular group will have to see its corresponding LTR code before it knows which repeater to trunk to. If there are a lot of active radios on a home channel, then the time for the other radios in a group to start hearing the conversation could be substantial.

If the home channel is not busy, then the time for the other radios in a group to trunk is 133 milliseconds. If the home channel is not busy but other radios homed to that channel is busy, then the other channels in that group will trunk between 133 milliseconds and 266 milliseconds.

If the home channel is busy and the radio trunks to another repeater, then the time for the other channels in the group to be homed to that channel will be between 133 milliseconds and 266 milliseconds plus the LTR BUS timing of 150 milliseconds.

Strategy For Wide Area Network

As you can see from the above analysis, if a radio is not using the home channel, then there could be an additional 150 milliseconds before the radios in the group will start hearing the conversation. In a like manner, it would be desirable if the source radio in a wide area network uses the home channel for its destination address. Unlike a conventional LTR system, the FLEX IV uses audio delay lines to compensate for the inevitable timing delays.