

**The FC Family of
Paging Controllers:
FC-2000, FC-2500, FC-3000**

User Manual

Kantronics

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Kantronics, Inc.

1202 E. 23rd Street, Lawrence, KS 66046-5099

Monday-Friday:

For Product Information and Commercial Technical Support
(785) 842-7745, FAX (785) 842-2031

e-mail: sales@kantronics.com

website: <http://www.kantronics.com>

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Radio Frequency Interference Statement

Information for the Paging Technician

Kantronics paging equipment was tested and found to comply with Part 15 Subpart A of the FCC Rules regarding radio frequency emissions.

Kantronics paging equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other communications equipment.

The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In addition, any peripheral device installed with this equipment must be connected with a high-quality shielded cable.

Manual Outline

This manual includes an introduction, installation, operation, maintenance, and reference materials for the FC-2000, FC-2500, and FC-3000 transmitter controllers. A separate manual exists for the Time Gate 1000, used with the controllers in some applications.

The introductory chapter presents an overview of the many ways the controllers can be used in a paging system.

Each remaining chapter provides installation and operational information for one of these ways in which the controllers can be used. The chapters are independent of one another; all cabling, programming of parameters, and operational procedures for a given use/application are contained within that chapter.

The appendices provide additional reference material, including a tabulation and description of commands available for each controller model, details on configuring and installing a GPS Smart Antenna, a details on interfacing to various excitors and transmitters, a listing of FAQs with answers, and more.

Introduction: System Overviews

Welcome to the FC family of paging transmitter controllers. The FC family is designed to provide high efficiency batching of mixed paging protocols and at the same time solve the common system problems that you as the paging provider deal with every day.

An FC can be configured to operate in several different types of paging systems:

- Master/Slave Simulcasting
- Synchronous Simulcasting
- Non-Simulcasting TNPP/Paging
- Purc Tone Repeating

Master-Slave System

Configured as a Master-Slave (MS) system, FC controllers may be mixed with previously purchased KPC-2000 controllers to form a satellite-based simulcasting system for Golay and/or POCSAG. FC controllers may be configured as either a Master or Slave and as such are KPC-2000 compatible. When you decide to upgrade your service to include FLEX, the FC controllers in your system may be upgraded with firmware. No hardware upgrade is necessary.

The MS system was introduced by Kantronics in 1997 and many SAT-based systems are now operational. A MS system consists of one Master at your paging switch site and one or more remote Slave controllers at each transmit site. The job of Master is to watch for traffic from the satellite downlink and to issue transmit (XMT) commands to synchronize the remote controllers. The XMT commands are routed through your paging switch as TNPP control frames and the switch combines them with the TNPP traffic. This combination of pages and XMT commands arrive at the Master and each Slave controller via the SAT feed. The XMT commands serve to divide the traffic into batches and to synchronize the controllers.

You may reprogram all FC controllers in either a SYNSIM or MS system by including an FC controller as a Master at your paging switch site. The FC as Master can accept a firmware file and forward it via satellite to the controllers. It is also possible to change individual parameters within one or more controllers, using the remote command feature.

To install a group of FC controllers in a Master-Slave system, refer to MASTER-SLAVE SYSTEM chapter. There is no need to read the installation chapters on SYNSIM or tone signaling systems.

SYNSIM System

Configured as a Synchronous Simulcasting system (SYNSIM), FC family units solve these problems:

- Paging channel arbitration with another provider,
- Combining FLEX with Golay and/or POCSAG pages,
- Driving more than one paging channel at a remote site,
- Unnecessary site visits to change controller parameters/firmware.

A SYNSIM system consists of one Time Gate (TG-1000) at your satellite uplink site and one or more FC controllers at each transmit site. The TG-1000 has two basic jobs: collect backhaul traffic from your switch – and others if you are sharing a satellite (SAT) and/or backhaul channel - and generate precise GPS-based TNPP formatted timing packets. The timing packets are combined with the SAT downlink traffic and are used to synchronize the station controllers. Hence, just one GPS Smart Antenna, a Palisades or Acutime 2000 by Trimble, is required by the TG-1000 at the SAT uplink site. GPS units are not required at any of the remote sites. You may wish to carry one GPS unit as maintenance equipment to measure SAT simulcasting delay from the uplink site to each remote site. With the GPS unit attached, the remote controller computes the uplink site to controller site delay. For example, the delay from a SAT uplink in Chicago to Lawrence, KS measured 252,000 microseconds.

Historically, TNPP traffic was combined from a number of paging switches and backhauled to a satellite uplink port via continuously leased line. Today, most providers deliver traffic to the uplink site via the internet. Consult with your satellite provider for details. There are a number of program and equipment options available.

To install a batch of FC controllers in a SYNSIM system, refer to the SYNSIM SYSTEM chapter. There is no need to read the installation chapters on MS systems or tone signaling. Each chapter stands alone.

Non-Simulcasting TNPP/Paging Controller

Configured as a TNPP stand-alone controller, an FC can be used to encode and transmit pages into a non-simulcasting area and can accept TNPP traffic from one or two communications channels. For example, you might combine your traffic with that of another provider to reach an isolated area, such as a parking garage.

Configured in PAGER mode, an FC can be combined with a PC or other serial source of traffic to send test pages or to send pages with an alias address, using the page directory facility of the unit. Using an alias as a pager address, you can combine an FC, a PC, and a generic communications terminal program, such as PROCOMM, to set up a small non-simulcasting paging system.

PURC Repeating Controller

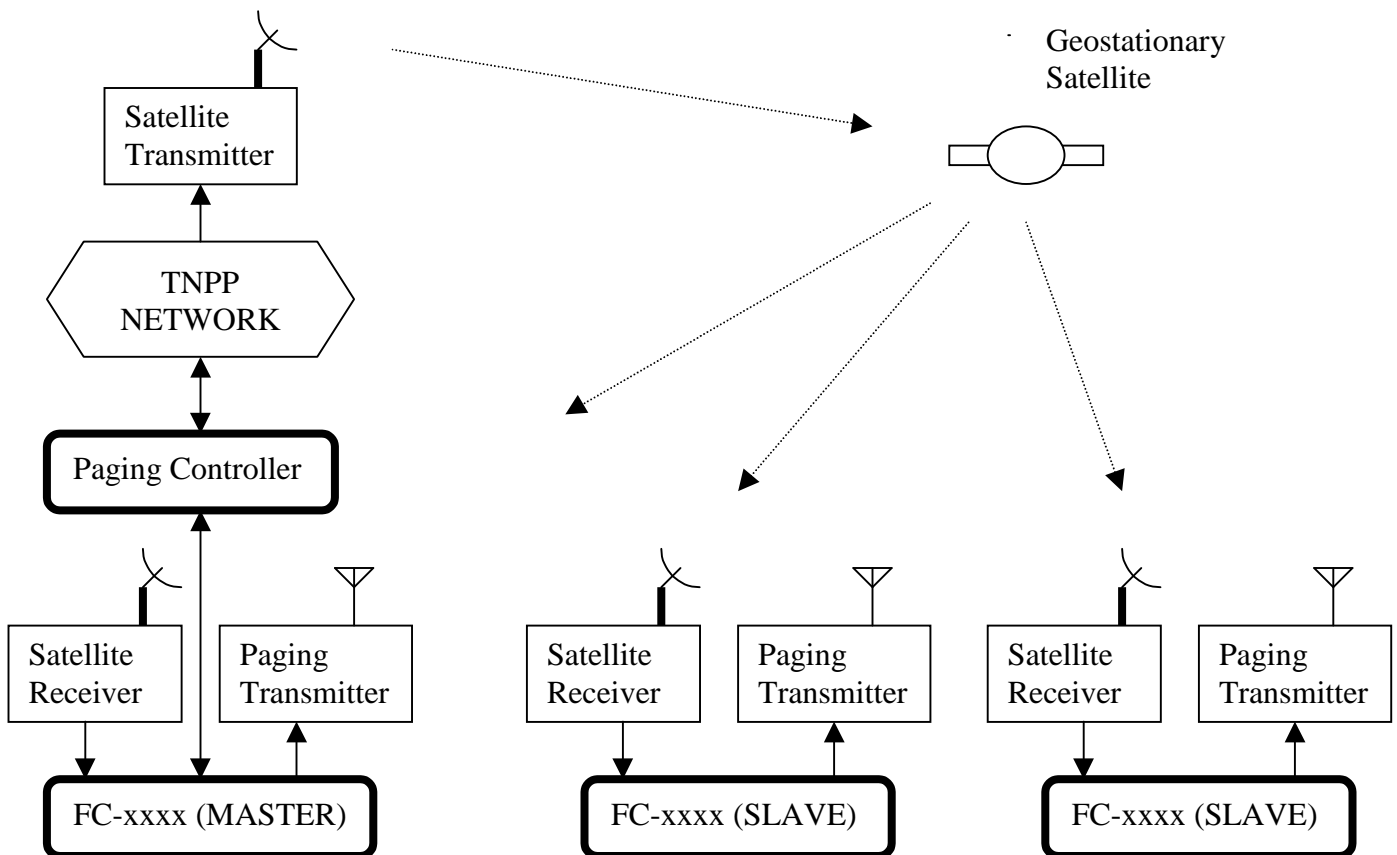
Configured as a PURC controller, an FC can receive, delay, and retransmit pages received in PURC tone format. This mode requires that an optional tone board be installed. The FC provides a digital delay and TTL/RS232 format exciter drive for simulcasting.

Master-Slave System

Introduction to the Master-Slave System

The Master-Slave (MS) system was developed by Kantronics to control the simulcasting of a group of paging stations. Kantronics MS system supports simulcasting of Golay and/or POCSAG traffic. Each MS system must contain one controller configured as a Master and situated at the paging switch, and can contain any number of controllers configured as Slaves for remote stations.

The major components of such a system are shown in the figure below: a paging terminal, transmission equipment to send pages to a satellite, the satellite, a Master ground station, and Slave stations. Each Slave station, in turn, is made up of a satellite antenna, satellite receiver, Slave transmitter controller, and paging exciter/transmitter with antenna.



The Flow of the Paging Traffic and Simulcasting Control

Pages enter the system from several sources: telephone, e-mail, and other paging terminals. These pages are encoded into The Telocator Network Paging Protocol (TNPP) format, placed in a queue, and sent to the satellite via uplink transmitters. Master and Slave stations on the ground, in turn, receive the stream of data from the geo-synchronous satellite. The data stream, often called the “downlink,” arrives at a specified rate: typically 1200, 2400, 4800 or 9600 bits per second. The uplink equipment, satellite transponder, and downlink equipment – consisting of a dish and satellite receiver – do not modify the TNPP data stream; they simply deliver it to the controllers. The controllers receive pages in TNPP format, store them in a modified form, and transmit like-kind batches under the timing control of the Master controller at the central site.

The Master Does Several Things to Control the Simulcasting of the Pages:

- *It receives pages from the satellite as do all the Slaves,*
- *It rejects pages whose TNPP destination address does not match one in its table of acceptable addresses, the TNPPDEST table,*
- *It stores pages addressed to it in a page buffer,*
- *In response to the first of a new batch of acceptable pages, it generates a “transmit” command, abbreviated XMT, and sends that command to the paging switch,*
- *It waits for the XMT to return via the satellite path,*
- *It then starts sending the oldest page in its buffer and others of like-kind.*

For example, suppose that the oldest un-sent page is a 512 baud POCSAG page. The controllers will then send that page and all other 512s it can find in the buffer. It will then look for the oldest page of another kind. Most often that would be a 1200 baud POCSAG page, and so on.

The XMT command divides pages received at the Master and Slaves into batches for retransmission on the paging channel. It also is used by the controllers at these stations to know when to start transmitting. In this way all stations start together and have an equal number and type of pages to transmit. In effect, the pages are transmitted simultaneously, i.e. simulcasted.

Algorithms for batching like-kind pages can be pretty complex. This is the job of the controllers, and each must run an identical program in order to have the system simulcast successfully.

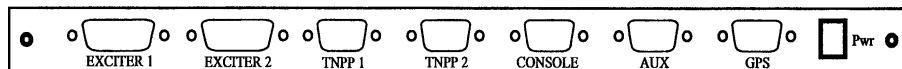
Installation/Cabling

To install any FC controller as a Master or Slave, you'll need to purchase or make up five cables. These cables will attach to the controller back panel shown below. Fortunately, you can use common-type molded cables for most of these connections. These cables are required:

1. **Power (12VDC)**
2. **Serial "NULL" for Computer Laptop**
3. **TNPP Input**
4. **TNPP Output (Master only)**
5. **Exciter Output**

FC controller Back Panel

Please note the connectors for exciter ports 1 and 2 are DB-15 female. Pin 1 of these connectors is at the upper right, looking at the back panel. The TNPP1, TNPP2, CONSOLE, and AUX ports are DB-9 male. Pin 1 of these connectors is at the upper left. The GPS port is a DB-15 male. The power jack is male.



Power Connection

Power is supplied to the unit via the "POWER" jack at the far right. Use a DC supply with a voltage in the range of +12 VDC to +18VDC capable of delivering 200 ma. Use the supplied green male two-position screw-terminal plug. Attach the positive lead from the supply to the right-hand terminal, and attach the ground lead to the left-hand terminal. Leave the power off until you have fully cabled the unit.

Auxiliary Port

This port is reserved for future use.

Console Port

To program the FC controller with your PC or laptop, you'll need an RS-232 NULL MODEM cable or a standard serial cable and a NULL MODEM ADAPTER. The NULL cable is required since the transmit and receive lines in the console port are reversed to accommodate the attachment of a modem (for remote supervision/maintenance). The pin-outs for the DB-9M console connector are listed in the appendix.

TNPP Inputs and Outputs

As a Slave remote station transmitter controller, the FC controller receives pages in TNPP format via TNPP Port 1.

Input data can come from any communications channel capable of delivering ASCII characters: satellite receiver, telephone line, or control link receiver. The TNPP data must be delivered in RS-232 format (8, N, 1) with a baud rate of 1200, 2400, 4800, 9600, or 19,2000. The FC controllers will accept any one of these rates, configured using the TBAUD command discussed later.

Satellite Delivery of TNPP

If your sites are to receive their TNPP feed via a satellite receiver, then a three-wire cable is sufficient to deliver this data to the FC controller. You'll have to make up at least one end of this cable. The fastest and easiest way to make up the cable is to purchase a molded DB-9F to DB-9F cable and cut it in half. You'll then attach a connector at the cut end to accommodate the satellite receiver pin-outs.

All connections from your satellite receiver go to TNPP Port 1 of the controller. We have used the SPACECOM M2000 satellite receiver to illustrate the necessary connections; other receiver brand pin-outs may vary. Please note "pin function" for determining connection to those receivers.

Cable Pin-Out Chart: Satellite to TNPP Port 1

FC controller DB-9M Pin Numbers	FC-2000 Pin Name	Function	Pins on Satellite Receiver, e.g. M2000
Pin 2	RxD	Satellite Data	M2000 pin 3
Pin 1	RxC	Satellite Clock	M2000 pin 9
Pin 6	TxC	Satellite Clock	M2000 pin 9
Pin 5	Ground	Ground	M2000 pin 5

TNPP Output Cable

(required only for the Master controller)

As a Master controller, the FC receives pages in TNPP format via TNPP Port 1, the same as if it was a Slave, and generates control packets via TNPP Port 2. Hence cable the satellite receiver to the Master as if it were a Slave (see table above), and ALSO wire a two-wire cable from Port 2 of the Master to your paging terminal as noted below.

Cable Pin-Out Chart: Master TNPP Port 2 to paging terminal TNPP Input

FC-xxxx TNPP Port 2 DB-9M pin numbers	Pin Name	Function	Paging Terminal
Pin 3	TxD	TNPP transmit data	A TNPP input port
Pin 2 (full dup option)	RxD	TNPP receive acks	A TNPP input port
Pin 5	Ground	Ground	Ground

As a Master, the FC controller automatically sends a TNPP system reset and TNPP “XMT” commands to itself and the Slave units via the backhaul path to the satellite. These commands are used to synchronize the Master and Slaves for simulcasting of Golay and POCSAG pages. The FC generates these commands at pin 3 of its TNPP Port 2 as shown above.

Exciter Port 1

All connections to the exciter or paging transmitter are made via the DB-15F connector at Exciter Port 1. For Golay and/or POCSAG transmissions, a three-wire cable is sufficient for most exciters/transmitters. The FC controller presents push-to-talk as an open-drain FET, requiring a pull-up resistor within the exciter’s input port. The format of the controller data output is jumper selectable as TTL or RS-232. If TTL is selected, the output circuitry is again an open-drain FET, requiring a pull-up resistor for this pin within the exciter’s input port. Most exciters/transmitters designed specifically for paging service include resistor pull-ups for these functions.

In the rare case where the pull-ups are not present within the exciter but TTL signal levels are required, FC circuit boards with rev number 1-500-3 or above have pads to attach internal resistor pull-ups to +5 VDC. See the “Positive Pull-Ups” appendix for details.

To make the FC to Exciter cable, these connections are required:

- Push-to-talk (open drain)
- Data (open drain or RS-232, jumper option)
- Ground

Cable Pin-Out Chart: FC to Exciter

FC-xxxx Exciter Port 1 DB-15 pin numbers	Pin Name	Function	Exciter Connections
Pin 1	PTT	Push-to-talk	As per exciter
Pin 5	TxD1A	DATA 2-level	As per exciter
Pin 15 or 9	Ground	Ground	As per exciter

CAUTION: If you are using a two-way radio (with flat audio) for an exciter, instead of an exciter designed explicitly for paging with built in deviation control and filtering, an attenuator and filter for the TTL output is required but is not provided or available from Kantronics. Drive level should be limited and conditioned so that transmitter deviation is not excessive.

Cabling/Interconnection Plans For These And Other Exciters/Transmitters Are Included In The Appendices:

- **Glenayre DSP Exciter 8500**
- **Glenayre 3T99B4**
- **PURC 5000 ASC exciter**
- **Sonik PTX-150**
- **Sonik DPT-series**

Configuring an FC controller for Master-Slave service

All three FC controllers - FC-2000, FC-2500, and FC-3000 - may be configured - that is, programmed - for service in a Master-Slave system as a Master or a Slave. Generally, you'll want to tailor the controller with these key parameters/commands:

Configuring the ports:

XCITER	to set the number of channels used per exciter port
TBAUD	to set the baud rate of the TNPP ports
BLIND	to set TNPP ports for blind or acknowledgement mode
TNPPDEST	to enter a list of allowable TNPP destination addresses
SIMSRC	to set the source address of the Master
SIMDST	to set the destination address of the Master
SIMFREQ	to set the satellite receiver clock frequency to lock to

Setting Timing:

TXDELAY	to set transmitter key-up delay
PAGEMAX	to set the maximum time for a page transmission in seconds
HOLDOFF	to set the time to hold off after a page transmission in seconds
SIMPLY	to set the simulcast delay for this remote site
BUSYTIME	to set a timeout for dumping pages

Setting Other Parameters:

CWID	to set the occurrence rate of a CW ID
CWIDTEXT	to set the STATION ID letters sent during CW ID.
PAGEXINV	to invert the paging channel signal if required.
PAGEBAUD	to set page types you wish to transmit: GOLAY and/or POCSAG
MAXALPHA	to set the maximum number of characters for alpha pages
MAXNUMER	to set the maximum number of characters for numeric pages

Setting ID for Remote Programming:

CMDTAG	to set the address for remote programming the controller
--------	--

Setting the Mode of Operation:

INTERFACE	to configure the unit for Master-Slave mode
-----------	---

Additional commands are available to tailor your system further. See the Command Reference in the Appendix for detail on all of the commands available.

Installing Parameters

Follow these steps:

STEP #1: Turn the FC Controller On.

Apply power.

STEP #2: Establish Communication Between Your PC and the FC Controller

With a NULL MODEM cable attached between the controller's CONSOLE PORT and your PC or laptop, you are ready to configure the unit. You'll need a communications terminal program running in your computer. We suggest using PROCOMM PLUS or HyperTerminal (Windows 9x). Configure the communications port (com X) of your PC or laptop for 19,200 baud (or another rate if you like) with an N, 8, 1 format.

Start at this rate with your laptop software. If you receive unreadable characters, then the unit is already set at another rate or was not set at the factory. Try hitting the "*" key at the top of your keyboard first, to set the baud rate. If this doesn't work, then the unit is set to another rate. Try 9600, 4800, and so on.

If you cannot establish communication, perform a hardware reset. Turn the unit off, remove the top of the chassis, place jumper J10 (located right behind the DATA IN LEDs) on both posts, and turn the unit back on. Wait a few seconds. Then turn the unit off, place the jumper at J10 on just one post (off), and turn the power back on. Then hit the "*" key to lock the controller to the rate of your communications software. Replace the top cover.

STEP #3: Configuring the Transmitter Exciter Ports.

In most cases, the controller will be configured to drive one exciter using one channel, and this is the default setting for the XCITER parameter. For this configuration, you don't have to program anything. However, the controller is capable of handling up to a total of four paging channels via its two exciter ports. Refer to the command appendix and the "Using Multiple Exciters" appendix for details if you wish to configure the controller for more than one channel.

STEP #4: Setting the Baud Rate of the TNPP Ports.

To set the baud rate of TNPP Ports 1 and 2, use the TBAUD command. The generic format is as follows:

```
cmd: TBAUD n/m . <enter>
```

The **(cmd:)** is displayed by convention and not meant to be part of the command line entry

(where n and m are the baud rates for port 1 and 2 respectively)

TNPP port 1 (TNPP1) is used to receive the paging traffic. You'll set the rate of this port to match the rate of data from your satellite feed or control

link. If you are configuring for a Master, you'll set a baud rate for both ports. See the **Command Reference** in the appendix for more detail.

Examples:

To configure a Slave to receive traffic at Port 1 at 9600 baud, enter the following:

```
cmd: TBAUD 9600 <enter>
```

To configure a Master to receive traffic at Port 1 at 9600 and send XMT commands to the paging terminal at 1200 baud via Port 2, enter the following:

```
cmd: TBAUD 9600/1200 <enter>
```

For Master/Slave simulcasting, you will generally want to use the clock from the satellite receiver for ongoing timing calibration. Setting TBAUD to 0 specifies using the satellite clock, which must be connected to TNPP port 1.

STEP #5: Setting the TNPP Protocol

TNPP channels can be one-way (blind) or two-way (full). When blind, the channel is receive only. When full, the receipt of a TNPP packet is acknowledged by the other end, and traffic can be two-way. The BLIND command is used to set the TNPP Ports of the controller as receive only, i.e. one-way and blind, or as full. The ports are defaulted as blind.

If a Slave FC controller is to receive its TNPP traffic from a satellite feed, then Port 1 must be set to receive only, i.e. blind. BLIND set to ON means blind; BLIND set to off means full. As a Slave, TNPP Port 2 need not be specified; its default is blind. Enter the command this way to configure your Slave:

```
cmd: BLIND ON <enter>
```

To configure the controller as a Master, you may wish to set TNPP Port 2 as blind or full. This is the port cabled to the paging terminal. If set full, the Master will "see" acknowledgments coming back from the paging terminal. Set the protocol as follows:

```
cmd: BLIND ON/OFF <enter>
```

What are we doing here? We've configured TNPP Port 1 as blind, i.e. receive only from the satellite and Port 2 as full.

STEP #6: Installing TNPP Destination Addresses

A controller will accept for paging only those TNPP formatted pages that contain an address that matches an entry in the controller's table of destination addresses. Hence, you can tailor your system to accept some addresses and not others. In this way, you can share a satellite channel with another provider and also zone your own system.

Use the TNPPDEST command to set the TNPP destination addresses in the controller. For example, suppose you want to accept these hex addresses: A801, 0801, and 1250. Enter the following:

```
cmd: TNPPDEST A801 0801 1250 <enter>
```

Note: All FC controllers default ON for TNPP parity and serial number checking. If you wish to turn these parameters off, refer to TNPPCRC and TNPPSER in the Command Reference in the Appendix.

STEP #7: Setting the Master Source and Destination addresses:

Use the simulcasting source and destination commands (SIMSRC and SIMDST) to set the simulcasting source and destination addresses in your Master and Slave controllers. SIMSRC must have a non-zero value. Both Masters and Slaves require the SIMSRC be set with the (same) source address. This address must be one that can be routed through your paging terminal and system that routes TNPP control packets to your system data feed (such as via a satellite feed).

Example:

```
cmd: SIMSRC A100 <enter>
```

Use SIMDST to enter the destination address of the TNPP command packets sent by the Master. SIMDST does not need to be in the TNPPDEST list but must be non-zero. SIMDST is the "group" address of your system of Slaves and the Master.

Example:

```
cmd: SIMDST 1152 <enter>
```

STEP #8: Setting the SIMFREQ Parameter:

CAUTION: If the clocks of a batch of Slaves are not locked to a common reference signal, such as the clock from the satellite receiver, their crystals will drift relative to each other. That means simulcasting will suffer if batch transmissions exceed a minute or so.

If you are going to lock the clock of the controller to the data clock of the satellite receiver, – recommended in a Master-Slave simulcasting system - then enter a value for SIMFREQ. This value may vary by satellite receiver brand and model. For Spacecom M2000 receivers, the data clock should be 1.0147 times the baud rate on channel. For example, if your SAT feed is 2400 baud, then enter 2435.28 for SIMFREQ:

cmd: **SIMFREQ 2435.28** <enter>

If you don't wish to lock the clock to the SAT receiver clock – perhaps your SAT receiver doesn't have or provide an accurate clock - then leave SIMFREQ at its default of 0.

If you are running only FC controllers in your Master-Slave system – no KPC-2000 units – and you have a Time Gate installed at the teleport site to feed your Slaves and SIMFREQ is set to zero, then you may wish to lock the controller clocks to the TNPP time packet included with the TNPP traffic. In this case, enter the following:

cmd: **TIMESRC [time source address]** <enter>

This is a good alternative when your satellite receiver or system does not support an accurate common clock.

STEP #9: Configuring Allowable Page Formats

All FC controllers are capable of encoding and sending Golay and all speeds of POCSAG. You can limit the formats to be transmitted, listing them with the PAGEBAUD command. For example, say you just want 512 bps POCSAG and no Golay. Then enter:

cmd: **PAGEBAUD 512** <enter>

The default for PAGEBAUD is 512, 1200, and 2400 POCSAG.

STEP #10: Configuring Transmitter Up/Down Time

Use the TXDELAY command to modify your transmitter key-up time. The default is 300 milliseconds (30 x 10 ms). Enter the following to obtain one-half second (500 ms):

cmd: **TXDELAY 50** <enter>

Use the TXTAIL command to modify the transmitter key release time. The default is 60 milliseconds (6 x 10 ms) of tone after the last data is sent to the transmitter.

STEP #11: Setting the Maximum Time to Page per Transmission Cycle

The controller does not have a command/parameter to set a “batch period” but instead batches on the fly. This scheme generally results in more pages being sent on average per minute.

Use the PAGEMAX command to set the maximum duration for each page transmission. The default value is 30 seconds. The range of this parameter is from 0 to 255 seconds. For example, to set a maximum time to 60 seconds, enter the following:

cmd: **PAGEMAX 60** <enter>

STEP #12: Setting A Hold Off Time.

The HOLDOFF command tells the controller to hold off paging for X seconds after each transmission is completed. Setting too low a holdoff value may result in wasting airtime, i.e. sending too many preambles. It may be better to wait a bit between transmissions to accumulate a number of pages that can be packed into a batch efficiently. Setting PAGEMAX to 60 and HOLDOFF to 20 works well on high traffic networks where the channel is shared. To set HOLDOFF to 20 enter:

cmd: **HOLDOFF 20** <enter>

STEP #13: Setting the Maximum Length of an Alpha Page.

With the advent of e-mail paging, you may want to increase or limit the length of your alpha pages. The controller defaults maximum length to 128. You may increase the allowed length up to 4,000 characters.

To set the limit on alpha pages to 500, for example, enter the following:

cmd: **MAXALPHA 500** <enter>

STEP #14: Inverting the Paging Channel Signal

Use the **PAGEXINV** command if you need to invert the polarity of your paging signal. If turned on, Golay and POCSAG will both be inverted. To invert enter

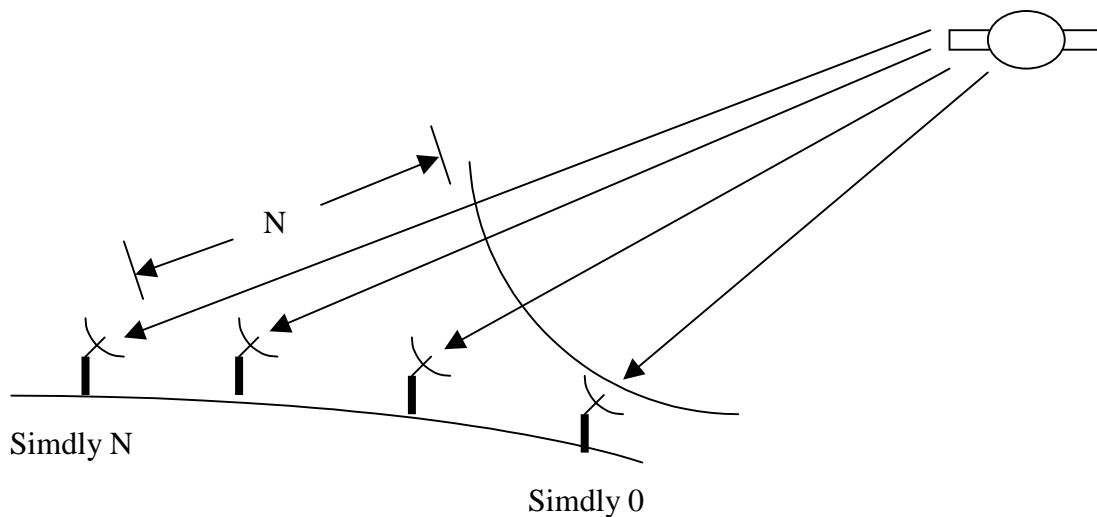
cmd: **PAGEXINV ON** <enter>

STEP #15: Configuring A Simulcasting Delay

If you plan to simulcast, you'll want to enter a simulcast delay for each Slave controller. Assuming a Master-Slave system that is fed by satellite, you'll want to enter the smallest delay for the Slave closest to the satellite and the largest delay for the Slave furthest from the satellite. For example, the Slave closest to the satellite could have a **SIMDLY** of 0; if another Slave is 15 miles further from the satellite, its **SIMDLY** would be 15. Your satellite provider should have a spread sheet program that will calculate the delays (in miles) from the satellite to a Slave station, given the satellite name and the latitude and longitude of your station.

Use the **SIMDLY** command to enter the delay in miles. For example, if you wish to have a unit delay 10 miles (5.3 usec/mile – 53 microseconds), then enter 10 miles:

cmd: **SIMDLY 10** <enter>



STEP #16: Entering Timeouts:

Timeouts must be established for the Master and Slave controllers to decide when to dump or abort pages if the system malfunctions. Procedures taken once the timeouts are reached are designed to restore the system to proper operation.

A “busy” timer is established for systems that must share a channel with another provider. If a second system (provider) fails to give the first system access after “N” minutes, the first system marks as aborted all accumulated pages. Once the system regains access, any new pages will be transmitted.

Two “simulcasting” timers are established: one for the Master and another time period for the Slaves. If XMT commands sent by the Master fail to reach the Master and Slaves (via the satellite backhaul path) after Master and Slave periods specified, the controllers will dump their pages on channel.

BUSYTIME:

When the Master controller has a page to transmit but the channel is busy, a Busy Timer is started. If the timer times out before the channel becomes available, any pages accumulated for that channel are marked as aborted. In addition, the Master sends out a BSYn command, via the backhaul channel, to all Slaves. Upon receiving the command, the Slaves also mark as aborted any pages accumulated in their buffers. Once the system recovers, new pages will push out any pages marked as aborted, thereby maintaining a sufficient paging buffer.

The default time for BUSYTIME is ten minutes. We recommend using this default. Use the BUSYTIME command to increase or decrease this timeout period for your system.

SIMTIME Timeout:

If the controller is operating as a Slave or a Master and does not receive a XMT command for a given duration, it will dump/transmit the pages it has accumulated on channel. The default periods for a Master and Slave are ten and 255 seconds respectively. We suggest that you start with these values.

Use the SIMTIME command to change from the defaults. For example, to change to 20 seconds timeout for the Master and 200 seconds for a Slave, enter the following:

```
cmd:SIMTIME 20/200 <enter>
```

STEP #17: Setting CW ID

Use the CWID and CWIDTEXT commands to configure each controller for transmitting a CW ID. For example, enter the CWIDTEXT and CWID interval as follows:

```
cmd: CWIDTEXT TX449 <enter>
```

```
cmd: CWID 10 <enter>
```

These settings will cause the unit to send a CW ID every ten minutes with the text “TX449.”

STEP #18: Use the CALIBRAT Command to Check TX Deviation

You may use the CALIBRAT command to assist you in checking exciter deviation. The CALIBRAT command gives you a number of baud rate choices to send a “COMMA” stream – alternating ones and zeros. PTT is also activated. The comma will be sent until you hit the “X” key. Simply type **CALIBRAT** and follow the screen prompts.

STEP #19: Changing Controller Parameters/Modes Remotely

After your controllers are installed at their remote sites, you can still update their parameters or update their firmware code from your paging switch site. In some situations, this may save you a few trips to these sites! To enable you to do this, you must program a command tag (CMDTAG) identification number into each controller. If you don’t enter a CMDTAG ID, you cannot perform remote programming. **SO DO IT NOW!**

The CMDTAG ID is a seven digit number. Use the first three digits to identify your system, as opposed to someone else’s that might be sharing your satellite feed. Use the last four digits to give each controller an individual identity. For example, let’s give your system the digits 111. Also, let’s assume you have two remotes, and we’ll give them addresses of 0001 and 0002.

So, to program the first controller, giving it a CMDTAG of 1110001, enter the following:

```
cmd: CMDTAG 1110001 <enter>
```

To program the second controller, giving it a CMDTAG of 1110002, enter the following:

```
cmd: CMDTAG 1110002 <enter>
```

When you are ready to program these controllers remotely, or if you are curious now, see the procedures outlined in the chapter titled OVER THE AIR PROGRAMMING. Keep in mind that you can send commands to all or individual controllers using this method.

STEP #20: Setting Mode of Operation

The last command you'll enter to configure the unit as a Master or a Slave in the Master-Slave system is the INTERFACE command. Enter the following to set the controller as a Slave:

```
cmd: INTERFACE SLAVE <enter>
```

Enter the following to set the unit as a Master:

```
cmd: INTERFACE MASTER <enter>
```

Operating the Controllers

During operation, i.e., when moving paging traffic, each FC-controller will be in a particular mode of operation. For example, if used in a Master-Slave system, a remote station controller will be in SLAVE mode. If used in a SYNSIM system, each remote station controller will be in SYNSIM mode.

While an FC-controller is passing traffic, you may check its status via its CONSOLE port. This port is independent of the TNPP and EXCITER ports. Simply attach a NULL MODEM cable between your laptop and the CONSOLE port and use PROCOMM or a similar communications terminal program to check the controller's status or issue commands.

For example, you may wish to see if traffic is backed up, i.e. delayed. Use the STATUS command to see how many pages are in the buffer, or use the PAGELOG command to list all or part of the pagelog.

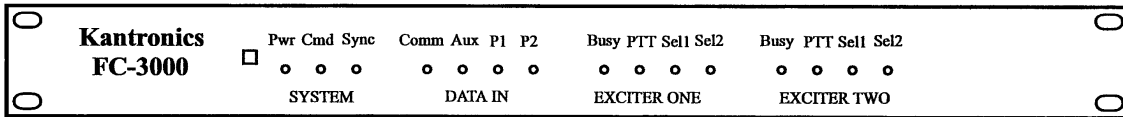
CAUTION: Avoid listing the whole pagelog. Once filled up it is lengthy and will take several minutes to scroll by on your PC screen! Entering another command, or just a carriage return, will stop the listing. Limit the number of pages you'd like to inspect by using the pagelog's "list" directive. For example, ask for a listing of the last twenty pages as follows:

cmd: **PAGELOG LIST 20** <enter>

In short form, for the same effect, enter the following:

cmd: **PAGEL 20** <enter>

For more detail on this command and others used during operation, look at the Commands Reference, found in the appendix.



Front Panel LEDs in Master Slave mode

The front panel houses the power switch and nineteen LEDs, divided into four groups:

- SYSTEM
- DATA IN
- EXCITER ONE
- EXCITER TWO

Some of the LEDs have no function when the controller is running in Master-Slave mode as noted below.

SYSTEM LEDs "Pwr, Cmd," and "Sync" are active in Master-Slave mode. Pwr denotes that the controller has power. "Cmd" indicates that the controller, if a Master, has sent out a command. The LED goes off when the command is acknowledged. Sync indicates that the clock of the controller is locked in step with either the clock output of the satellite receiver or with GPS time. The time source is chosen, using either the SIMFREQ or SIMTIME command.

The DATA IN LEDs denote data activity at the inputs of the console (Comm), auxiliary (Aux), TNPP 1 (P1), and TNPP2 (P2) ports. When a remote is installed and processing traffic, P1 is the only active port. If you attach a PC to the console port, you'll see data coming into that port on the Comm LED. The AUX port is currently reserved for use so there is no LED activity for the AUX LED.

The LEDs on the two exciter ports are identical in function. Generally, the push-to-talk (PTT) LED is the only one active. PTT is ON whenever the push-to-talk (PTT) line goes active.

The "Busy" and "Error" LEDs are inactive in Master-Slave mode. The select LEDs, "Sel1" and "Sel2," are active only if multiple TX channels have been configured. For example, if you specified two channels of operation with the XCITER command, "sel2" would be ON when the second channel is selected for transmission of pages. The select LEDs mirror the activity of the select output lines that are used to switch the TX channel of the exciter(s). The "mode" LED is active if the "mode" output controller line is active and required to operate an exciter.

Mixing FC and KPC-2000 controllers

FC and KPC-2000 controllers may be mixed in a Master-Slave system. However, since the FC series of controllers feature an advanced "batching" algorithm for Golay and POCSAG, it is necessary that the firmware PROM of KPC-2000 units, designed and produced earlier, be replaced with a newer version to include this feature. Two new commands have been added also, RESYNC and WARMUP. See the Command Reference in this manual for details.

The KPC-2000 has been discontinued with the advent of the FC series controllers. The bottom line is that if you wish to mix KPC-2000 and FC controllers within the same simulcasting system, then you must update the firmware in your KPC-2000s installed in the field. Any of the FC series controllers can be mixed with KPC-2000s given that the system is to run in Master-Slave mode. A KPC-2000 or an FC controller may be used as the Master and/or a Slave.

SUGGESTION: If you are adding FC controllers to an existing KPC-2000 based Master-Slave system, we highly recommend that you replace the KPC-2000 Master at the central site with an FC controller configured as the Master.

All FC controllers can encode "remote commands," a feature not included in the older KPC-2000. Through the use of the remote command feature, you can reconfigure parameters in remote Slave units over-the-air (OTA). FC controllers, when configured as a Master only, allow you to enter FC commands via the console port – with a laptop, and the FC encodes these commands in TNPP COMMAND format for insertion into the outgoing TNPP port traffic stream along with Master XMT commands.

The format of the FC remote command is as follows:

REMCMD <cmdtag> <remote command>

For example, to include A801 as an additional TNPP destination address in all Slaves with a system address (cmdtag) of 111, enter the following:

cmd: **REMCMD 1110000 TNPPDEST +A801 <enter>**

See CMDTAG and REMCMD in the commands appendix for more detail. The REMCMD command is a feature of the FC series of controllers, not in the KPC-2000, and is accessible only in Master mode.

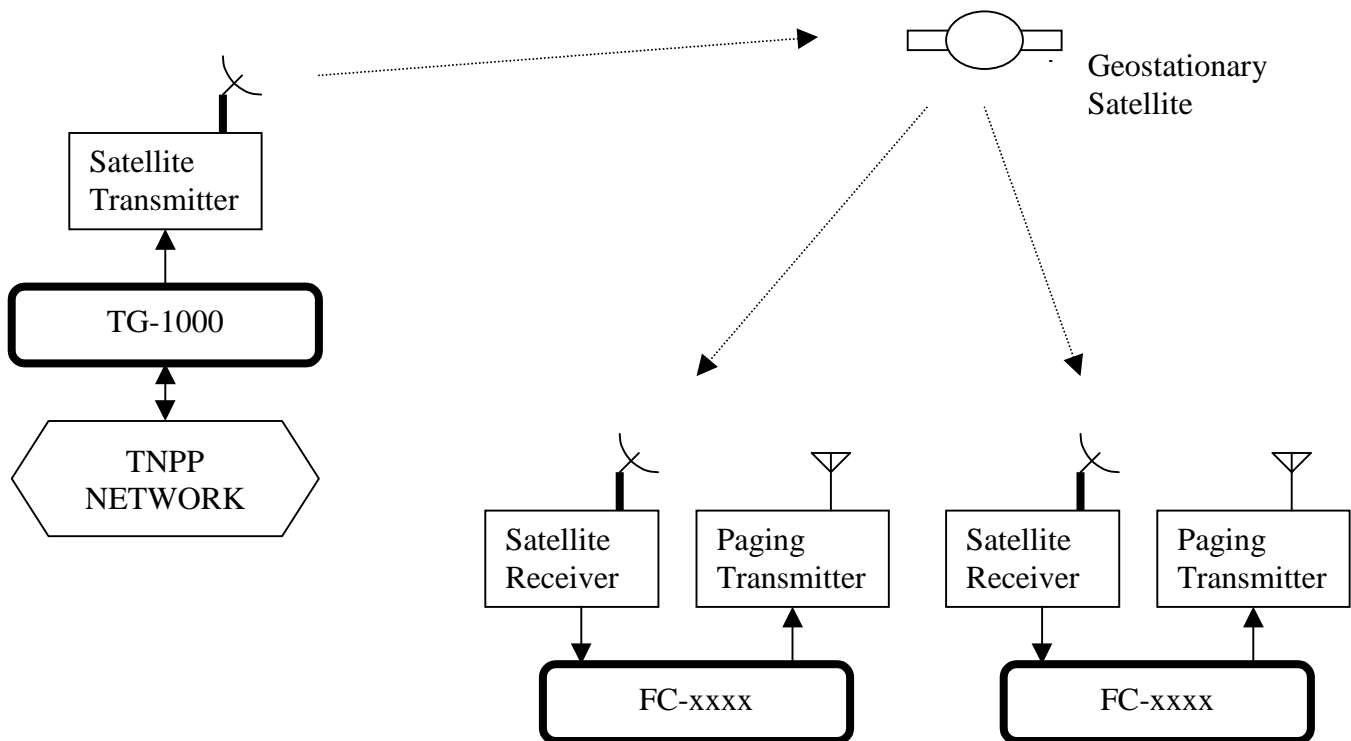
SYNSIM System

What is the Synchronous Simulcasting System (SYNSIM)?

It is the operating system developed by Kantronics to control the simulcasting of groups of FC series transmitter controllers. SYNSIM can be used for Golay/POCSAG operation with any combination of FC series controllers. SYNSIM also supports a combination of Golay, POCSAG, and FLEX paging with the FC-2500 and FC-3000 controllers. The FC-2500 supports 1600 FLEX, while the FC-3000 supports 1600, 3200, and 6400 FLEX.

A SYNSIM system must consist of a Time Gate 1000 (TG-1000) at a satellite teleport site (or at a control channel central site) and may have any number of FC controllers located at remote station sites. System timing is established by the TG-1000, which inserts accurate GPS-based time packets into the TNPP stream.

The major components of a SYNSIM System are shown in the figure below: a paging terminal, a TG-1000, transmission equipment to send pages to a satellite, the satellite, a master ground station, and any number of remote stations. Each remote station, in turn, is made up of a satellite antenna, a satellite receiver, remote transmitter controller, and paging exciter/transmitter with antenna.



The flow of paging traffic and simulcasting control

Pages can enter the system from several sources: telephone, e-mail, and other paging terminals. These pages are encoded by the paging switch into The Telocator Network Paging Protocol (TNPP) format, placed in a queue, and sent to the teleport by internet or direct phone line means. At the teleport, these pages are merged with a periodic comprehensive time packet by the TG-1000 and then sent to the satellite via uplink transmitters. The TG-1000 obtains the time packet from a Palisades or Acutime 2000 GPS smart antenna also installed at the teleport site. The GPS device establishes accurate system wide timing.

Remote stations on the ground, in turn, receive the stream of data from the geo-synchronous satellite. The data stream, often called the “downlink,” arrives at a specified rate: typically 1200, 2400, 4800 or 9600 bits per second. The uplink equipment, TG-1000, satellite transponder, and downlink equipment – consisting of a dish and satellite receiver – do not modify the TNPP pages and time packets in the data stream; they simply deliver them to the controllers. The controllers use the time packets as a time reference; that is, their clocks are locked to the satellite clock. The controllers also store the pages, received in TNPP format, in a modified form and transmit like-kind batches based on a 4-minute cycle established within each controller. A Master at the central site is optional since it is not involved in the flow and transmission of pages but can be used for over-the-air (OTA) programming of parameters and updating FLASH firmware. OTA operations are described in a separate chapter.

What does each remote station do with the stream of TNPP pages?

- It rejects pages whose TNPP addresses do not match those in its table of acceptable addresses, the TNPPDEST table,
- It stores pages addressed to it in a page buffer,
- It transmits these pages based on in internal 4-minute clock.

For example, take the case where the system is configured to support Golay and POCSAG pages only. It will always transmit the oldest and like pages first; that is, if it is transmitting 512 pages it will transmit them all and then look for the oldest page of another kind in the buffer. If that page is GOLAY, it will send those. The batching algorithm is a bit more complex than that, but you get the idea.

Suppose the system is configured for 1600 FLEX in addition to POCSAG. The algorithm for batching like-kind pages that includes FLEX in the mix is more complex. In simplified terms, the controller will transmit FLEX pages it has at the top of the minute and then send POCSAG pages for the remainder of the minute. How often FLEX pages are sent during the 4-minute cycle depends upon parameters set for the system.

In effect, all controllers must run an identical program in order to have the system simulcast successfully.

Restrictions and other factors

In order for a SYNSIM system to work properly, the TG-1000 must be connected directly to the uplink transmitter. Also, the satellite system must not insert any variable delays between the TG-1000 and the remote FCs; in other words, there must be a fixed delay between the time the TNPP time packets leave the TG-1000 and arrive at the FCs.

Although SYNSIM is based on the 4 minute FLEX cycle, SYNSIM can be used with just Golay and POCSAG traffic.

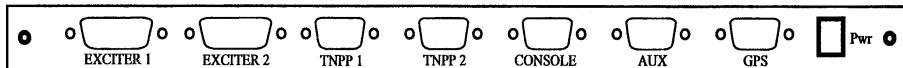
If you are sharing a satellite channel of TNPP traffic with another provider, you can both make use of the TG-1000 installed at the teleport site. In addition, just one GPS Smart Antenna is required for SYNSIM operation at the teleport site, driving more than one TG-1000

Installation/cabling

To install any FC controller as a remote in a SYNSIM system, you'll need to purchase or make up four cables. These cables will attach to the controller back panel shown below. Fortunately, you can use molded cables for most of these connections. These cables are required:

- Power
- Serial "NULL" for Computer Laptop
- TNPP Input
- Exciter Output

FC controller back panel



The connectors for exciter ports 1 and 2 are DB-15 females, with pin 1 at the upper right of each, looking at the back panel. The TNPP1, TNPP2, CONSOLE, AND AUX ports are DB-9 male, with Pin 1 of these connectors at the upper left. The GPS port is a DB-15 male, with Pin 1 at the upper right also. The power jack is male, with the left Pin assigned to ground. .

POWER CONNECTION

Power is supplied to the unit via the “POWER” jack at the far right. Use a DC supply with a voltage in the range of +12 VDC to +18 VDC capable of delivering 200 ma. Use the supplied green male two-position screw-terminal. Attach the positive lead from the supply to the right-hand terminal, and attach the ground lead to the left-hand terminal. Leave the power off until you have fully cabled the unit.

AUXILIARY PORT

This port is reserved for future use.

CONSOLE PORT

To program the FC controller with your PC or laptop, you’ll need an RS-232 NULL MODEM cable or a standard serial cable and a NULL MODEM ADAPTER. The NULL cable is required since the transmit and receive lines in the console port are reversed to accommodate the attachment of a modem (for remote supervision/maintenance). The pin-outs for the DB-9M console connector are listed in the appendix.

TNPP INPUTS

As a remote station transmitter controller, the FC receives pages in TNPP format via TNPP Port 1.

Input data can come from any communications channel capable of delivering ASCII characters: satellite receiver, telephone line, or control link receiver. The TNPP data must be delivered in RS-232 format (8, N, 1) with a baud rate of 1200, 2400, 4800, 9600, or 19,2000. The FC controllers will accept any one of these rates, configured using the TBAUD command discussed later.

Satellite Delivery of TNPP

If your sites are to receive their TNPP feed via a satellite receiver, then a two-wire cable is sufficient to deliver these data to the FC controller. You’ll have to make up at least one end of this cable. The fastest and easiest way to make up the cable is to purchase a molded DB-9F to DB-9F cable and cut it in half. You’ll then attach a connector at the cut end to accommodate the satellite receiver pin-outs.

All connections from your satellite receiver go to TNPP Port 1 of the controller. We have used the SPACECOM M2000 satellite receiver to illustrate the necessary connections; other receiver brand pin-outs may vary. Please note “pin function” for determining connection to those receivers.

CABLE: Satellite to TNPP Port 1

FC controller DB-9M Pin Numbers TNPP Port 1	FC-2000 Pin Name	Function	Pins on Satellite Receiver, e.g. M2000
Pin 2	RxD	Satellite Data	M2000 pin 3
Pin 1	RxC	Satellite Clock	M2000 pin 9
Pin 5	Ground	Ground	M2000 pin 5

All connections to the exciter or paging transmitter are made via the DB-15F connector at Exciter Port 1. For Golay, POCSAG, and 1600 FLEX transmissions, a three-wire cable is sufficient for most exciters/transmitters. A second data line is required for 3200 or 6400 FLEX. The FC controller presents push-to-talk as an open-drain FET, requiring a pull-up resistor within the exciter’s input port. The format of the controller data output is jumper selectable as TTL or RS-232. If TTL is selected, the output circuitry is again an open-drain FET, requiring a pull-up resistor for this pin within the exciter’s input port. Most exciters/transmitters designed specifically for paging service include resistor pull-ups for these functions.

In the rare case where the pull-ups are not present within the exciter but TTL signal levels are required, FC circuit boards with REV Number 1-500-3 or above have pads to attach internal resistor pull-ups to +5 VDC. See the “Positive Pull-Ups” appendix for details.

If you plan to run 4-level FLEX, connect the second data line listed below. In addition, your exciter designed for 4-level FLEX may require a transmit data clock.

To make the FC to Exciter cable for Golay, POCSAG, and 2-level FLEX, these connections are required:

- Push-to-talk (open drain)
- Data (open drain or RS-232, jumper option)
- Ground

CABLE: FC to Exciter for Golay, POCSAG, and 2-Level FLEX

FC-xxxx Exciter Port 1 DB-15F pin numbers	Pin Name	Function	Exciter Connections
Pin 1	PTT	Push-to-talk	As per exciter
Pin 5	TxD1A	DATA 2-level	As per exciter
Pin 15 or 9	Ground	Ground	As per exciter

CAUTION: If you are using a two-way radio (with flat audio) for an exciter, instead of an exciter designed explicitly for paging with built in deviation control and filtering, an attenuator and filter for the TTL output is required but is not provided or available from Kantronics. Drive level should be limited and conditioned so that transmitter deviation is not excessive.

To make the FC to Exciter cable for 4-level FLEX or for exciters/transmitters requiring a data clock, these connections are required:

- Push-to-talk (open drain)
- Data Low (open drain or RS-232, jumper option)
- Data High (open drain or RS-232, jumper option)
- Data Clock (optional)
- Ground

CABLE: FC to Exciter for 4-Level FLEX and/or Golay/POCSAG

FC-2000 DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	Exciter Connections
Pin 1	PTT	Push-to-talk	As per exciter
Pin 5	TxD1A	Data Low	As per exciter
Pin 6	TxD1B	Data High	As per exciter
Pin 13	CLK	Tx Data Clock	As per exciter
Pin 15 or 9	Ground	Ground	As per exciter

Cabling/interconnection plans for these and other exciters/transmitters are included in the Appendices:

- Glenayre DSP Exciter 8500
- Glenayre 3T99B4
- PURC 5000 ASC exciter
- Sonik PTX-150
- Sonik DPT-series

Configuring an FC controller for SYNSIM service

All three FC controllers - FC-2000, FC-2500, and FC-3000 - may be configured - that is programmed - for service in a SYNSIM system. Generally, you'll want to tailor each controller with these key parameters/commands:

Configuring the ports:

XCITER	to set the number of channels used per exciter port
TBAUD	to set the baud rate of the TNPP ports
BLIND	to set the TNPP protocol mode per TNPP port
TNPPDEST	to enter a list of allowable TNPP destination addresses
TIMESRC	to set the address of the time gate source
SIMSRC	to set the system source address for over-the-air programming
SIMDST	to set the system destination address for OTA programming

Setting Timing:

TXDELAY	to set transmitter key-up delay
GPSDELAY	to set the simulcasting delay
SIMTIME	to set a timeout to dump pages
SYSCLLPS	to set the FLEX system collapse value

Setting Other Parameters:

CWID	to set the occurrence rate of a CW ID
CWIDTEXT	to set the STATION ID letters sent during CW ID.
PAGEXINV	to invert the paging channel signal if required.
PAGEBAUD	to set page types you wish to transmit: FLEX, GOLAY, POCSAG
MAXALPHA	to set the maximum number of characters for alpha pages
MAXNUMER	to set the maximum number of characters for numeric pages

Setting ID for Remote Programming:

CMDTAG	to set the address for remote programming
--------	---

Setting the Mode of Operation:

INTERFACE	to configure the unit as a SYNSIM remote
-----------	--

Additional commands are available to tailor your system further. See the Command Reference in the appendix for detail on all of the commands available.

Installing Parameters

Follow these steps:

STEP #1: Turn the FC Controller On.

Apply power.

STEP #2: Establish Communication Between Your PC and the FC Controller

With a NULL MODEM cable attached between the controller's CONSOLE PORT and your PC or laptop, you are ready to configure the unit. You'll need a communications terminal program running in your computer. We suggest using PROCOMM PLUS or HyperTerminal (Windows 9x). Configure the communications (comm) port of your PC or laptop for 19,200 baud (or another rate if you like) with an N, 8, 1 format.

Start at this rate with your laptop software. If you receive unreadable characters, then the unit is already set at another rate or was not set at the factory. Try hitting the "*" key at the top of your keyboard first, to set the baud rate. If this doesn't work, then the unit is set to another rate. Try 9600, 4800, and so on.

If you cannot establish communication, **perform a hardware reset**. Turn the unit off, remove the top of the chassis, place jumper J10 (located right behind the DATA IN LEDs) on both posts, and turn the unit back on. Wait a few seconds. Then turn the unit off, place the jumper at J10 on just one post (off), and turn the power back on. Then hit the "*" key to lock the controller to the rate of your communications software. Replace the top cover.

STEP #3: Configuring the Transmitter Exciter Ports.

In most cases, the controller will be configured to drive one exciter using one channel, and this is the default setting for the XCITER parameter. For this configuration, you don't have to program anything. However, the controller is capable of handling up to a total of four paging channels via its two exciter ports. Refer to the Command appendix and the Using Multiple Exciters appendix for details if you wish to configure the controller for more than one channel.

STEP #4: Setting the Baud Rate of the TNPP Ports.

To set the baud rate of TNPP Ports 1 and 2, use the TBAUD command. The generic format is as follows:

cmd: **TBAUD n/m <enter>**

The **(cmd:)** is displayed by convention and not meant to be part of the command line entry

where n and m are the baud rates for port 1 and 2 respectively.

TNPP port 1 (TNPP1) is used to receive the paging traffic. You'll set the rate of this port to match the rate of data from your satellite feed or control. See the Command Reference in the appendix for more detail.

To configure a SYNSIM remote to receive traffic at Port 1 at 9600 baud, enter the following:

cmd: **TBAUD 9600...<enter>**

You will generally want to use the clock from the satellite receiver for ongoing timing calibration, especially if the satellite baud rate is less than 9600. Setting TBAUD to 0 specifies using the satellite clock, which must be connected to TNPP port 1.

STEP #5: Setting the TNPP Protocol

TNPP channels can be one-way (blind) or two-way (full). When blind, the channel is receive-only. When full, the receipt of a TNPP packet is acknowledged by the other end, and traffic can be two-way. The BLIND command is used to set the TNPP Ports of the controller as receive only, i.e. one-way and blind, or as full. The ports are defaulted as blind.

If a remote FC controller is to receive its TNPP traffic from a satellite feed, then Port 1 must be set to receive-only, i.e. set BLIND to ON, which is the default for this parameter. As a remote, TNPP Port 2 need not be specified.

cmd: **BLIND ON...<enter>**

STEP #6: Installing TNPP Destination Addresses

A controller will accept for transmission only those TNPP formatted pages that contain a destination address that matches an entry in the controller's table of destination addresses. Hence, you can tailor your system to accept

some addresses and not others. In this way, you can share a satellite channel with another provider and also zone your own system.

Use the TNPPDEST command to set the TNPP destination addresses. For example, suppose you want to accept these hex addresses: A801, 0801, and 1250. Enter the following:

```
cmd: TNPPDEST A801 0801 1250...<enter>
```

Note: All FC controllers default ON for TNPP frame parity and serial number checking. If you wish to turn these parameters off, refer to TNPPCRC and TNPPSER in the Command Reference in the Appendix.

STEP #7: Setting the Time Source Address

You must enter a time source address for all remotes in a SYNSIM system. Use the TIMESRC command to set the address of the time source (the TG-1000 at the teleport uplink site). For example, if the TG-1000 for your system has an address of 1122, enter the same for each remote controller:

```
cmd: TIMESRC 1122 <enter>
```

STEP #8: Setting Master Source and Destination addresses for OTA Programming:

You'll want to set these addresses in your remote stations if you plan to use the remote programming features of the SYNSIM system: updating individual parameters for one or all remotes, and upgrading the firmware program running in each remote. The details on over-the-air (OTA) programming are presented in a separate chapter of this manual. An additional FC controller is required for OTA and it must be configured as a Master and located at your paging switch site.

Use the SIMSRC and SIMDST commands to store Master source and destination addresses in the controller. The SIMSRC must be the same as that entered in the Master located at the paging switch. In addition, this address must be one that can be routed through your paging terminal and system that routes TNPP control packets to your system data feed (such as via a satellite feed).

```
Example: cmd: SIMSRC A100 <enter>
```

Use SIMDST to enter the destination address of the TNPP packets sent by the Master. SIMDST does not need to be in the TNPPDEST list but must be non-zero. SIMDST is the “group” address of your system of remotes.

Example: cmd: **SIMDST 1152** <enter>

STEP #9: Configuring Transmitter Up Time

Use the TXDELAY command to modify your transmitter key-up time. The default is 300 milliseconds (30 x 10 ms). Enter the following to obtain one-half second (500 ms):

cmd: **TXDELAY 50** <enter>

STEP #10: Setting Simulcasting Delay in a SYNSIM System

Use the GPSDELAY command to enter the time delay in microseconds from the uplink site to a remote station site. This delay can be estimated or measured. To measure it for a particular remote station location, you’ll need to take the controller and a Palisades or Acutime 2000 GPS Smart Antenna to that site. At the site, use the CALIBRAT command to obtain the delay in microseconds. This delay will then be entered in the controller you’ll place at that site, use the GPSDELAY noted above.

Suppose the CALIBRAT command gave you a value of 250000 usec (1/4 second). Enter this value in the GPSDELAY as follows:

cmd: **GPSDELAY 250000** <enter>

A specific delay example. The delay from Spacecom’s teleport to a remote in Lawrence, KS was measured to be 252,494 usec. The particular channel used Telstar 5.

STEP #11: Setting the FLEX System Collapse Value

Use the SYSCLLPS command to enter the FLEX system collapse value, 0 to 7. For a value of 4, you’d enter the following:

cmd: **SYSCLLPS 4** <enter>

For systems where Golay and POCSAG carry a majority of the traffic, enter a low value, such as 0 or 1. All remotes in the system must have this value. A low value will force FLEX pagers to listen for their pages more

often and leave more time allotted for Golay and POCSAG pagers during each minute.

STEP #12: Setting a Timeout to Dump Pages

An FC configured as a remote and placed in a SYNSIM system will transmit (dump) its pages if it does not receive a time packet for a given period of time. Use the SIMTIME command to set this timeout period. For example, if you wish to time out in two minutes, having not received a time packet via the satellite feed during that period, enter the following:

cmd: **SIMTIME /120 <enter>**

Note SIMTIME has two parameters. The first, x/, is only used if the controller is configured for a Master-Slave system as the Master. As a SYNSIM remote, enter the timeout value as shown above, i.e. with the "/" first.

STEP #13: Setting the Maximum Length of an Alpha Page.

With the advent of e-mail paging, you may want to increase or limit the length of alpha pages. The controller defaults maximum length to 128. You may increase the allowed length up to 4,000 characters.

To set the limit on alpha pages to 500 characters, enter the following:

cmd: **MAXALPHA 500 <enter>**

STEP #14: Inverting the Paging Channel Signal

Use the PAGEXINV command if you need to invert the polarity of your paging signal. If turned on, Golay, POCSAG, and FLEX will all be inverted. To invert enter

cmd: **PAGEXINV ON <enter>**

STEP #15: Configuring Allowable Page Formats

All FC controllers are capable of encoding and sending Golay and all speeds of POCSAG. You can limit the formats to be transmitted, listing only those you wish to send with the PAGEBAUD command. For

example, say you require just 512 bps POCSAG and no Golay. Then enter:

cmd: **PAGEBAUD 512** <enter>

The default for PAGEBAUD is 512, 1200, and 2400 POCSAG.

The FC-2500 and FC-3000 controllers feature FLEX encoding as well. The FC-2500 can send only 1600 FLEX. For these controllers, again, use the PAGEBAUD command to list which pages you wish to enable. For example, say you want to send just 1600 FLEX and 1200 POCSAG. Enter the following:

cmd: **PAGEBAUD 1200 FLEX16** <enter>

STEP #16: Setting CW ID and CWIDTEXT

Use the CWID and CWIDTEXT commands to configure each controller for transmitting a CW ID. For example, enter the CWIDTEXT and CWID interval as follows:

cmd: **CWIDTEXT TX449** <enter>

cmd: **CWID 10** <enter>

These settings will cause the unit to send a CW ID every ten minutes with the text "TX449."

STEP #17: Channel Sharing

If you have full access to the radio channel, SYNSHARE should be set to ALL. If you are sharing a radio channel, you must set SYNSHARE so that you can only transmit during the times allotted to you. SYNSHARE uses the 128 1.875 second frames defined in FLEX, even if you are not using FLEX. To have access to every other minute, starting at the top of the hour, you would set SYNSHARE as follows:

cmd: **SYNSHARE 0-31,64-95** <enter>

To have access to every other 30 seconds, starting at 30 seconds after the top of the hour:

cmd: **SYNSHARE 16-31,48-63,80-95,112-127** <enter>

If you are using FLEX, SYNSHARE must include several frames at the beginning of each minute. A radio channel cannot be shared by two FLEX providers.

STEP #18: Changing Controller Parameters/Modes Remotely

After your controllers are installed at their remote sites, you can still update their parameters or update their firmware code from your paging switch site. In some situations, this may save you a few trips to these sites! To enable you to do this, you must program a command tag (CMDTAG) identification number into each controller. If you don't enter a CMDTAG ID, you cannot perform remote programming. **SO DO IT NOW!**

The CMDTAG ID is a seven digit number. Use the first three digits to identify your system, as opposed to someone else's that might be sharing your satellite feed. Use the last four digits to give each controller an individual identity. For example, let's give your system the digits 111. Also, let's assume you have two remotes, and we'll give them addresses of 0001 and 0002.

So, to program the first controller, giving it a CMDTAG of 1110001, enter the following:

```
cmd: CMDTAG 1110001 <enter>
```

To program the second controller, giving it a CMDTAG of 1110002, enter the following:

```
cmd: CMDTAG 1110002 <enter>
```

When you are ready to program these controllers remotely, or if you are curious now, see the procedures outlined in the chapter titled **OVER THE AIR PROGRAMMING**. Keep in mind that you can send commands to all or individual controllers using this method.

STEP #19: Setting Mode of Operation

The last step in configuring your controller is to put it in its mode of operation. To set the mode of operation of the controller, i.e. to configure it as a remote within a SYNSIM system, enter the following:

```
cmd: INTERFACE SYNSIM <enter>
```

Operating a SYNSIM system

During operation, i.e., when moving paging traffic, each FC-controller will be in a particular mode of operation. For example, if used in a Master-Slave system, a remote station controller will be in SLAVE mode. If used in a SYNSIM system, each remote station controller will be in SYNSIM mode.

While an FC-controller is passing traffic, you may check its status via its CONSOLE port. This port is independent of the TNPP and EXCITER ports. Simply attach a NULL MODEM cable between your laptop serial port and the FC CONSOLE port and use PROCOMM or a similar communications terminal program to check the controller's status or issue commands.

For example, you may wish to see if traffic is backed up, i.e. delayed. Use the STATUS command to see how many pages are in the buffer, or use the PAGELOG command to list all or part of the pagelog.

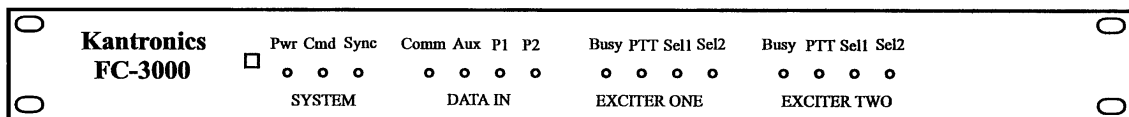
CAUTION: Avoid listing the whole pagelog. Once filled up it is lengthy and will take several minutes to scroll by on your PC screen! Entering another command, or just a carriage return, will stop the listing. Limit the number of pages you'd like to inspect by using the pagelog's "list" directive. For example, ask for a listing of the last twenty pages as follows:

```
cmd: PAGELOG LIST 20 <enter>
```

In short form, for the same effect, enter the following:

```
cmd: PAGEL 20 <enter>
```

For more detail on this command and others used during operation, look at the Commands Reference, found in the appendix.



Front Panel LEDs in SYNSIM mode

The front panel houses the power switch and nineteen LEDs, divided into four groups:

- SYSTEM

- DATA IN
- EXCITER ONE
- EXCITER TWO

Some of the LEDS have no function when the controller is running in SYNSIM mode as noted below.

SYSTEM LEDs “Pwr” and “Sync” are active in SYNSIM mode. Pwr denotes that the controller has power. Sync reports that the clock of the controller is locked in step with GPS time. If this LED is out, the controller’s crystal clock is not in sync with the GPS time received as reported by the TG-1000 at the teleport site.

The DATA IN LEDs denote data activity at the inputs of the console (Comm), auxiliary (Aux), TNPP1 (P1), and TNPP2 (P2) ports. When a remote is installed and processing traffic, P1 is the only active port. If you attach a PC to the console port, the Comm LED will indicate data coming into that port.

The LEDS on the two exciter ports are identical in function. Generally, the push-to-talk (PTT) LED is the only one active. PTT is ON whenever the push-to-talk line is active.

The “Busy” and “Error” LEDs are inactive in SYNSIM mode The select LEDS, “Sel1” and “Sel2,” are active only if multiple TX channels have been configured. For example, if you specified two channels of operation with the XCITER command, “Sel2” would be ON when the second channel is selected for transmission of pages. The select LEDs mirror the activity of the select output lines that are used to switch the TX channel of the exciter(s). The “Mode” LED and the “Mode” output line are active during FLEX transmissions.

NON-SIMULCASTING SYSTEMS

In the first two chapters, we've shown how the FC family of controllers can be used in a Master-Slave (MS) system or in a synchronous simulcasting (SYNSIM) system, both invented by Kantronics for simulcasting. In addition, you've seen that a FC controller is configured as a Slave for an MS system or as a remote for a SYNSIM system using the INTFACE command.

The INTFACE command offers two additional modes of operation: TNPP and PAGER.

In TNPP mode, the FC controller stands alone; that is, no attempt is made to simulcast with any other controllers. TNPP traffic entering the controller is transmitted on demand, subject to PAGEMAX, HOLDOFF, and the other commands in the controller. FLEX is also supported, assuming you are installing a FC-2500 or FC-3000.

A unique feature of the TNPP mode is that both TNPP Ports can be used to receive traffic. Thus, you could - among other applications - combine your traffic with that of another provider for transmission into a non-simulcasting area. You'd feed your traffic into TNPP Port 1; your partner would feed his traffic into TNPP PORT 2.

If you choose to install an FC-controller in TNPP mode, use the installation steps called out for in the MASTER-SLAVE SYSTEM chapter. Of course, in the final install step, you'll use TNPP rather than SLAVE as the INT parameter. That is, enter the following for the INTface command:

```
cmd: INTFACE TNPP <enter>
```

In Pager mode, you can use the controller to send test pages, To send a test page, use the PAGE command. For example, to send a 1200 baud POCSAG numeric page to capcode 0010001 enter the following:

```
cmd: PAGE 0010001 1234567 <enter>
```

For more details, see the PAGE command syntax in the Command Reference in the appendix.

In Pager mode, the FC controller may also be set up as a small private paging system, with paging directory, when combined with a terminal or computer. Pages may be sent, using the PAGE command, and a directory of alias names can be set up, including pager parameters and capcodes.

For example, a list of employees could be entered. Within this list the details of each employee's pager are stored, including capcode. The operator may then page an employee in the list simply by typing that person's name and following it with a message. For example, at the command prompt, you'd type the following:

cmd: **PAGEID BOB Hey Bob, Call the office right away. <enter>**

The controller looks up Bob's pager details in its Page Directory, including the capcode, collects the message, forms up a POCSAG page, and delivers it to the transmitter port.

For more information on the use of pager mode, see these commands in the Commands Reference in the appendix: PAGEDIR, PAGEID, PAGE.

If you choose to install an FC controller as a stand alone paging system, use the install steps called for in the MASTER-SLAVE SYSTEM chapter for the transmitter portion of the installation. At the input side of the system, you'd simply use your computer to feed page commands to the CONSOLE port.

Tone Control System

INTRODUCTION

The FC-2000, FC-2500, or FC-3000 may be installed in a tone control system as a station controller if the TONE OPTION BOARD is installed. The option board decodes control tones, keys or de-selects the controller, and demodulates paging data received in Bell 202 (dual-tone) format. The controller's only functions in this mode of operation are to delay the paging data for simulcasting and to provide push-to-talk (PTT) for the exciter/transmitter.

CAUTION: Your control link radio system must provide solid communications, i.e. full quieting FM, for the system to work well.

The "TONE CONTROL OPTION" for the FC series controllers is a plug-in circuit board, enabling (PURC) tone control of a paging station. Data-Only (Binary-Only) tone control is supported, as described in Motorola's Simulcasting System Controller (SSC) Manual, 68P81063E15-O. **Voice (analog) or mixed voice-data operation is not supported.** For reference, a listing of the audio control frequencies may be found at the end of this chapter.

The option board is 3.4 inches by 3.2 inches and installs internally in the controller, plugging into accessory jumper J19 (adjacent to exciter port 1). Power is obtained via jumper J19 from the main board. Current draw is < 10 ma at +5VDC. The board includes a modem for the reception of the Bell 202 paging tones, analog circuitry for the detection of the control tone frequencies, and a micro-controller unit (MCU). The MCU is used to gate the pages, provide proper timing, provide push-to-talk (PTT), and acts as a watchdog timer.

INSTALLATION AND OPERATION

When using a FC-2000, FC-2500, or FC-3000 as a TONE-BASED TRANSMITTER CONTROLLER, only the exciter port and the power port are cabled. The TONE OPTION BOARD must, of course, be installed, and the controller placed in TONE mode. While in TONE mode, the TNPP ports of the FC controller are not used. Even though the TONE OPTION BOARD is installed, the FC controller may be switched to any of its other modes of operation: TNPP, MASTER, SLAVE, etc.

The console port is temporarily used for installing parameters such as transmitter up time and simulcasting delay, and for placing the unit in TONE mode.

You will complete these steps to install and configure the controller for tone-based operation:

- Install the option board (if not already plugged into the FC circuit board)
- Set the option board dip-switches (if zoning/de-selection desired)
- Prepare cabling
- Link receiver to exciter port 2 cable
- Exciter port 1 to transmitter exciter cable
- Power cable
- Use a NULL modem cable between your PC and the console port to program parameters
- Enter parameters to configure the controller, using a terminal program such as PROCOMM PLUS (DOS) or HyperTerminal (Windows 9x).
- Bench test the unit
- Place it in service

Installing the Tone Option Board

Remove the cover of the controller (two screws, right and left sides).

Orient the controller so that the back panel is facing you. Note that there is a ten position header at the far left, labeled J19.

Plug the connector on the bottom of the option board into J19 such that the dip switch on the top of the option board is nearest the front panel of the controller. Note that the standoff on the option board should line up with a pad on the controller board.

Setting the Dipswitches

If you plan to transmit all pages received, i.e. to not de-select the paging station by tone addressing (for zoning), place the DIP- SWITCHES in their default positions.

View the 8-position dipswitch from the back (panel) of the unit. Switch # 1 is nearest the front panel; switch # 8, which is not used, is nearest the back panel. “R,” or to the right, is equivalent to a “0.” “L,” or left, is equivalent to a “1.” The default positions for the switches are from # 1 through # 7: RRLLLLR, or 0001110.

Note that in any event, switch “1” must be in the “0” or right-hand position (as viewed from the back of the unit). When set to the left, the unit will be in TEST mode as described later in this chapter.

If you plan to zone your installation, i.e. use tones to de-select stations with a particular station identification, then you’ll want to assign a STATION ID to the option board. Setting dipswitches 2 through 7 does this. Only one ID number (of 30 possible) may be assigned. Make the assignment based on the Station Number Table listed below. For more detail, see the Table of Tone Frequencies in the appendix.

Setting Exciter Port 2 Jumpers

Make sure J17 is set to open (no pins connected)

Station Number Selection and Dipswitch Settings.

Again, viewing the unit from the back, pushing a switch to the Left programs a “1.” Pushing a switch to the Right programs a “0.” Switch # 1, nearest the front panel, must be to the right (a “0”) for the unit to be in tone control mode.

Station Number Selection Table

Station Number (Transmitter)	DIP SW setting 1-7	DIP SW Setting 1-7
Default	0 00 1111	R RR LLLL
1	0 01 0001	R RL RRRL
2	0 01 0010	R RL RRLR
3	0 01 0011	R RL RRLR
4	0 01 0100	R RL RLRR
5	0 01 0101	R RL RLRL
6	0 01 0110	R RL RLLR
7	0 01 0111	R RL RLLL
8	0 01 1000	R RL LRRR
9	0 01 1001	R RL LRRL
10	0 10 1010	R RL LRLR
11	0 10 0001	R LR RRRL
12	0 10 0010	R LR RRLR
13	0 10 0011	R LR RRLR
14	0 10 0100	R LR RLRR
15	0 10 0101	R LR RLRL
16	0 10 0110	R LR RLLR
17	0 10 0111	R LR RLLL
18	0 10 1000	R LR LRRR
19	0 10 1001	R LR LRRL

20	0 10 1010	R LR LRLR
21	0 11 0001	R LL RRRL
22	0 11 0010	R LL RRLR
23	0 11 0011	R LL RRLR
24	0 11 0100	R LL RLRR
25	0 11 0101	R LL RLRL
26	0 11 0110	R LL RLLR
27	0 11 0111	R LL RLLL
28	0 11 1000	R LL LRRR
29	0 11 1001	R LL LRRL
30	0 11 1010	R LL LRLR

AUDIO INPUT CABLE: Link Receiver to Exciter Port 2 Cable (two-wire)

This cable will supply link receiver audio and ground to exciter port 2 of the controller. In TONE MODE, exciter port 2 is the INPUT PORT.

Link Receiver	From-To	FC Exciter Port 2	Pin Number
Speaker or discriminator audio	TO	Audio Input/TXD2A	Pin 5
Ground	TO	Ground	Pin 9

CONTROLLER TO TRANSMITTER CABLE: Exciter port 1 to Transmitter Exciter (three wire)

This cable supplies push-to-talk, paging data, and ground for the exciter. Note that both the PTT and DATA lines are OPEN-DRAIN and require pull-up resistors at the exciter for proper operation. These signals are digital and TTL in format, i.e. high is typically +5 to 8 volts, low is ground. RS-232 feed is jumper selectable if your exciter needs that format.

Most exciters have pull-ups as standard. If your exciter can accept a TTL signal but does not have pull-ups in its input circuitry, pads exist on the controller board to add pull-ups (only on boards at rev number 3 or later).

If an analog drive is required, you'll have to fashion an adapter to convert the TTL data (or RS-232 data, optionally by jumper) to the analog level required. CAUTION: you'll need to filter and limit the drive so that your RF emissions meet paging channel standards. This is your responsibility, not ours.

CABLE: Controller to Transmitter

FC-Exciter Port 1	Pin Number	From-To	Exciter

PTT (open drain)	Pin 1	TO	PTT
DATA (open drain)	Pin 5	TO	DATA
Ground	Pin 9	TO	Ground

Power Cable:

Power for the option board is supplied by the FC-2000/2500 via jumper J19. Refer to the FC-200/2500 User’s Manual for providing power to the FC-2000/2500.

CONFIGURING PARAMETERS IN THE CONTROLLER

A comprehensive list of all commands is available in the Commands Reference in the Appendix. You’ll use a terminal or computer running a commercial terminal program (such as PROCOMM PLUS) to program the parameters you’ll need to run the controller with the TONE OPTION BOARD in TONE MODE.

REMINDER: The console port of the controller requires a NULL MODEM adapter and accepts a DB-9 female connector.

In most cases for tone control operation, the only parameters you’ll have to change are the simulcast delay and the mode of operation. These are set using the SIMDLY and INTFACE commands. If simulcast delay is not a concern, then simply set the INTFACE command for TONE.

1. For simulcast delay, at the command prompt (cmd:) enter the following:

cmd: **SIMDLY X <enter>**
 where X is in miles, up to 255.

2. To configure the unit for TONE MODE, enter the following:

cmd: **INTFACE TONE <enter>**

Upon hitting the return key, the unit will go immediately into TONE MODE.

CAUTION: To take the unit out of TONE mode, it is necessary to enter a “RESET” command and <enter> at the console port. That is, attach your laptop or PC to the console port, type RESET in capitol letters, and then hit the return key. The controller will respond with the usual sign-on message and again provide you with a command prompt for programming/changing parameters of the controller

NOTE: Typing RESET to return the console port to command mode is only necessary when the unit has been placed in TONE mode. For all other modes of operation, the console port is always in command mode.

NOTE: If it's been some time since you've attached a PC to the console port, you may have to try different baud rates with your Comm program. The last tech may have changed the rate on you! 19,200 or 9,600 are most common.

Bench Testing before Field Installation

We highly recommend that you bench test the FC controllers with the TONE OPTION installed before installing them in the field. Include your radio link in the test. Supply the tone feed from your paging switch to the link transmitter, and feed the output of a link receiver to the controller under test. If the transmitter and receiver are nearby each other, you should do ok with a dummy load for the transmitter, or use an in-line attenuator. Your control link radio system must provide solid communications, i.e. full quieting FM, for the tone control system to work well.

Consider using the following bench setup. An alternative arrangement is listed later in this chapter, if you don't have an IFR Comm Service Monitor or equivalent.

Bench Setup:

- Use an IFR 1200A Communications Service Monitor (or similar equipment) to generate a PURC audio sequence.
- Apply the sequence from the "tone out" BNC jack to the link transmitter.
- Cable the output of the link receiver to Exciter Port 2, pin 5, of the controller (as per cable described above).
- Cable the output of the FC controller, Exciter Port 1, to another IFR, paging exciter, or oscilloscope for monitoring.
- Observe the FC front panel LEDs and exciter output for proper operation.

Example: Program the tone control sequence listed below into the IFR as follows:

Program the following tones into the IFR:

(Use the program and tone buttons to enter each tone. Follow each entry of a tone with a duration and delay for that tone, as shown in the second table below. To program duration and delay press the three keys "program-2nd function-tone" and enter the delays.)

Tone	Hertz	Action
Tone 0	0001	IFR requires tone "0" be assigned
Tone 1	2175	simulates High Level Guard Tone (HLGT)
Tone 2	1350	
Tone 3	1450	
Tone 4	1950	simulates K1 tone, calling for data
Tone 5	1200	1200/2200 tones alternating to simulate modem data
Tone 6	2200	
Tone 7	1200	

Tone 8 2200 after this tone, the generator provides no tone, just silence.

Program the time ON and DELAY for each tone into the tone sequence generator as follows:

Tone 0	0000	0000	SINE	
Tone 1	0500	0050	SINE	;500 millisecond 2175 tone
Tone 2	0050	0000	SINE	
Tone 3	0050	0000	SINE	
Tone 4	0050	0000	SINE	;key tone
Tone 5	0500	0000	SINE	;1200 tone, simulates data
Tone 6	0500	0000	SINE	
Tone 7	0500	0000	SINE	
Tone 8	0500	0000	SINE	

The first numeric column sets the duration of the tone. Column two sets a silence period following the tone.

With the tone sequence programmed, pressing “2nd Function” and then “TSEQ” on the IFR panel will transmit the sequence of tones listed above. There will be a 50 ms period of silence following the 2175 Hertz tone.

Use this sequence to check that the controller will key or not key given appropriate settings of the DIPSWITCHES. With the dip switch set to default [0001110 for switches 1 through 7], the unit transmits all pages, i.e. it does not deselect for any station ID codes. With the switches set for GROUP ONE, STATION 4 [001 0100], the unit will deselect with the tone sequence given above, since tone 1450 is included. You can test for keying or de-selection by using these two sets of dipswitch settings and the tone sequence listed above. Saying it another way, the unit will transmit with the switches set to defaults using the above sequence. The unit will not transmit with the second set of dip switch settings (station 5) using the above sequence.

LED Displays

When running an FC controller in tone mode, only four LEDs are active and used to denote action:

- PWR (power)
- ERROR2 LED,
- BUSY2 LED,
- PTT1 LED,

where the “2” in ERROR2 denotes exciter port 2, and the “1” in PTT1 denotes exciter port 1.

With the tone option board installed, tone audio entered at exciter port two, pin 5, is demodulated (Bell 202) and drives the ERROR2 LED at exciter port 2. Hence, any tone data received from a link receiver (or other means) shows up on the far right LED of the controller front panel.

Once a high-level guard tone (HLGT – 2175) and group tone one (K1 - 1950) are received, the tone option board notifies the FC controller and turns on the BUSY2 LED. The BUSY2 LED will stay lighted until the tone board times out, i.e. noting an unmodulated carrier (or lack of an audio tone) for at least 250 milliseconds. In other words, BUSY2 denoted the period during which paging data is being accepted.

The PTT LED at exciter port 1 is lighted once it receives PTT from the tone board. Hence, it will appear that BUSY2 and PTT1 go on and off together.

During tone mode, there is no TNPP activity and no LED action for the TNPP ports.

Alternate Bench Test Arrangement.

If you don't have an IFR signal generator with the tone-sequencing feature, you can still check the PURC default sequence using an audio signal generator. This test will allow you to "send" a High Level Guard Tone (HLGT) followed by a K1 (group and key PTT tone). Simply set the frequency of an audio generator at about 2,500 Hertz and then slowly reduce the frequency, passing it through 2175 and 1950. The option board will "pick up" these frequencies and then key the controller. You can watch the PTT light to note that the controller was indeed keyed. Then turn the audio generator off and the PTT LED should go off after a delay of 250 milliseconds. This denotes that a tone or modem tones have not existed for at least 250 ms.

Theory of operation

This manual is not intended as a tutorial for tone control signaling. It is a quick summary, a review if you will. Additionally, we assume that your central site generates all of the necessary "standard" (PURC) tones to control the flow of pages transmitted over a control link. The tones we consider standard are listed in the Tone Table below.

Tone Signaling Protocol.

Pages received at a remote transmitter site are not retransmitted unless that site first receives a GO signal in the form of a High Level Guard Tone (HLGT), a 2175 Hertz tone. Further, if the TONE CONTROLLER at the remote site receives a station identification that matches its ID, that station will ignore the batch of pages arriving thereafter. If that de-selection signal is not received by the station but a 1950 Hertz group tone is received, then the pages following are transmitted. Once a period of silence (carrier but no tones) exceeding 250 ms has been received, the controller de-keys the

transmitter, and no additional pages will be sent until a new HLGT starts the whole process up again.

Each controller with tone option can be assigned just one station ID number. The protocol allows for one of 30 possible station numbers. A station ID is sent using one of ten tones and one of three group tones. See the Tone Table for additional detail.

Table of Tone Signaling Frequencies

The dipswitch on the option board (U4) is used to set the station number of the controller or to set the board into its TEST mode. The dipswitches are numbered 1 to 8. Pin 1 is nearest the front edge of the board. The switches program a “1” when slid to the left (L), a “0” when to the right, as viewed from the back of the unit. Switch 1 should be set to the right for normal operation. It’s set left to put the board into its test mode. Switch 8 is not used.

The station number is determined by a group number and a tone number. Three group numbers and ten tone numbers provide for 30 possible station numbers. For example, station number 14 is programmed as group 2, or KT2, and tone 4. **The table in the install section lists DIP SW settings by station number.** These switches, except switch # 1, may be changed during power up. A change of switch # 1 will be recognized only after the next power cycle.

Dipswitch 8 is not used.

Tone Name	Frequency (Hz)	Dip Switch No(s)	Dip Switch setting	Comment
HLGT	2175	NA	NA	High Level Guard Tone
KT3	2050	2-3	11	Group three tone
KT2	1850	2-3	10	Group two tone
KT1	1950	4-7	01	Group one tone
ANY TONE		4-7	1111	
1	1750	4-7	0001	Tone numbers
2	1650	4-7	0010	
3	1550	4-7	0011	
4	1450	4-7	0100	
5	1350	4-7	0101	
6	1250	4-7	0110	
7	1150	4-7	0111	
8	1050	4-7	1000	
9	950	4-7	1001	
10	750	4-7	1010	

Test Mode

CAUTION: If you plan to test the option board while not installed in an FC controller, be sure to power it with only +5 VDC at pins one and two at the ten-pin header. Pin 1 and 2 are not connected together on the option board, so you'll need to jumper them. Additionally, provide ground to both pins 9 and 10. Pins 9 and 10 are also not connected together on the board.

Test mode may be used to check most of the operation of the option board, whether installed in an FC controller or not. The option board is put in test mode by setting dipswitch # 1 to a "1" (left) and cycling the power supplied to it.

Test mode is a quick way of checking the following:

- That the processor is running
- That the unit is properly decoding the signaling tones
- That the push-to-talk signal (to the FC controller) is operational
- That the modem chip is demodulating.

First, attach a scope probe to the PTT line, or observe the PTT LED if the board is installed in the FC controller. Then set your audio signal generator for an output of at least 200 mv pp and sweep it slowly from about 2500 Hertz to 600 Hertz. Observe the PTT line as you do. You should see it key 14 times, once for the HLGTT, once for each of the three group tones (K1-K3) and once for each of the ten station tones. This test verifies that the processor is running, the PTT line is functional, and the tone detection circuitry is working.

To check that the Bell 202 modem chip is working, attach an audio generator to the audio input of the board (at pin 8 of the header) and attach a scope to the DATA out line (at pin 4 of the header). Pin 1 of the header is top left, when viewed from the component side of the option board. The pins are numbered 1-2 for the first row, 3-4 for the second row, etc.

Alternatively, if the option board is installed in an FC controller, insert your audio signal at exciter port 2, pin 5, as outlined above. (Remember to have J17 open.)

The Bell 202 tones are 1200 and 2200 Hertz. Observe the binary output of the modem at pin 4 as you sweep your signal generator from 1200 to 2200 and back. The binary output should swing on and off as you do so.

Table of Header Pin-Outs on the TONE OPTION BOARD
(Mating Jumper J19 on the FC series controller boards)

PIN NO.	TONE OPTION PCB NAME	CONTROLLER BD NAME	USE
1	+5 VDC	+5 VDC	+5 for tone pcb digital chips
2	+5 VDC	+5 VDC	+5 for tone pcb analog circuits
3	PTT (key out)	BUSY2	PTT for mother board
4	RXD (data out)	ERROR2	Data for mother board
5		SEL2A	Future use
6		SEL2B	Future use
7		MODE2	Future use
8	RXA (audio in)	TXD2A	Audio in for tone pcb
9	GROUND	GROUND	Ground

TONE OPTION Board Specifications

Signal	Min	Nominal	Max
Board Size		3.4 by 3.2 inches	
External Supply	4.5 VDC	5.0 VDC	5.5 VDC
Supply Current		< 1 ma	
Audio Input @ 2175 Hertz	100 mv pp		2.0 v pp
Input Impedance		600 ohms	
Data Output		CMOS	
MCU oscillator Frequency		4.000 Mhz	

FAQs Frequently Asked Questions

Q1: What is a Master-Slave (MS) System ?

It is the operating system developed by Kantronics to control the simulcasting of groups of KPC-2000 transmitter controllers. Kantronics MS system supports simulcasting of Golay and/or POCSAG traffic. An MS system must contain one controller configured as a Master and may include any number of controllers configured as Slaves for the remote stations.

The Master must be placed at the paging terminal site, and its primary purpose is to generate XMT commands in TNPP format upon receiving pages via satellite or a control channel. The XMT commands are merged with TNPP traffic arriving at the paging terminal and sent – via satellite or control channel – back to the Master and the Slaves in the MS system. The controllers use the XMT, upon reception, as a “gate” or “go” signal to initiate the transmission of pages held in their buffers. Hence, timing for this system is asynchronous, based on the arrival of paging traffic and the XMT command.

Each Slave station consists of a satellite antenna and receiver (or control link antenna and receiver), a Kantronics controller, and the exciter-transmitter.

Q2: Can I use FC-2000s in a KPC-2000 system?

Yes. Any FC series controller can emulate a KPC-2000 Master or Slave and make use of the XMT command sent by a Master just as a KPC-2000 Slave does. If you introduce FC controllers, such as the FC-2000, into a Master-Slave (MS) system, you’ll need to upgrade the KPC-2000 EPROMS. This is due to the fact that a more efficient batching algorithm was incorporated within the FC controllers, so the KPC-2000 update EPROM includes that.

Q3: What is a Synchronous Simulcasting System (SYNSIM)?

It is the operating system developed by Kantronics to control the simulcasting of groups of FC series transmitter controllers. SYNSIM can be used for Golay/POCSAG operation with any combination of FC series controllers. SYNSIM also supports a combination of Golay, POCSAG, and FLEX paging with the FC-2500 and FC-3000 controllers. The FC-2500 supports 1600 FLEX, while the FC-3000 supports 1600, 3200, and 6400 FLEX.

A SYNSIM system must contain a Time Gate 1000 at a satellite teleport site (or at a control channel central site) and may have any number of FC controllers located at remote station sites. The system uses the TG-1000 to insert accurate time packets into the TNPP stream. These packets are used to time and control the batching of pages.

Q4: Will a KPC-2000 run in a SYNSIM system?

No. However, FC-2000s can emulate a KPC-2000 and be run within a MS system.

Q5: Is the KPC-2000 upgradeable to a FC-2000?

No. The hardware does not support an upgrade.

Q6: Is the KPC-2000 upgradeable to FLEX?

No. To run FLEX traffic, you'll need to purchase an FC-2500 or FC-3000 or upgrade the base FC-2000.

Q7: Why would I want to convert my system to a SYNSIM system?

If you wish to carry FLEX traffic, then SYNSIM is required. The MS system does not support FLEX. Even if you don't wish to run FLEX, SYNSIM is more straightforward, more efficient, faster, and easier to install. With SYNSIM, a Master is not required at your paging terminal site. This means that you don't have to cable a KPC-2000 or FC-2000 Master to an TNPP input port of your paging terminal and reprogram the TNPP routing within your terminal. You must, however, install a TG-1000 at the teleport site (if using satellite delivery) or at the transmit end of your RF control link. The TG-1000 supplies very accurate GPS timing for the system.

Q8: Do I need to install my own TG-1000 at the teleport site to run SYNSIM if one is already there?

No. Only one TG-1000 should insert timing packets into any given TNPP channel. So, if you are sharing a channel of TNPP traffic with another provider, you both can make use of the same TG-1000 installed at the teleport site.

Q9: If I run SYNSIM, do I have to have a GPS device and antenna at each remote station?

No! Only one GPS Smart Antenna is required for a SYNSIM system, attached to the TG-1000.

Q10: How do I set the simulcasting delay at each remote station controller in a SYNSIM system?

Temporarily attach a GPS Smart Antenna to the GPS port of the FC-2000/FC-2500/FC-3000 at the remote site. Then issue the CALIBRAT command to the unit. The FC controller will then compare the time received at its latitude and longitude to that delivered to it in TNPP format from the TG-1000 installed at the teleport site. The difference in delay will then be displayed on your terminal, and you may use this value for GPSDELAY.

Q11: What kind of GPS antenna is required for a SYNSIM system?

Kantronics has adopted the “Palisades” or “Acutime 2000,” both manufactured by Trimble Navigation. These GPS smart antennas are off-the-shelf items from Trimble. Order them direct! Trimble has told us that the Acutime 2000 will replace the Palisades in early 2001. Both units are pin and function compatible. Check Trimble’s website, www.trimble.com, for additional information. The GPS units are titled “smart antennas” because they contain a GPS antenna, the GPS receiver, an RS-422 interface, and power regulator.

Q12: How long a cable can I use with the GPS Smart Antenna (Trimble’s Palisades or Acutime 2000)?

These units feature an RS-422 interface. Hence, you can run shielded twisted-pair cable up to 3,000 feet. This is a real necessity when your paging equipment is housed inside a large building, requiring a cable run of several hundred feet to allow the GPS device to receive un-obstructed GPS satellite signals.

Q13: How do I power the remote GPS antenna.

The unit receives its power via the GPS cable. That cable is connected to the TG-1000 or FC series controller at its GPS port, and power is supplied there.

OVER-THE-AIR (OTA) PROGRAMMING

NOTE: The following assumes that you feed your remote station controllers by satellite and that you backhaul all of your TNPP traffic via your paging switch to a satellite uplink port for delivery.

With an FC controller installed at your paging switch and connected to the TNPP network, you can reprogram parameters or update the firmware of your remote station controllers. Keep in mind that the programming is one-way via satellite and hence the programming is not verified. Most of the time things work well, but events, such as rain fades, can cause receive errors in a command or file transfer. Still, OTA programming can save trips to remote sites.

MAKING PROGRAMMING EASY

Using the remote command (REMCMD) feature of the FC, you can enter commands for remote stations as if you were entering them at their console ports. You simply enter the command at the local FC console port but include a remote station address. In addition, if you attach a satellite receiver to the local FC, you can upload new firmware for remote stations by using the UPLOAD command, include a remote station address, and enter the firmware via your PC at the console port.

Using remote programming, you can do these things among others:

- Reset one or all remote station controllers
- Update parameters in one or all controllers
- Upload a new version of firmware to one or all controllers
- Command the remotes to use the new firmware

Installing An FC At Your Paging Switch Site

Installing n FC includes cabling it to your laptop, paging switch, and satellite receiver (optional); and configuring some of its parameters to set it up for remote programming service.

Generally, four cables are required:

- Power for the FC
- Cabling from the CONSOLE port to your PC
- Cabling from TNPP PORT 2 to a TNPP input PORT on your Paging Switch
- Cabling the satellite receiver to TNPP Port 1.

Use a +12 VDC supply to power the FC.

Use a NULL MODEM cable to interconnect the FC via its CONSOLE PORT with a serial port of your PC.

Prepare a cable to go between TNPP PORT 2 of the FC and a spare TNPP input port on your paging switch. TNPP PORT 2 is a standard RS-232 DB-9M connector, configured as DTE. Pinouts for this and all ports of the FC are displayed in the appendix. Refer to your paging switch manual for TNPP input port pinouts and operation.

If you are running a Master-Slave (MS) system, as described in the MASTER-SLAVE SYSTEM chapter, then you've already installed the Master as required for remote programming. If you are running a TNPP or SYNSIM system, with no FC at the central site, install an FC configured as a Master as shown below, cabling TNPP PORT 2 of the FC to a TNPP input port of your paging switch. If you are running a TNPP or SYNSIM system with an FC at the central site, connect TNPP PORT 2 of the local FC to a TNPP input port of your paging switch.

If you wish to upload firmware to the remote stations, then include a satellite antenna and receiver at your paging switch site. Wire the satellite receiver to TNPP PORT 1 as shown below. The reason for this is that the firmware transfer program waits for an acknowledgement from itself via the backhaul path before sending another line of the firmware file. It also does some error checking. You are certain, therefore, that the file was accurately transferred, at least to the central site. This usually indicates, if you don't have a rainy day, that the file made it to the remote sites too.

TNPP Port 2 Cable

Wire a two or three-wire cable from TNPP Port 2 of the FC to your paging terminal as noted below.

CABLE: FC TNPP Port 2 to paging terminal TNPP Input

FC-xxxx TNPP Port 2	Pin Name	Function	Paging Terminal
Pin 3	TXD	TNPP transmit data	A TNPP input port
Pin 2 (if full dup TNPP)	RXD	TNPP receive data	A TNPP input port
Pin 5	Ground	Ground	Ground

Satelite Receiver To TNPP Port 1 Cable

Prepare a three-wire cable from the receiver to the port as noted below. This is the same wiring for attaching a SAT receiver to remote station controllers.

You'll have to make up at least one end of this cable. The fastest and easiest way to make up the cable is to purchase a molded DB-9F to DB-9F cable and cut it in half. You'll then attach a connector at the cut end to accommodate the satellite receiver pin-outs.

All connections from your satellite receiver go to TNPP Port 1 of the controller. We have used the SPACECOM M2000 satellite receiver to illustrate the necessary connections; other receiver brand pin-outs may vary. Please note "pin function" for determining connection to those receivers.

CABLE: Satellite to TNPP Port 1

FC-xxxx TNPP Port 1 DB-9M pin numbers	FC Pin Name	Function	Pins on Satellite Receiver
Pin 2	RxD	Satellite Data	M2000 pin 3
Pin 1	RxC	Satellite Clock	M2000 pin 9
Pin 6	RxC	Satellite Clock	M2000 pin 9
Pin 5	Ground	Ground	M2000 pin 5

Configuring The FC For Remote Programming

NOTE: Any FC model (2000, 2500, or 3000) may be used for remote programming.

The FC controller automatically sends a TNPP system reset to the page switch on power up. It also sends any remote commands to the switch in TNPP format.

In addition, firmware files for OTA uploading are sent to the switch, embedded in TNPP frames, when you UPLOAD the file, with a remote address tag (a command tag), via the console port.

As you may have noted in earlier chapters, the remotes will not accept these OTA commands or the firmware file unless their remote address, called a command tag (CMDTAG) matches that embedded within the OTA command. In addition, the system source and destination addresses within the TNPP frames must match too. Hence, you must configure the FC with the proper SIMSRC and SIMDST addresses in the following software installation steps.

Note: If you did not add CMDTAG addresses or SIMSRC and SIMDST system addresses to your remotes when you installed them, you will not be able to remotely program them with new parameters or do remote firmware updating.

You are ready to install parameters in the FC
Follow these steps:

STEP #1: Establish communication between your PC and the FC controller

Attach a NULL MODEM CABLE between the controller's CONSOLE PORT and your PC or laptop. You'll need a communications program to complete the programming. We suggest that you use PC PLUS or HyperTerminal for Windows. Configure the comm port of your PC for 19,200 baud and a format of N,8,1.

Turn on the controller. If you do not get a sign-on message, try hitting the "*" key (shift 8) at the top of your keyboard (not the right-side keypad) first, to set the baud rate of the FC. If this doesn't work, then the unit is set already to another rate. Try 9600, 4800, and so on. Once you have established communications, you may use the ABAUD command to change to a rate your prefer. See ABAUD in the Command Reference in the appendix for procedures.

STEP #2: Set the Baud Rate for TNPP Ports 1 and 2

To set the baud rates for these ports, use the TBAUD command. Match the rate required by the satellite receiver for port 1 and that required by your TNPP input port on your paging switch for port 2. Suppose the satellite uses 2400 baud and your switch is set to accept 9600. In this example, enter these rates as follows:

cmd: **TBAUD 2400/9600** <enter>

If you are using the satellite clock, set the TBAUD rate to 0:

cmd: **TBAUD 0/9600** <enter>

For details on the syntax of the TBAUD command, see the Command Reference in the appendix.

STEP #3: Set the TNPP protocol of TNPP Port 2

You don't have to set the TNPP protocol to "full" unless you want the paging switch to handshake on data you send it or unless your switch simply requires it to work. If so, use the BLIND command to switch the FC's port 2 to full. If not, make sure that your paging switch has configured the TNPP input port for blind operation, i.e. not full. See the Command Reference in the appendix for details on the BLIND command.

NOTE: TNPP channels are said to be one-way (blind) or two-way (full), loosely referring to the TNPP protocol, or handshaking, on the channel. When transmitting pages one-way on a channel, the sending station is sending blind. In other words, it doesn't know if the pages got there. When transmitting two-way, or full-duplex, the sending channel expects a receipt for its message, i.e. an acknowledgement.

STEP #4: Set the FC's system source and destination addresses.

Use SIMSRC and SIMDST to enter the FC's system source and destination addresses respectively. Each address is made up of four hexadecimal digits. For example, use DC11 for these addresses:

cmd: **SIMSRC DC11** <enter>

cmd: **SIMDST DB11** <enter>

Note: If the FC is not receiving any traffic, just being used to generate TNPP commands or send update files from your PC, there is no need to enter any TNPPDEST addresses or change the parameters of any of the traffic oriented commands here. That includes not having to enter a remote ID, a CMDTAG, for this unit, since we don't plan to send anything to it remotely!

STEP #5: Enter Master, TNPP, or SYNSIM Mode

Use the INTface command to put the FC in the desired mode. For example, enter Master mode as follows:

```
cmd: INTFACE MASTER <enter>
```

The unit will now stay in the selected mode until you return it to terminal or some other mode with the INTface command.

You may now install the FC at your paging switch.

Entering Commands

We show you below how to enter commands that are to be sent to remote units. Procedures for uploading firmware to remote units are found in Appendix F.

It is assumed in the following that you have your PC attached to the CONSOLE port of the local FC, that TNPP PORT 2 is cabled to a TNPP port of your paging switch, and that you are running a generic communications terminal program such as PROCOMM or HyperTerminal for Windows.

The command you are most likely to send to remote stations is RESET. The process is quite simple. At the cmd: prompt, enter the remote command (REMCMD), followed by a command tag address (CMDTAG) for the remote, followed by the actual command to be sent. The command to be sent must be fully spelled out and in CAPS. So, to send a RESET command, enter the following:

```
cmd: REMCMD cmdtag RESET <enter>
```

where cmdtag is a seven digit number.

If that cmdtag address is 1120001, enter the command as follows:

```
cmd: REMCMD 1120001 RESET <enter>
```

That's it. The command will be encoded in a TNPP frame, sent via the backhaul path to the satellite facility, downloaded, received by all of the remotes, decoded by just the remote with the address 1120001, which will then reset itself.

Assuming that the first three digits of the CMDTAG for all of your remotes was programmed to be 112, then enter the following to RESET all remotes:

```
cmd: REMCMD 1120000 RESET <enter>
```

The following FC commands can be executed remotely:

ABAUD	BLIND	BUSYTIME	CDINVERT	CHDELAY
CWID	CWIDTEXT	GPSDELAY	HOLDOFF	MAXALPHA
MAXNUMER	PAGEBAUD	PAGEDIR	PAGEHOLD	PAGEMAX
PAGEXINV	PDA	PFTIMER	POUND	RELOAD
RESET	RESYNCS	SELPTT	SIMPLY	SIMFREQ
SIMTIME	STAR	STATUS	SYNSHARE	TBAUD
TNPPDEST	TNPPFILT	TNPPPREF	TNPPSER	TXDELAY
TXMARGIN	TXTAIL	UPLOAD	WARMUP	

For more detail on remote programming, see REMCMD, SIMSRC, SIMDST, CMDTAG, LOAD, UPLOAD, and RELOAD in the Command Reference appendix.

Remote Status

The remote STATUS command works differently than the STATUS command at the CONSOLE port. For example, the command

cmd: **REMCMD 1124354 STATUS 43254 <enter>**

will cause the FC with CMDTAG 1124354 to send a POCSAG status page to capcode 43254 during a time when the other remotes should not be transmitting. The status page is always in POCSAG format, default alphanumeric (-A4) at 1200 bps (-1200). Baud rate and form can be changed in the command:

REMCMD cmdtag STATUS [-{A|N}{1-4}] [-{512|1200|2400}] capcode.

The status page will include the following information:

- Version. The version number of the firmware will be displayed. If a different version of the firmware has been loaded or uploaded to the FC properly, but has not started executing because of a RELOAD command or power cycle, its version number will also be displayed in brackets.
- Runtime. The runtime since the last reset is displayed.
- Pages Pending. The total number of pages in the pagelog not yet sent will be displayed. If there is more than one channel, the number of pending pages for each channel will also be displayed.
- Pages Sent. The total number of pages in the pagelog that have been sent will be displayed. If there is more than one channel, the number of sent pages for each channel will also be displayed.
- Free Blocks. The number of free memory blocks is displayed.

- Battery. If the voltage of the on-board lithium memory backup battery gets low, -BAT is displayed.

Appendix A: Connectors

The FC series back panel contains these connectors, left to right:

- Exciter Port 1 (DB-15F),
- Exciter Port 2 (DB-15F),
- TNPP Port 1 (DB-9M),
- TNPP Port 2 (DB-9M),
- Console Port (DB-9M),
- Auxiliary Port (DB-9M),
- GPS Port (DB-15M),
- Power Connector.

The Exciter Ports:

While there are two exciter ports, only one is active at a given time, sending paging data. Two ports are provided for convenience in cabling two transmitters. Note that all push-to-talk (PTT) and channel select lines are open-drain. That means that they will work well with the typical paging exciter that uses a TTL input and includes a pull-up resistor. Data lines 1 and 2 are provided in two formats, open drain or RS-232, jumper selectable

Note: The FC-3000 supports 4-level FSK modulation when using both data lines. If your exciter is capable of 4-level [or is in the 4 level mode] but you wish to operate 2-level and are using “TTL” inputs, strap the Data 2 pin to ground at the exciter and don’t connect it to the FC-3000.

The busy inputs on both ports are TTL inputs.

The TNPP Ports:

Both ports are full RS-232, supporting 300 to 19,200 baud.

Connect the receive clock pin of a satellite receiver to the transmit clock pin of the FC if you wish to stabilize the crystal clock of the FC series unit when operating in other than SYNSIM mode. The stability of the satellite clock is useful if you wish to page for durations longer than sixty seconds. It is not necessary to connect this clock if you plan to run in SYNSIM mode; there, stability is derived from a TNPP timing packet (from a TG-1000 at the teleport uplink site) mixed in with the regular TNPP data stream.

Console Port:

This DTE port may be used while the FC series unit is in service, enabling you to check status without going “off-line.” All signals are RS-232, and the port supports from 300 to 38,400 baud operation.

Auxiliary Port:

This port is reserved for future use.

GPS Port:

This port is used to attach a remote Palisades or Accutime Smart Antenna by Trimble to obtain a measure of satellite delay for simulcasting. See the “Measuring Satellite Delay” appendix. The signal format used is RS-422, a differential format enabling long cable runs of up to 3,000 feet. The Trimble unit provides a comprehensive timing packet and a synchronizing pulse each second.

Power Connector:

The power connector receives both ground and +12 VDC. The +12 VDC is looped through to the GPS port to provide power to the Trimble GPS receiver.

Exciter Port One: DB-15

Pin #	Signal Name	Format	Comment
1	Push-to-talk 1 (PTT1)	Open drain	
2	Select 1A	Open drain	
3	Select 1B	Open drain	
4	Mode1	Open drain	
5	Transmit Data 1A	Open drain/RS-232	Jumper select format
6	Transmit Data 1B	Open drain/RS-232	Jumper select format
7	Error1	Pull-up input	With resistor
8	Busy 1	Pull-up input	With resistor/loop-back
9	Ground		
10	Ground		
11	Ground		
12	Ground		
13	TxD2B	Open drain/RS-232	From port 2 loop back
14	Ground		
15	Ground		

Exciter Port Two: DB-15

Pin #	Signal Name	Format	Comment
1	Push-to-talk 2 (PTT2)	Open drain	
2	Select 2A	Open drain	
3	Select 2B	Open drain	
4	Mode2	Open drain	
5	Transmit Data 2A	Open drain/RS-232	Jumper select format
6	Transmit Data 2B	Open drain/RS-232	Jumper select format
7	Error2	Pull-up input	With resistor
8	Busy 2	Pull-up input	With resistor/loop-back
9	Ground		
10	Ground		
11	Ground		
12	Ground		
13	Ground		
14	Ground		
15	Ground		

TNPP Port 1 (TNPP1):

Pin #	Signal Name	Format	Comment
1	RxCinA/CDA	RS-232	Clock in, or carrier detect
2	RxA	RS-232	Receive data
3	TxA	RS-232	Transmit data
4	TxCoutA/DTRA	RS-232	Transmit Clock Out, or data terminal ready
5	Ground		Ground
6	TxCinA/DSRA	RS-232	Transmit Clock In, or data set ready
7	RTSA	RS-232	Request to send
8	CTSA	RS-232	Clear to send
9	RIA	RS-232	Ring indicator

TNPP Port 2 (TNPP2):

Pin #	Signal Name	Format	Comment
1	RxCinB/CDB	RS-232	Clock in, or carrier detect
2	RxB	RS-232	Receive data
3	TxB	RS-232	Transmit data
4	TxCoutB/DTRB	RS-232	Transmit Clock Out, or data terminal ready
5	Ground		ground
6	TxCinB/DSRB	RS-232	Transmit Clock In, or data set ready
7	RTSB	RS-232	Request to send
8	CTSB	RS-232	Clear to send
9	RIB	RS-232	Ring indicator

Console Port (control):

Pin #	Signal Name	Format	Comment
1	CD0	RS-232	Carrier detect
2	RxD0	RS-232	Receive data
3	TxD0	RS-232	Transmit data
4	DTR0	RS-232	Data terminal ready
5	Ground		Ground
6	DSR0	RS-232	Data set ready
7	RTS0	RS-232	Request to send
8	CTS0	RS-232	Clear to send
9	RI0	RS-232	Ring indicator

Auxiliary Port:

Pin #	Signal Name	Format	Comment
1	CD1	RS-232	Carrier detect
2	RxD1	RS-232	Receive data
3	TxD1	RS-232	Transmit data
4	DTR1	RS-232	Data terminal ready
5	Ground		Ground
6	DSR1	RS-232	Data set ready
7	RTS1	RS-232	Request to send
8	CTS1	RS-232	Clear to send
9	RI1	RS-232	Ring indicator

GPS Port (GPS):

Pin #	Signal Name	Format	Comment
1	Power	DC	+12 to 13.8 VDC (from FC power connector)
2	Transmit Port “-“	RS-422	-COMMAND packet to the GPS
3	Transmit Port “+”	RS-422	+COMMAND packet to the GPS
4	Na		
5	Na		
6	Na		
7	Na		
8	Receive Port “-“	RS-422	-TIME packet from the GPS
9	Ground		
10	Receive Port “+”	RS-422	+TIME packet from the GPS
11	PPS “+”	RS-422	+Pulse-Per-Second from GPS
12	PPS “-“	RS-422	-Pulse-Per-Second from GPS
13	Ground		
14	Ground		
15	Ground		

Note: RS-422 is a differential-pair-signaling format. Each data or control signal to or from Trimble’s Palisade or Accutime GPS antenna has both a negative ‘-‘ and a positive ‘+’ lead, enabling well-shielded cable runs of up to 3,000 feet. Details for connecting and configuring a Trimble GPS unit are provided in Kantronics’ TG-1000 manual.

Power Connector:

Pin #	Signal Name	Format	Comment
1	+12 VDC	DC	A battery adapter may be used, see the specs.
2	Ground	ground	

Appendix B: Command Reference

The commands listed below in the PAGING COMMANDS COMPARISON CHART are used to configure or monitor activity of the FC family of transmitter controllers (FC-2000, FC-2500, and FC-3000), and the predecessor KPC-2000 controller. Users of the KPC-2000 will note the similarity in commands. In fact, for Master-Slave simulcasting, any of the FC controllers can emulate a KPC-2000, and thus work within an existing KPC-2000 based system. When FLEX must be added to your system, you'll have to utilize the FC-2500 for 1600 FLEX or the FC-3000 for all speeds of FLEX

The chart shows that not all commands are included in each model. Each FC controller has a console port in addition to the TNPP ports. The KPC-2000 shared one port for these functions. Hence, some commands dealing with the dual-use of the single serial port in the KPC-2000 are no longer needed.

(Note to users of the Kantronics KPC-2000. Command mode is always present at the console port of the FC series controllers; that is, there is no need to use three control-C characters to leave a paging operating mode to return to command mode.)

The chart also includes, where applicable, the default values of the parameters associated with commands. "Default" values are those values set at the factory. Some commands do not have a value (a number or letter combination) or a logical switch (ON or OFF) but are immediate. These commands cause an action rather than set a parameter. For example, the CALIBRAT command, when entered, is used to generate tone test patterns at the exciter outputs.

A blank for a table entry (such as no entry for BLIND and KPC-2000) denotes that the command does not exist for that unit. "Immediate" denotes that an action will occur.

Use PROCOMM PLUS (DOS or Windows), HyperTerminal (Windows 9x), or any other similar general communications terminal program with a PC or laptop to configure or monitor activity via the DB-9M "console" port of the controller. (Reminder: a NULL MODEM cable to connect console port to a PC serial port.)

THIS APPENDIX CONTAINS THESE CHARTS, DESCRIPTIONS AND TABLES IN THE FOLLOWING ORDER:

PAGING COMMANDS COMPARISON CHART, with default parameters
SHORT FORM HELPS FOR EACH COMMAND
AN ALPHABETIC LISTING AND DESCRIPTION OF EACH COMMAND

A short form description of each command is always available at the console port. At the command prompt (cmd:), simply type HELP or “?” followed by the command name.

Paging Commands Comparison Chart

With default values for parameters

A blank for the default value means the command does not exist for the unit. “Immediate” means that the command causes an action rather than setting a value. The table includes values for the FC series and the current firmware of the KPC-2000 as of 03-01-01.

Name	KPC-2000 default	FC-2000 default	FC-2500 default	FC-3000 default	Comments
ABAUD	0	0	0	0	Console port rate
AUTOLF	ON	ON	ON	ON	Applies to console port
BLIND		ON/ON	ON/ON	ON/ON	TNPP ports protocol
BKONDEL	ON	ON	ON	ON	Applies to console port
BP96	OFF				
BUSYTIME	10	10	10	10	In minutes
CALIBRAT	immediate	immediate	immediate	immediate	Test tones, GPS delay measure
CANLINE	\$18	\$18	\$18	\$18	Applies to console port
CANOUT	\$19				
CDINVERT	OFF	OFF/OFF	OFF/OFF	OFF/OFF	Inverts sense of CD input
CHDELAY	30	30	30	30	Channel change delay in tens of milliseconds
CMDTAG	0000000	0000000	0000000	0000000	Remote command address
CMDTIME	1				
COMMAND	\$03				
CWID	OFF	OFF	OFF	OFF	ON OFF
CWIDTEXT	DE call	DE call	DE call	DE call	Your entered callsign
DAYSTR	US form	US form	US form	US form	Mm/dd/yyyy hh:mm:ss
DAYTIME	1/1/2000	1/1/2000	1/1/2000	1/1/2000	With zero time
DELETE	\$08	\$08	\$08	\$08	Applies to console port
DISPLAY	immediate	immediate	immediate	immediate	Applies to console port
EANDM	OFF	OFF/OFF	OFF/OFF	OFF/OFF	Channel sharing
ECHO	ON	ON	ON	ON	Applies to console port
EQUALIZE	115				
ESCAPE	OFF	OFF	OFF	OFF	ESC printed as “\$”

Name	KPC-2000 default	FC-2000 default	FC-2500 default	FC-3000 default	Comments
ETB		OFF	OFF	OFF	ETB added before last ETX
FLEXTXC			OFF	OFF	
FLOW	ON	ON	ON	ON	Applies to console port
GPS		OFF	OFF	OFF	If ON, timing from GPS in stand-alone TNPP mode
GPSALIGN		OFF	OFF	OFF	If ON, timing aligned to GPS in TNPP mode
GPSDELAY		0	0	0	Usec, time from uplink
HELP	immediate	immediate	immediate	immediate	Applies to console port
HOLDOFF	0	0	0	0	In sec, holdoff between transmissions
HOPS	0				For POCSAG repeating
INTERFACE	TERM	TERM	TERM	TERM	Sets mode
LOAD		immediate	immediate	immediate	Update flash program
MAXALPHA	128/128	128/128	128/128	128/128	Max # char transmitted
MAXNUMER	65/65	65/65	65/65	65/65	Max # char transmitted
MONITOR	OFF				Monitors POCSAG
PAGE	immediate	immediate	immediate	immediate	Send a page
PAGEBAUD	512, 1200, 2400	512, 1200, 2400	512, 1200, 2400	512, 1200, 2400	512, 1200, 2400 POCSAG, Golay. Can add FLEX with FC-2500/FC-3000.
PAGEDIR	immediate	immediate	immediate	immediate	Puts entries in Page Directory
PAGEDST	0				For POCSAG repeating
PAGEID		immediate	immediate	immediate	Send page using Page Directory
PAGELOG	immediate	immediate	immediate	immediate	View pages sent and queued
PAGELOSS	50				
PAGEMAX	30	30	30	30	Maximum transmission duration in stand-alone and Master-Slave modes
PAGERPTR	0				For POCSAG repeating
PAGESRC	0				For POCSAG repeating
PAGEXINV	OFF	OFF	OFF	OFF	Inverts TX channel data
PASS	\$16	\$16	\$16	\$16	
PASSLOCK		immediate	immediate	immediate	Enable Password protection
PASSWORD		none	none	none	Modem Password
PDA	ON	ON	ON	ON	POCSAG standard

Name	KPC-2000 default	FC-2000 default	FC-2500 default	FC-3000 default	Comments
PFTIMER	0	0	0	0	Power fail timer
PGRCLLPS			0	0	Applies only to FLEX
POUND	IGNORE	IGNORE	IGNORE	IGNORE	Choices for #, in numeric pages
PRIORITY		OFF	OFF	OFF	Enables TNPP priority pages
REDISPLAY	\$12				
RELOAD		immediate	immediate	immediate	Reloads program from flash
REMCMD		Yes	Yes	Yes	Send remote command
RESET	immediate	immediate	immediate	immediate	Reset unit
RESTORE	immediate	immediate	immediate	immediate	Restore defaults
RESYNCS	0	0	0	0	Sets rate for resending preamble
STATUS		immediate	immediate	immediate	
SELPTT		OFF	OFF	OFF	SEL lines used as PTTs
SIMBAUD	simfreq				
SIMDLY	0	0	0	0	Simulcasting delay
SIMDST	0000	0000	0000	0000	Hex address
SIMFREQ	0.00	0.00	0.00	0.00	Locks timing to SAT receiver
SIMSRC	0000	0000	0000	0000	Master-Slave source address
SIMTIME	10/255	10/255	10/255	10/255	Simulcasting timeout
STAR	IGNORE	IGNORE	IGNORE	IGNORE	Choices for *, in numeric pages
START	\$11	\$11	\$11	\$11	Applies to console port
STOP	\$13	\$13	\$13	\$13	Applies to console port
SYNSHARE		ALL	ALL	ALL	Sets frames avail. for TX
SYSCLLPS			0	0	Applies only to FLEX
TBAUD		0/0	0/0	0/0	Sets TNPP ports rates
TIMESRC		0000	0000	0000	Hex TG-1000 address
TNPPCRC	ON	ON/ON	ON/ON	ON/ON	Enables error checking
TNPPDEST	immediate	immediate	immediate	immediate	Enter TNPP addresses
TNPPFILT	immediate	immediate	immediate	immediate	Enter TNPP addresses
TNPPREF	immediate	immediate	immediate	immediate	Enter TNPP addresses
TNPPSER	ON	ON/ON	ON/ON	ON/ON	Enables error checking
TRACE	OFF				Binary trace monitor
TXDELAY	30	30	30	30	TX keyup delay (x 10ms)
TXMARGIN		30	30	30	Margin to release PTT
TXTAIL		6	6	6	TX keydown delay
UPLOAD		Immediate	Immediate	Immediate	Update flash via TNPP
VERSION	immediate	immediate	immediate	immediate	Display software version

Name	KPC-2000 default	FC-2000 default	FC-2500 default	FC-3000 default	Comments
WARMUP	OFF	OFF	OFF	OFF	POCSAG warm-up pattern
XCITER	1 1	1/0	1/0	1/0	Channels & transmitters
XMTLVL	64				Transmit output level
XFLOW	ON	ON	ON	ON	Applies to console port
XOFF	\$13	\$13	\$13	\$13	Applies to console port
XON	\$11	\$11	\$11	\$11	Applies to console port

Short Form Helps For Each FC Command

You may recall these short form descriptions of each command while connected to the console port of the unit by typing HELP or “?” at the cmd: prompt followed by the name of the command.

ABAUD	RS232 terminal baud rate
AUTOLF	LF sent to terminal after CR
BLIND	TNPP port uses BLIND TNPP
BKONDEL	If on, DELETE will backspace; else \
BUSYTIME	If a channel is busy for more than n minutes, the FC-xxxx will dump pages for that channel
CALIBRAT	Output a squarewave at different rates
CANLINE	Char used to cancel a partial input line
CDINVERT	Inverts sense of CHANNEL BUSY pin for paging (per radio)
CHDELAY	Delay used after changing to a different channel (10 msec)
CMDTAG	Code word used for changing parameters via TNPP
CWID	n ON OFF If on, CWID sent after every page, else after n minutes
CWIDTEXT	Text sent during CW IDs
DAYTIME	yymmddhhmm[ss]
DAYSTR	Format used when displaying time and date
DELETE	Char used to delete last char in line
DISPLAY	{ASYNC CHAR ID PAGE SIMULCAST TIMING TNPP}
ECHO	Characters from terminal are echoed back
EANDM	Enables channel sharing with GLENAYRE
ESCAPE	If on, received ESCAPE characters printed as \$
ETB	If on, ETB added to last TNPP block before ETX
FLOW	FC-xxxx will not send data to terminal until input line complete
FLEXTXC ¹	Enables transmit data clock for flex modes
GPS	If on, timing is from attached GPS module
GPSALIGN	If on, FLEX will be aligned to GPS time in PAGER and TNPP modes.

¹ FC-2500 and FC-3000 only.

GPSDELAY time in microseconds to receive an uplinked time packet (0-100000)
HELP command[*] Prints help message
HOLDOFF Minimum time to wait between page transmissions
INTERFACE {TERMINAL | PAGER | TNPP | MASTER | SLAVE |SYNSIM|TONE}
LOAD loads a new program into the FC-xxxx through the console port
MAXALPHA prefs/norm Max chars sent in an alphanumeric page (10-4000)
MAXNUMERprefs/norm Max chars sent in a numeric page (10-4000)
PAGE² Specifies a page to add to the pagelog using the form
[-Af|-Nf|-Bf|-Df][!] [-512|-1200|-2400|-G|-T|-F] [-P] [-x] capcode message
where f (0-8) is function code and x (1-4) is XCITER channel
and ! is priority and -P is preference
PAGEBAUD³ Allows sending pages only in these formats
{{ [+|-] [512] [1200] [2400] [GOLAY] [TYPE2A]
[{FLEX16|FLEX32|FLEX32D|FLEX64D}] } | NONE }
PAGEDIR⁴ {LIST | ALIAS alias |CAPCODE capcode} |
{+|- alias [-Af|-Nf|-Bf|-Df] [-512|-1200|-2400|-G|-T|-F] [-P] [-x] capcode}
where f (0-8) is function code and x (1-4) is XCITER channel
PAGEID⁵ [-f][!] [-P] alias message
sends message to capcode defined by alias in PAGEDIR
where f (0-8) is function code, ! is priority, and -P is preference
PAGELOG STATUS | LIST [n] | CLEAR | CLEARALL | FIND capcode | OLDEST
PAGEMAX Maximum time allowed for sending pages in one transmission
PAGEXINV Inverts polarity of transmitted pages
PASS Char used to pass special characters as data
PASSWORD Modem password (upto 15 chars, single % to clear)
PASSLOCK If PASSWORD is set, no more commands accepted without password
PDA Forces two POCSAG address words between POCSAG messages
PFTIMER {0-60000 | OFF} If power is off for more than n seconds, pagesthat
have not yet been sent are marked as aborted.
PGRCLLPS⁶ Set to minimum pager collapse supported [0-7]
POUND {IGNORE|SPACE|DASH|SPARE} How # is handled in a numeric page
PRIORITY Allows priority pages
RELOAD Reload program memory from FLASH
REMCMD cmdtag remote-command Sends commands to remote units
(remember the remote-command must be spelled in full)
RESYNCS Number of POCSAG batches sent before preamble is resent
RESET Soft reset
RESTORE Reloads program memory and changes parameters to factory defaults
STATUS Displays current status for interface mode
SELPTT Changes select lines to extra PTTs
SIMDLY Difference in miles to sat between this unit and unit closest to sat

² For FC-2000, -D, -F options are not available and function codes are 1-4.

³ For FC-2000, no FLEX is available; for FC-2500 only FLEX16 is available.

⁴ For FC-2000, -D, -F options are not available and function codes are 1-4.

⁵ For FC-2000, function codes are 0-4.

⁶ FC-2500 and FC-3000 only.

SIMDST	TNPP destination address for simulcasting (in hex)
SIMFREQ	Frequency of synchronizing signal
SIMSRC	TNPP source address for simulcasting (in hex)
SIMTIME	Master/Slave timeouts (secs) for TNPP network operating properly
STAR	{IGNORE SPACE DASH SPARE} How * is handled in a numeric page
START	Char to restart serial output from FC-xxxx to terminal
STOP	Char to stop serial output from FC-xxxx to terminal
SYNSHARE	{ALL NONE [+ -] a,b-c,d-e,f,g-h} where i is 0-127 Specifies which frames are available for time sharing
SYSCLLPS ⁷	Sets FLEX system collapse [0-7]
TBAUD	TNPP baud rates port1 (SLAVE)/ port2 (MASTER)
TIMESRC	TNPP source address of time packets (in hex)
TNPPCRC	{OFF TRANSPAR ON} Enables CRC checking in TNPP modes
TNPPDEST	[+ -] xxxx>xxxx[,xxxx>xxxx] Accepted TNPP source>destinations in hex
TNPPFILT	[+ -] xxxx[,xxxx] Rejected TNPP sources in hex
TNPPREF	[+ -] xxxx>xxxx[,xxxx>xxxx] TNPP source>destinations given preference
TNPPSER	Enables serial number checking in TNPP mode
TXDELAY	Time delay between PTT and preamble radio data out (10 msec)
TXMARGIN	Time margin to release PTT when channel sharing (10 msec)
TXTAIL	Time delay after last bit sent before PTT is released (10 msec)
UPLOAD	[-H] [-n] cmdtag Uploads a new program into the FC-xxxx using the TNPP ports, where -H specifies hex transfer (binary by default) and -n specifies max number of 32 byte blocks per TNPP packet (default 1)
VERSION	Displays firmware version number
WARMUP	If ON, warm-up sent before 512 and 1200 baud POCSAG preamble
XCITER	Selects number of channels per radio port
XFLOW	Master switch for software flow control
XOFF	Char to stop serial input from terminal to FC-xxxx
XON	Char to restart serial input from terminal to FC-xxxx

⁷ For FC-2500 and FC-3000 only

Command Descriptions

ABAUD n (n=300, 600, 1200, 2400, 4800, 9600, 19,200, 38,400) default 0

Use this command to set the baud rate of the console port. ABAUD (the rate of the console port) is set automatically to your computer's rate if set at 0 when the power is turned on. You must hit the "*" (usually a Shift 8) key to set the rate. After turning the power off and back on (or after a reset), the rate will remain set. Changing ABAUD requires a reset or power cycle before taking effect.

AUTOLF {ON|OFF} default ON

This command is one of several commands used to configure communications at the console port. When ON, a line feed is sent to the attached terminal after each carriage return. See also ECHO, FLOW.

BLIND {ON|OFF} default ON

This command configures the TNPP ports for blind or full TNPP operation, depending upon the mode in use. In TNPP mode, both ports can support the full TNPP protocol. BLIND ON means that the port is configured as blind; hence the port does not acknowledge incoming TNPP frames.

BKONDEL {ON|OFF} default ON

If ON, the sequence backspace-space-backspace is sent to the attached terminal when the DELETE character is entered. When OFF, the backslash character "\" is sent to the terminal.

BUSYTIME n (n=0...255) default 10 minutes

When the FC has a page to transmit but the channel is busy, a busy timer is started. If the busy timer times out before the channel becomes clear, any pages accumulated for that channel are marked as aborted. The busy timer is suspended while the FC is sending pages to another channel. In Master mode (simulcasting), the FC will send a BSYn command to the TNPP network when the busy timer times out. When the Master and Slaves receive the BSYn command from the network, they all abort the pages accumulated for that channel

CALIBRAT

When issued, the CALIBRAT command will display a list of waveforms that you may use to drive/test your exciter's deviation, etc. In addition, the CALIBRAT command can be used to determine the GPSDELAY for simulcasting. For more details on this application, see Appendix H. For an FC-3000, you have these choices:

PAGING CALIBRATE MODE:

- 1 send 512 bps square wave
- 2 send 1200 bps square wave
- 3 send 2400 bps square wave
- 4 send 300 bps square wave
- 5 send 600 bps square wave
- 6 send 1600 bps square wave
- 7 send 3200 bps square wave
- 8 send 1600 baud step wave
- 9 send 3200 baud step wave
- R stop sending

- G calibrate GPSDELAY

- U update EEPROM

- X exit

Options 6-9 are not available in the FC-2000; options 7-9 are not available in the FC-2500. Option U is only displayed if there is ever a programming change that needs to be made to the loading program in the internal EEPROM.

CANLINE n (n=\$00-\$FF) default \$18 <Ctrl+X>

This command sets the cancel-line input editing character. This character will cancel any characters sent to the console port since the last un-PASSed carriage return.

CDINVERT [ON | OFF] default OFF/OFF

This command inverts the sense of the paging "busy" pin in the Exciter interface. When set to OFF, a TTL low (0V) signal is expected to signify "busy". When ON, a TTL high (+5 VDC) is expected.

CHDELAY n (n=0...255) default 30 (300 msec)

Delay (in tens of milliseconds) between when the channel is changed (exciter port select lines) and channel access is determined or PTT is activated.

CMDTAG ddddddd (ddddddd is seven numeric digits) default 0000000

In order to enable the controllers for remote programming, you'll need to assign them an address. The remote ID is set by the CMDTAG command.

Most of the commands may be changed remotely if the CMDTAG of the unit is set to a non-zero value. To change them, send a TNPP command packet addressed to SIMDST. The command packet will have a KAN manufacturer code, followed by the CMDTAG of the unit or units you wish to change, followed by one of the commands with its parameters. The commands must be fully entered (full spelling). There should be a space between the command and the parameter value.

If the CMDTAG in the TNPP command packet is of the form ddd0000, then all controllers with a CMDTAG of ddd0000 (and the proper SIMDST) will accept the command. If the last 4 digits of the CMDTAG in the packet are not 0, then the controller with that exact same CMDTAG is the only controller which will accept the command.

There is no indication (feedback) from the remote controller that any command has been accepted or not. If the controller does accept the command but finds errors, no parameters are changed.

See the "TNPP TOOLBOX" appendix for details on a DOS program that may be used to generate these remote TNPP commands. If you have an FC configured as a Master, you can also send remote commands directly using REMCMD.

Here are some examples of TNPP command blocks:

```
CKAN5320000TXDELAY 25
```

```
CKAN5324435SIMDLY 5
```

The first command block sets TXDELAY in all controllers that have the CMDTAGs beginning with 532. The second command block sets SIMDLY only in the controller that has a CMDTAG of 5324435.

Remote commands are disabled if CMDTAG in a controller is 000000, which is the default.

CWID {n | ON | OFF} default OFF/OFF

This command can be used to force a CWID. If ON, a CWID is sent after every transmission in a Master-Slave or TNPP system. If n is not 0, a CWID is sent after a POCSAG transmission every n minutes. If the controller is running under a SYMSIM system, then a CWID is sent every n minutes, where n is an integer which evenly divides 60 (1,2,3,4,5,6,10,12,15,20,30,60). Text sent is set by the CWIDTEXT command.

CWIDTEXT text-string (0-15 characters)

This command sets the text to be transmitted when the controller performs an automatic CWID.

DAYTIME

This command is used to read the time and date of the controller clock. The “clock” of an FC can be locked to its own internal free-running crystal, a satellite receiver’s clock, an attached GPS device, or a TG-1000’s comprehensive time packet coming from the teleport site. If the controller clock is set by the time packet, an offset message is included in the time report.

DAYTIME 03/01/2001 08:30:12 UTC OFFSET -13.

DAYSTR format-string default mm/dd/yyyy hh:mm:ss

This command may be used to set the format of time and date presented using the DAYTIME command. This command determines format only, it does not report or set time.

DELETE n (n=\$00-\$FF) default \$08 <Ctrl+H>

This command sets the character used to delete the last character in the line entered at the console port.

DISPLAY [c] {ASYNC | CHAR | ID | PAGE | SIMULCAST | TIMING | TNPP}

This command may be used to display a list of the parameters currently configured. Entering a choice, e.g. TNPP, will limit the list to that topic. Otherwise, the full list of parameters is displayed.

ECHO {ON|OFF} default ON

This command is one of several used to configure console port communications. When ON, characters from the terminal are echoed back and displayed. Synchronize this command with your terminal program settings.

EANDM {ON|OFF} default OFF/OFF

EANDM is used to configure input and output control lines so that two or more paging switches may share a channel. EANDM uses a type of RTS-CTS signaling. EANDM cannot be used on an exciter port which has more than 1 channel. See Appendix I.

ESCAPE {ON|OFF} default OFF

This command may be used to substitute a "\$" character for an escape character sent to the console.

ETB {ON|OFF} default OFF

If this command is turned on, an ETB character is added to the last TNPP block before ETX.

FLEXTXC {ON|OFF} default OFF

This command exists only in the FC-2500 and FC-3000. If this command is turned on, the TxD2B pin on XCITER port 2 will output a baud clock signal when the FC is transmitting FLEX. There is an internal jumper in the FC which can be used to bring this line to the XCITER port 1 connector. If your exciter does not require a data clock signal for proper operation, leave this command off.

FLOW {ON|OFF} default ON

This command is one of several used to configure console port communications with your PC or terminal. The console port will not send data to the terminal until the input line is complete. When FLOW is ON, any character entered from the terminal will halt output from the console port until the current command is completed.

GPS [ON|OFF] default OFF

If ON, the controllers clock is locked to the attached GPS module. See Appendix H for information about connecting a GPS unit.

GPSALIGN [ON|OFF] default OFF

If ON, timing will be aligned to GPS time.

GPSDELAY default 0 microseconds

Enter n as derived from the CALIBRAT command to set the delay in the controller for simulcasting in a SYNSIM system.

HELP

This immediate command displays a list of the commands available for within a given mode of operation. See also INTFACE command.

HOLDOFF n (n=0...255) default 0

Holdoff sets the minimum time to wait between page transmissions when running in Master-Slave or TNPP mode, i.e. running in a Master-Slave or TNPP system.

INTFACE {TERMINAL | PAGER | TNPP | MASTER | SLAVE | SYNSIM | TONE}

INTFACE sets the mode that the FC will run in when it is powered up or reset. Generally, you will configure the unit while in TERMINAL mode and then change INTFACE to one of the paging modes.

(Note that the TNPP ports are not active in terminal mode but are active in a paging mode.)

LOAD

This command is issued to load new firmware into flash memory via the console port. For detailed procedures see the appendix titled “Firmware Update Procedures.”

See also RELOAD.

Caution. If you have an FC-2000 and want to reconfigure the unit as an FC-2500 or an FC-3000 or if you have an FC-2500 and want to reconfigure the unit as an FC-3000, you'll need to obtain a special upgrade file for a specific FC unit directly from the factory. Upgrade code carries an upgrade charge.

If you inadvertently attempt to load the wrong code, say for a FC-2500 into a FC-2000, the FC will generate an error message "UNAUTHORIZED FILE".

MAXALPHA n (n=10-1024) default 128/128

This command sets the maximum number of characters actually transmitted in each alphanumeric page.

MAXNUMER n (n=10-1024) default 65/65

This command sets the maximum number of characters actually transmitted in each numeric page. Alpha characters may appear in a page to a numeric pager as shown in the pagelog; however, these characters are ignored when the numeric page is transmitted.

PAGE [-Af|-Nf|-Bf|-Df][!] [-512|-1200|-2400|-G|-T|-F] [-P] [-x] capcode message

This command allows the paging technician to send pages in PAGER or TNPP mode using the console port. The options specify the following:

- A alphanumeric
- N numeric
- B tone only
- D binary (FLEX only)
- f function code (1-4 for POCSAG/Golay 0-8 for FLEX)
- ! priority
- 512 512 bps POCSAG
- 1200 1200 bps POCSAG
- 2400 2400 bps POCSAG
- G Golay
- T Type 2A Golay
- F FLEX (for FC-2500 or FC-3000 only)
- P preference
- x exciter channel

PAGEBAUD [512|1200|2400] [Golay] [TYPE2A]

default 512 1200 2400

This command sets the type of pages allowed by the controller. Pages received (in TNPP) but not listed in PAGEBAUD will be discarded and not sent.

For the FC-2500, with 2-level FLEX enabled, add [FLEX].

For the FC-3000, with 4-level FLEX enabled, add these:

[FLEX16|FLEX32|FLEX32D|FLEX64D].

PAGEDIR {LIST | ALIAS alias |CAPCODE capcode} |

{+|- alias [-Af|-Nf|-Bf|-Df] [-512|-1200|-2400|-G|-T|-F] [-P] [-x]}

This command is used to set up and manage the page directory. The page directory is used to store a list of “shortcuts,” i.e. alias name, type, special function, and baud to specific pages. The alias name is used when manually sending a page to the capcode associated with that alias, using the PAGEID command. LIST will display all entries in the page directory. ALIAS will display all entries associated with a given alias. CAPCODE will display all entries with the given capcode. + and – will add or remove entries from the page directory. When removing an entry, all parameters must match.

PAGEID [-f][!] [-P] alias message

This command enables you to send a page message to “alias” if the parameters of the pager associated with the “alias” are stored in the page directory (PAGEDIR). The f parameter can be used to override the function code specified in the page directory; an f of 0 means to use the default function code specified in the page directory. ! indicates priority and –P indicates preference.

PAGELOG STATUS | [LIST] [n] | CLEAR | CLEARALL | FIND capcode | OLDEST

This command is used to list the contents of the log or to clear it. STATUS will show the number of pages in the log which have been sent or are waiting to be sent. To list the total pagelog enter “PAGEL L.” CAUTION! The FC controllers are capable of storing over 10,000 pages. Be selective by requesting just that portion of the pagelog you need, e.g. enter PAGELOG 10. This will display the last ten pages. If you accidentally request to have all pages listed, you can stop the listing by entering another command or simply just a carriage return (CR). CLEAR will delete all pages from the log that have been sent. CLEARALL will delete all pages and cause a reset. FIND will display all pages for a given capcode. OLDEST will display the oldest page in the log which has not yet been sent.

PAGEMAX n (n=0...255) default 30 seconds

PAGEMAX sets the maximum time allowed for sending pages in one transmission in PAGER, TNPP, or MASTER-SLAVE modes. PAGEMAX and HOLDOFF parameters are ignored in a SYMSIM system.

PAGEXINV {ON|OFF} default OFF

This command is used to invert the page signal going to the exciter and applies to all pages being transmitted: Golay, POCSAG, or FLEX.

PASS n (n=\$00-\$FF) default \$16 <Ctrl+V>

The command specifies the character used to pass special characters as data.

PASSLOCK

This is an immediate command which will lock the console port until a proper password is entered. If PASSWORD is left blank, the PASSLOCK command has no effect.

PASSWORD password-string

This command is used to enter a password to restrict access to the console port of an FC controller. If the password is left blank, access is not restricted. The password may be reset, i.e. set blank, by issuing a “%” following PASSWORD.

PDA {ON | OFF} default ON

This command forces two POCSAG address words between POCSAG pages. This command was added so that the KPC-2000 and FC models conform to the POCSAG standard. If a POCSAG pager is receiving a message but misses the first address word indicating the end of the message, the second address word will end the message; missing two consecutive words will also end the message. Turning this feature off may increase through-put at the risk a pager will receive someone else’s message appended to one he was supposed to receive.

satellite between this unit and the unit closest to the satellite. When simulcasting within a SYNSIM system, see the command GPSDELAY.

SIMDST dddd (where each d is a hexadecimal character) default 0000

This command sets the destination address of a simulcasting controller. If the FC is used as a Master or Slave, this parameter must be set. It is not used in a SYNSIM system.

SIMFREQ n default 0.00

This command is used to lock the clock of the controller to that coming from the satellite receiver when the controller is used in a Master-Slave simulcasting system. The SIMFREQ parameter is ignored when the controller is running in other modes.

For example, if a SPACECOM M2000 has a clock of 1218.10 or 2435.18, set SIMFREQ to that value and press enter. If the rate is not correct to within a very small percentage, the FC SYNC LED will not light. If the LED is not ON the controller will not simulcast accurately with another controller, since their clocks will drift apart over time. Pages will still be sent. Transmissions under a minute will usually be accurate enough without the receiver clock correction.

SIMSRC dddd (where each d is a hex character) default 0000

Use this command to set the source address of a simulcasting Master controller. If the FC is to be used with a Master or Slave – in that mode – this parameter must be set.

SIMTIME m/s (0-255) default 10/255 seconds

This parameter is used only in Master-Slave systems. SIMTIME is the maximum time in seconds between when the Master sends a TNPP command in the TNPP network and when that command is to be received from the satellite. If a sent command is not received before SIMTIME times out, the Master will go ahead and start sending its pages. If a Slave has pages in a queue and does not receive a command, it will start sending its pages when SIMTIME expires. (Note: For debugging installations, the “wait” LED will light when the TNPP XMT command is sent to the network (via backhaul) then cleared when the TNPP command is received back from the satellite.)

STAR [IGNORE | SPACE | DASH | SPARE] default IGNORE

This command is used to specify how the FC converts a * received for a POCSAG numeric page into one of the permissible POCSAG numeric characters. To send to a “canned message” type of pager, STAR would typically be set to DASH.

START n (n=\$00-\$FF) default \$11 <Ctrl+Q>

This command specifies the character used to restart serial output from the console port. If set to \$00 only hardware flow control is used.

STOP n (n=\$00-\$FF) default \$13 <Ctrl+S>

This command specifies the character used to stop serial output from the console port. If set to \$00, only hardware flow control is used.

SYNSHARE (a,b-c,d-e, etc) default ALL 0-127

This command may be used to set the start and duration of transmission times for each paging channel. If a competing paging provider is also using an FC controller, this command can be used to arbitrate your channel transmissions. This command specifies which frames of time are available for time sharing, when the unit is running in the SYNSIM mode. Time is broken up into 128 frames every four minutes, where each frame has a duration of **1.875** seconds. For example, suppose you are running two channels of paging with the FC, and you wish to send CH1 during the first half of odd minutes and CH2 during the second half of odd minutes. To configure the FC to do so, enter SYNSHARE in this format:

cmd: **SYNSHARE 0-15,64-79 / 16-31,80-95 <enter>**

Another provider on channel would program his controller to be active during the even minutes.

Note that 8 frames are sent every 15 seconds; hence the following table may be used to divide channel transmissions up into 15 second intervals:

frames	Time complete	Duration	Example
0-7	15 seconds	15 seconds	CH 1
8-15	30	15 seconds	CH 1
16-23	45	15 seconds	CH 2
24-31	60=1 minute	15 seconds	CH 2
32-39	75	15 seconds	

40-47	90	15 seconds	
48-55	105	15 seconds	
56-63	120=2 minutes	15 seconds	
64-71	135	15 seconds	CH 1
72-79	150	15 seconds	CH 1
80-87	165	15 seconds	CH 2
88-95	180=3 minutes	15 seconds	CH 2
96-103	195	15 seconds	
104-111	210	15 seconds	
112-119	225	15 seconds	
120-127	240=4 minutes	15 seconds	

The table can, of course, be larger, allowing for durations less than 15 seconds, as long as the duration is a multiple of **1.875** seconds. Different durations may be applied to each channel too.

This command applies to all paging protocols of the given FC when it is running in SYNSIM mode: Golay, POCSAG, and/or FLEX. Of course, you must have an FC-2500 or FC-3000 to run FLEX.

SYSCLLPS n (0-7) default 0

This value sets the system collapse when running FLEX. It is recommended that this value be set to 0 or 1 for systems where there is only a little flex and a lot of POCSAG.

TBAUD n/m (0, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400) default 0

The command is used to set the baud rate of TNPP ports 1 and 2. If 0, the rate of that port is determined by an external clock (RS-232, see appendix A for details). In general, port 1 is usually connected to a satellite receiver and port 2 may be connected to the TNPP network. Note that n and m may be at different rates.

TIMESRC dddd (where each d is a hex character) default 0000

If you want to use TG-1000 timing packets coming from the uplink side of the satellite link (if you are running SYNSIM, yes you do), use this command to enter the source address of the TG-1000 that you will be hearing.

TNPPCRC {OFF | TRANSPAR | ON} default ON

This command can be used to enable or disable CRC checking of received TNPP packets. The default is to check. TRANSPAR specifies using 4 hexadecimal characters for the CRC instead of 2 binary characters, as described in the TNPP specification.

TNPPDEST [+|-] xxxx>xxxx[,xxxx>xxxx]

This command allows setting up to 32 TNPP source>destination addresses per transmitter channel that are compared to the addresses of incoming TNPP frames. If the source>destination of the received frame matches an entry in the table, then the page is accepted into the controller's pagelog buffer. Wild cards (****) can be used to specify the source or the destination. A single address is treated as a destination with a wild card source. The command expects addresses to be expressed in hex. For example:

cmd: **TNPPDEST A401, 3005>****, 4BC1, BC09>E499** <enter>

The FC will now accept any pages for destination A401 and 4BC1, any pages from 3005, and any pages to E499 from BC09.

TNPPFILT [+|-] xxxx[,xxxx]

This command establishes a list of TNPP source addresses to reject. TNPP frames received containing a source address in the table are rejected.

TNPPREF [+|-] xxxx>xxxx [xxxx>xxxx]

This command allows setting up to 32 TNPP source>destination addresses that are compared to the addresses of incoming TNPP frames. If the source>destination of the received frame matches an entry in the table, then the page is accepted into the controller's pagelog and given preference.

TNPPSER [ON|OFF] default ON

The command enables number checking of incoming TNPP frames. If ON, frames with a serial number the same as any received in the last 64 are discarded. If OFF, all packets are received without regard to serial number. Protocol practice calls for leaving this command ON.

TXDELAY n (n=0 to 255) default 30

This command sets the transmitter key up delay (before data is sent) as 10*n milliseconds.

TXMARGIN n (n=0 to 255) default 30

This command sets the time margin to release PTT when channel sharing is active. Each count is equal to 10 msec. Hence, the default of 30 cuts 300 msec off the time of transmission.

TXTAIL n (n=0 to 255) default 6

This command sets the delay between the last POCSAG or GOLAY data sent to the transmitter and the release of PTT in non-SYNSIM modes. A tone is sent during this period

UPLOAD [-H] [-n] cmdtag

This command is used to upload new flash firmware code for FC series controllers via satellite or other TNPP circuit. The new firmware code is supplied to the console port of an FC that must be configured as a “Master,” and is routed via the Master’s TNPP PORT 2 to a TNPP input port of the backhaul circuit to the satellite uplink site. The code loaded will also update the Master’s flash if and only if the cmdtag address of the Master matches that entered as the parameter of the **UPLOAD** command. **SIMSRC** and **SIMDST** must also match in the Master and in all stations for the file to be loaded in those units.

The **-H** option specifies that the Master is to send the upload code in a hexadecimal format instead of binary. This is for those cases where the backhaul circuit may have trouble passing binary characters along. Unfortunately, the **-H** option approximately doubles the amount of data that must be sent.

The **-n** option specifies the number of 32 byte blocks sent in a single TNPP packet. The default is 1 (32 bytes). Increasing this will reduce the time needed to upload the entire file through the backhaul. However, setting it too high will hog the satellite channel and may have problems caused by packets which are too large for the network to handle.

See also the **REMCMD** command. The Master at your paging switch site can also be used to generate remote commands in TNPP format to update specific parameters of selected remote stations. You simply enter the command **REMCMD** followed by a cmdtag and then followed by the usual command you’d enter at the remote station’s console. The FC Master regenerates this command in a TNPP command block packet and sends it to the backhaul satellite channel.

For detail on “cmdtag” addressing of remote stations, refer to “remote programming” and ‘firmware update procedures’ in this manual.

VERSION

Use this command to display the version of the firmware currently loaded in memory and the serial number of the controller (stored in an IC on the PCB). Example for an FC-2000 controller:

```
cmd: VER <enter>
FC-2000-01058-1.0
Serial Number 0000076802E4
cmd:
```

WARMUP {ON | OFF} default OFF

If ON, a warm-up pattern is sent before each 512 or 1200 POCSAG page according to the following table:

POCSAG rate	512	1200
Duration of comma	400 ms	200 ms
Frequency of comma	750 bps	1500 bps

XCITER m/n default 1/0
where “m” sets the number of channels assigned to exciter port 1 and “n” sets the number of channels assigned to exciter port 2. The total number of channels available is 4. In other words, $m+n \leq 4$.

XFLOW {ON|OFF} default ON

XFLOW sets the Master switch for flow control of the console port. When XFLOW is ON, the software flow control will be implemented according to the START, STOP, XON, and XOFF parameters. When OFF, the unit will only use and recognize hardware flow control lines (CTS and RTS). The RS-232 cable must include these lines for hardware flow control. Some communication programs may not support hardware flow; however, PROCOMM PLUS does.

XOFF n (n=\$00-\$FF) default \$13 <Ctrl+S>

The command selects the character sent out from the console port to stop input from the computer or terminal. If XOFF is set to 0, hardware flow control must be used.

XON n (n=\$00-\$FF) default \$11 <Ctrl+Q>

This command selects the character sent out from the console port to restart input from the computer or terminal. If XON is set to 0, hardware flow control must be used.

Appendix C: Using Multiple RF Channels

When running Golay and/or POCSAG, the FC family supports a maximum of four channels of RF with exciter ports 1 and 2. When running any level of FLEX with or without Golay/POCSAG, just one RF channel is supported for FLEX via exciter port 1. In other words, FLEX is supported only on Channel one of EXITER PORT 1, while POCSAG/Golay is supported on up to 4 channels of both EXCITER PORTS. (including the FLEX channel).

The hardware of the FC family supports two exciter ports. Each port supports the following:

- Push-to-talk (PTT), open-drain
- Two Data Bits, open-drain or RS-232 (jumper selectable)
- Two channel select lines
- One mode line
- One error input
- One busy input.

When running POCSAG and/or Golay without FLEX, A MAXIMUM OF FOUR CHANNELS CAN BE SUPPORTED AT ANY TIME by the two exciter ports. For example, you could configure exciter port one to support three channels of one transmitter while exciter port two supports one channel of another transmitter. Or, you may wish to support just four channels of a transmitter cabled to exciter port 1. The most common configuration is to support just one channel of one exciter attached to exciter port 1. The channel select lines are used to enable each channel the exciter may support. This parallel arrangement of control lines to support channels works, of course, only with radios that support selection by parallel line control. TNPP destination addresses determine to which channel pages are routed for transmission.

During multi-channel operation, the front panel LEDs of each exciter port may be viewed to follow the action: BUSY, PTT, SEL1, SEL2, MODE, AND ERROR. For example, PTT ON, SEL1 OFF, and SEL2 OFF on exciter port 1 would denote that the current transmission is on port 1 and on channel 1 of 4 possible. PTT ON and both SEL LEDs on would denote a transmission on channel 4.

The channels are configured using the XCITER command. For example, you may wish to configure exciter port 1 for one channel and exciter port 2 for one channel. To do so, enter the following at the command prompt:

```
cmd: XCITER 1/1 <enter>
```

Enter this command before setting other parameters. The commands following will then prompt you to enter parameters as needed for each channel configured.

The general form for the XCITER command is as follows:

cmd: **XCITER A/B <enter>**, where A+B must not exceed a max of 4.

Destination addresses are assigned to each channel using the TNPPDEST command. In this way, each page is assigned one of the available channels. For the example immediately above, enter the following to assign pages with TNPP destinations of A801 and A802 to channel 1 of exciter 1 and 1520 and 1521 to exciter 2 channel 1:

cmd: **TNPPDEST A801 A802 / 1520 1521 <enter>**

Parameters affected or modified by setting XCITER to more than one channel are:

CDINVERT	CWID	CWIDTEXT	EANDM	HOLDOFF
MAXALPHA	MAXNUMER	PAGE	PAGEBAUD	PAGEMAX
SELPTT	SYNSHARE	TNPPDEST	TNPPREF	TXDELAY
TXMARGIN	TXTAIL			

Appendix D: TNPP Toolbox

A diskette titled TNPP TOOLBOX is shipped with each FC controller or TG-1000. The diskette contains programs for monitoring, generating, and transmitting pages in TNPP ASCII format. This collection of programs is helpful in bench testing and monitoring system performance. The main programs on the diskette, all DOS based, are the following:

- Simulate
- Tnppmon
- Tnppgen
- Testpage

SIMULATE can merge up to two TNPP sources for retransmission. The resulting stream of pages is renumbered and checked. Pages not meeting TNPP requirements are rejected. Simulate can use files of TNPP pages on diskette as one of its two sources, and these may be selected at random and with a chosen rate. Hence, Simulate combined with a PC with two comm ports (limited to com1 and com2) is ideal for bench testing (without a pager terminal or TNPP source).

TNPPMON may be used to display raw TNPP pages in a more readable format. Just one TNPP page is printed per display line and each segment of the page is separated by a space or spaces, making the pages more readable for testing or monitoring.

TNPPGEN may be used to establish files of TNPP pages in Golay, POCSAG, or FLEX. These files may then be used by **SIMULATE** for testing.

TESTPAGE may be used to send numbered TNPP formatted test pages (to an FC controller.... or any TNPP input) at a chosen rate.

Appendix E: FC board Jumpers

There are six jumpers on the FC-2000/FC-2500/FC-3000 boards:

- Hard reset, J10
- Data clock, J23
- Data outputs, RS-232/TTL: J15, J16, J17, J18

Hard Reset Jumper (J10). Default OFF

This jumper is used to perform a hard reset. After the reset all parameters will be forced to factory defaults. The jumper is located just behind LED D7.

To perform a hard reset, turn power to the unit OFF, place a jumper on both pins of J10, turn the power ON, wait ten seconds, turn the power OFF, and place a jumper on just one post (off) of J10. The unit will then be in autobaud mode; that is, the processor will be looking for a “*” character to appear at the input of the console port to match that port’s baud rate with that of your attached PC and terminal program. Once you hit the “*” key the unit will generate a sign-on message and display the command prompt, cmd:. At this point you may enter new parameters to reconfigure the controller.

Data Clock Jumper (J23). Default OFF

Some paging exciter require a data clock to accompany the paging data. The clock is presented at the output of exciter port 1 on pin 13 when a jumper is placed on the center pin (2) and pin 3 of jumper J23. Generally, for 2-level exciter operation, i.e. Golay, POCSAG, and 1600 FLEX, the clock is not required.

For 4-level FLEX operation, most exciter require the data clock. Note that pin one is the left-hand pin when viewing the jumper from the back of the unit.

Data Output Jumpers (J15, J16, J17, J18). Default TTL Output

Many transmitter exciter use resistor pull-ups on their input lines, thus accepting an open-collector or open-drain drive from the attached controller. The FC family offers you two choices for data drive, TTL (in the form of an FET open-drain) or RS-232. All outputs are open-drain (TTL) when jumpers are placed on pins 1 and the center pins (2) of jumpers J15-J18. Outputs are RS-232 when a jumper is placed on the center pin (2) and pin 3. Note that pin 1 is the left-hand pin when viewing the jumpers from the back of the unit.

Jumpers J15 and J16 are used to configure the low and high data bits of exciter port 1. **Only J15, the low bit, is required for 2-level modulation:** Golay, POCSAG, and 1600 FLEX. In like manor, Jumpers J17 and J18 are configured for exciter port 2.

There are no jumpers for the push-to-talk outputs of exciter ports 1 and 2; these are both open-drain.

When operating in TONE mode with the tone option board installed, set J17 jumper to the open position (no pins connected).

Appendix F: Firmware Update Procedures

When maintenance update firmware becomes available for the FC-2000, FC-2500, FC-3000, or TG-1000, you'll be able to load that firmware into the unit using a laptop PC. The updated firmware, in the form of an encrypted ASCII file for each specific model, is loaded through the CONSOLE port of the unit. These files will be available on diskette or via our website. FC-3000 code will not load into the FC-2500 or FC-2000, and FC-2500 code will not load into the FC-2000. The TG-1000 code is also specific to that unit. To purchase upgrades (e.g. FC-2000 to FC-2500, etc) rather than in-kind updates (new version of FC-2000 code for an FC-2000), contact the sales department. You may use any full-featured terminal program to load the ASCII files. Procedures using PROCOMM PLUS (DOS version) and HyperTerminal (Windows 9x) are given below.

Flash memory within each of these units is large enough to hold both the current program in use and the update you'll load. You may load the new file via the console port while the unit is still on line, i.e. processing pages. Once the new version is loaded into the FLASH, you will use the RELOAD command to switch operation of the unit to the new program. When you do so the unit resets and transfers the new program to RAM.

Updating flash memory through the console port.

PROCOMM PLUS (DOS)

The following is an example of loading new firmware into an FC-2500 using PROCOMM PLUS.

Configure the terminal options of PROCOMM PLUS as follows: terminal emulation as ANSI, duplex as FULL, use either software or hardware flow control.

Cable the serial port of your laptop to the CONSOLE port of the unit. Recall that you MUST USE A NULL MODEM as part of the cable system.

Set your laptop serial port for operation at the same baud rate as the console port of the unit. The default rate for the console port is 19,200, but it may have been changed since leaving the factory. Useable rates are 300, 1200, 2400, 4800, 9600, 19200, or 38400 with an N81 format.

You will also have to set the 'pacing' character. Use ALT-S to get to the PROCOMM PLUS setup menu. Select PROTOCOL OPTIONS, then ASCII TRANSFER OPTIONS. Set the pacing character to '*' (2A hex or 42 decimal).

Place the update diskette in the A: drive. You can load the program from there or copy the file to a hard drive and load it from that directory.

When you run PROCOMM PLUS (or another terminal program), you'll encounter the command prompt of the FC-2500 at the console port. This port will always be in command mode. At the command prompt, type LOAD and hit return:

cmd: **LOAD** <enter>

The unit will respond with the following line:

NEW FLASH SECTOR ERASED, START LOADING...

Hit the PageUp key (for PROCOMM PLUS), which will bring up a window requesting the type of file to upload. Select A for ASCII and hit return. Another window will pop up asking for the file name, and you'll enter the drive and name of the file. For example, if your update is still on diskette and in the A drive, you'll complete the following:

ENTER FILE NAME> **A:UPDATENAME.ENC** <enter>

The screen will then scroll as the file is being loaded into FLASH memory. It will take roughly 2-4 minutes for the program to load at 19200 baud.

Once the program has loaded, the screen will prompt you to continue as follows:

CYCLE POWER OR TYPE "RELOAD" TO LOAD NEW PROGRAM INTO RAM.

Until you cycle the power or use the reload command, your unit is still running and processing paging data in real time with the old program. Once you act, the unit will change over to the new program and continue operating with the current pages in memory and with the current parameters. Changeover from the old program to the new occurs in less than a second, thereby keeping you on the air.

At the command prompt, enter the reload command:

cmd: **RELOAD** <enter> new program starts.

HyperTerminal

The following is an example of loading new firmware into an FC-2500 using HyperTerminal.

In WIN95, HyperTerminal is located in the PROGRAMS\ACCESSORIES\ folder. Get there by clicking on the START button, select the PROGRAMS menu, select the ACCESSORIES menu, and then click on the HyperTerminal folder.

In WIN98, HyperTerminal is located in the PROGRAMS\ACCESSORIES\ COMMUNICATIONS folder. Get there by clicking on the START button, select the PROGRAMS menu, select the ACCESSORIES menu, select COMMUNICATIONS, and then click on the HyperTerminal folder.

In the HyperTerminal folder, double-click the HYPERTERM.EXE program. It will start up as a NEW CONNECTION, and will request a name for the connection and allow you to select an ICON to use for this connection. The name you enter and the ICON selected, should be ones you can remember and can use to provide a shortcut in starting HyperTerminal with this configuration. Enter a name such as FC-2500.

The next screen will ask for phone number/type of connection. A phone number is not needed, as we are not communicating through a telephone modem. In the "CONNECT USING" selection box, choose DIRECT TO COM 1 (or COM 2, COM 3, etc., the COM port number where the serial cable from the FC has been connected), and click OK.

The next step is to select the port settings for this serial port connection.

BITS PER SECOND	19200
DATA BITS	8
PARITY	NONE
STOP BITS	1
FLOW CONTROL	XON/XOFF

Click OK. None of the ADVANCED settings should need to be changed. The terminal screen will now be displayed.

Click on the FILE menu, and select PROPERTIES, then click on the SETTINGS tab. Set the EMULATION to VT100. Click on the ASCII SETUP button, set LINE DELAY to 10 milliseconds (enter 10 in the box), click on OK, and OK again.

Click on the FILE menu, and choose SAVE, to store this configuration (any changes made later, can also be SAVED.)

Remember to use a "NULL" cable, to connect the FC CONSOLE port, to the computer serial port, as the CONSOLE port is configured as a DTE port.

To upload a new firmware file to the FC-2500, establish and verify that communication exists (you should see a cmd: prompt when pressing the ENTER key.) Enter the LOAD command, and the FC will respond with START LOADING....

Click on the TRANSFER menu, and select the SEND TEXT FILE. If your firmware file is not located in the HyperTerminal folder, you will need to locate and select the file. It can be loaded from the local Hard disk, or from A: or B: drives. In the FILES OF TYPE: box, you may want to select ALL FILES (*.*), so that all file extensions will be listed (the FC firmware file does not have a .TXT extension, but will be in text form.)

You should see a line by line echo of the file as it is sent to the FC-2500. At 19200 baud, it will take about 3.5 minutes to completely load the file. When the file has finished loading, the FC will display the message “CYCLE POWER OR TYPE “RELOAD” TO LOAD NEW PROGRAM”. Enter the “RELOAD command, or turn the FC power switch OFF and ON, to start the new firmware code.

Updating flash memory in remote units over the air (OTA) via TNPP

If you wish to load new code into remote stations over-the-air, you’ll need to position an FC series unit at your paging switch central site and connect it to the TNPP network, as described in the Master/Slave section. In fact, it is best to position an FC at the central site anyway, since it can also be used to update specific parameters in remote units directly from an attached PC keyboard running a simple comm program such as PROCOMM PLUS or HyperTerminal. This FC will need to be connected to the satellite downlink in order to verify and pace the sending of program data to the remotes.

Follow the above procedures for starting your terminal program. At the command: prompt, enter UPLOAD command:

cmd: **UPLOAD dddddd <enter>** (dddddd is seven digits)

dddddd is the cmdtag of the remote unit you wish to update. If the last 4 digits are 0, all remote units which have cmdtags beginning with the first 3 digits will be updated.

When you get the “START LOADING” message, start the file transfer according to your terminal program. As the file is loaded through the console port, the FC starts sending program data blocks into the TNPP network. As each block goes in, the FC waits to see that block come down from the satellite before sending another. This is done to verify that the block got through the network without error and also to pace the blocks so as not to hog the bandwidth. If the FC does not receive a block from the satellite before the SIMTIME timer expires, it will resend the block, up to a maximum of 3 tries before aborting.

Because of the round trip time through the TNPP network, up to the satellite and back, your terminal program must have some kind of “pacing” enabled. PROCOMM PLUS can use a pacing character; set it to ‘*’ (2A hex or 42 decimal). HyperTerminal does not use a

spacing character (although its bigger brother HyperACCESS does); for HyperTerminal you should set the Line Delay to be at least the round trip time.

If soon after starting the upload the FC displays the error message “FEEDBACK CORRUPTED”, something somewhere in the TNPP network is probably not transferring the binary program data transparently. Try using the `-H` option with upload:

cmd: **UPLOAD -H cmdtag <enter>**

The TNPP packets that the FC now generates will have hexadecimal data rather than binary. Unfortunately, the amount of data is now doubled.

To speed up the upload, you can use the `-n` option with the `UPLOAD` command. Each TNPP packet generated by the FC has a block of 32 bytes. The `-n` option will specify how many 32 byte blocks to send in each TNPP packet. For example, “`UPLOAD -4 1230000`” will send 128 bytes of program data in each packet, effectively speeding up the upload by a factor of 4. Be careful if you are going to use a large `n`; there may be packet size limitations in the TNPP network; also, you probably would not want to do this during a time of heavy traffic.

Because transferring data through a satellite is one way, delivery is not guaranteed. The FC makes sure that it receives all the data that it sent, but it has no way of knowing if all the remote stations received the data without error. It would probably be a good idea to use the `UPLOAD` command 2 or 3 times to send the same update file to the remotes. If a remote missed any of the data blocks, it will just fill in with resent data. Uploading the same file will cause no problem for remotes who have already received the program data without errors.

Once all the remotes have the new firmware, you can use the FC to send a remote reload command to start the new firmware:

cmd: **REMCMD cmdtag RELOAD <enter>**

If a remote unit did not receive the new firmware without error, it will reload the last valid firmware that it did receive.

Appendix G: Interfacing Paging Exciters

Most transmitter exciters designed specifically for paging service require three signals from the transmitter controller to send batches of Golay, POCSAG, or 1600 baud FLEX pages:

- Push-to-talk (PTT)
- DATA (MSB)
- Ground

Both the PTT and DATA signals are digital; that is, each signal can be either HIGH or LOW.

The PTT signal is used to key the exciter. Most exciters will key (transmit) when they receive a LOW PTT signal from the controller. The exciter will stay keyed until PTT again goes HIGH. Most exciters have a pull-up resistor at their PTT (or KEY) input line, tied to +5 or +8 VDC. The FC series controllers use a FIELD EFFECT TRANSISTOR (FET) at the PTT output to “pull LOW” the exciter KEY input.

The DATA signal may be configured by jumper within the controller as TTL or RS-232. If jumpered for TTL, the signal is identical to the PTT signal, in that an FET open-drain output is used and the controller expects the DATA input of the exciter to have a pull-up resistor. This is the most common format used by exciters.

Exciters designed for high-speed FLEX paging require an additional data line, and some brands/models also require a data clock. Hence, these exciters require at least five signals from the controller to send batches of 4-level 3200 or 6400 baud FLEX:

- Push-to-talk (PTT)
- DATA (MSB)
- DATA (LSB)
- DATA CLOCK (some models require)
- Ground

MSB stands for most significant bit. This data line conveys Golay, POCSAG, 1600, and 3200 (2-level) FLEX pages. The LSB DATA bit is required when one wishes to run 3200 or 6400 4-level FLEX.

“Level” refers to the deviation of the paging channel FM signal. Two-level denotes that the paging signal frequency is increased or decreased about the carrier frequency. Recommended deviation for Golay and POCSAG is 4.5 Kilohertz above and below the channel carrier. Four-level FLEX uses four levels of deviation (+4.8, +1.6, - 1.6, and -4.8 kilohertz).

Some paging providers make use of two-way radios as exciters. Generally, these are land mobile radios that were not designed for exciter or data use. Some models are capable of “data” operation and have “digital card” options available, presenting the user with an RS-232 input. If the data option is not available, a flat audio analog drive (to the varactor of the radio) is required for successful paging. Driving the MIC circuit is unacceptable. If you plan to use a two-way radio as an exciter, an attenuator and filtering will be required to interface the TTL or RS-232 output provided by the FC series of controllers. Drive level should be limited and conditioned so that deviation is not excessive and adjacent channel interference does not result.

Cabling plans are tabulated in this application note for the paging exciters listed below. While many of the exciters have been used as a part of a complete station package – including the same brand of power amplifier (PA) and transmit controller (TXC), you’ll note that all of the exciters have pull-up resistor inputs or accept TTL or RS-232 inputs for DATA and PTT. That means that the FC series can replace the existing transmitter controller – that may have had a “tone control” type front end, or a proprietary signaling control scheme – and supply the inputs needed. It is normally straightforward to find the proper jack or

DB- connector on the exciter and attach it directly to the FC series controller exciter port. Hence, it’s easy to convert your existing stations for satellite control with TNPP inputs and POCSAG or POCSAG/ FLEX operation.

Specific Exciters Included in this Application Note:

- Glenayre 3T99B4
- Glenayre DSP Exciter (for 8615, 8600, 8500 station)
- Motorola PURC 5000 with ASC Controller
- Nucleus with NAK Controller
- Micor with “Digital Card”
- Sonik DPT-Series
- Sonik PTX-150

Interfacing the Glenayre 3T99B4 TX

Cabling to the Glenayre 3T99B4 is from the FC’s Exciter Port #1. You’ll make these connections:

- Push-to-talk (PTT) (open drain)
- DATA (open drain)
- Ground

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	Exciter Connections
Pin 1	PTT	Push-to-talk	7
Pin 5	TXD1A	DATA	5
Pin 15 or 9	Ground	ground	14,15

The 3T99B4 has pull-up resistors and series protection resistors on its PTT and DATA inputs.

Interfacing the Glenayre DSP Exciter (8500, 8600, 8651, etc)

Cabling to the Glenayre DSP exciter is from the FC's Exciter Port 1 (DB-15F) to the DSP's J4 connector (a DB-25M). You'll make these connections:

- Push-to-talk (PTT)
- DATA (MSB) (open drain or RS-232, jumper option)
- DATA (LSB) (open drain or RS-232, jumper selectable)
- Ground

Note that the DATA CLOCK is not required. The Glenayre DSP includes its own "edge detector" circuitry, eliminating the need for a data clock.

Also note that the cabling recommended here assumes that you are installing the DSP exciter for channel one operation. The exciter supports 8 and/or 16 channel operation. By not connecting any of the three "channel select" lines, the pull-up resistors at these pins within the exciter automatically select channel one for operation. The mode select line is also tied high, so the mode will be that selected within the software of the DSP exciter. You may change rise time, mode, and DATA INVERT by connecting a laptop at 9600 baud and 8,N,1 format to configure the internal settings of the exciter.

WE RECOMMEND that you leave the DSP exciter in the DATA NON-INVERTED mode, along with our pagers. Then use the DATA INVERT feature of the FC controller, if necessary, if the PA calls for it.

When ordering Glenayre stations, all you'll need is the following:

- The "standard" interface board, PN 263-0082 036 (as of this data, 07-03-00)
- The internal 10 Mhz Reference Oscillator (within the DSP)
- Power Amplifier
- Power Supply
- Cabinet is optional.

Clearly, if you are just updating a station and already have most of the above, you'll simply need to install the "standard" interface. The FC family of Kantronics Transmitter Controllers (KTXC) has FET open drain outputs for push-to-talk (PTT), its data lines, and channel select lines. The Glenayre exciter has internal resistor pull-ups on its J4 inputs that complement these FET outputs. Wire the two units together as follows:

Interfacing a Glenayre DSP Exciter:

FC-3000 DB-15F Pin Name	Pin #	DSP "J4" DB-25 Pin Name	Pin #	Comment
Ground	9 and/or 15	Ground/shield	3	Ground
PTT	1	KEY IN	4	Push-to-talk
TXD1A	5	DATA 1	17	DATA MSB.
TXD1B	6	DATA 2	5	DATA LSB (For 4-level FLEX only*)
	-	Mode Sel 1	No connection **	Open = high
	-	Mode Sel 2	No connection **	Open = high
	-	CH Sel 1	No connection **	Open = high
	-	CH Sel 2	No connection **	Open = high
	-	CH Sel 3	No connection **	Open = high

Notes:

*The LSB bit for 4-level modulation (FLEX) is not used for FLEX1600 or FLEX3200 (2-level), so this bit is optional. This data bit is not supported in the FC-2000 or FC-2500. It is only supported with the FC-3000.

** You may choose to strap these differently. The default strappings shown result in CH 1 operation. Refer to your DSP Exciter User's Manual for different configurations.

Interfacing a PURC 5000 ASC TX

PURC 5000 Transmitters may include an SSC or ASC control shelf. This appendix deals with those including the Advanced Simulcasting Control (ASC) module. Control lines from the FC series controller attach to the transmitter at connector J2 of the advanced control shelf. J2 is a DB-25 connector.

Cable the controller to the transmitter as follows:

PURC 5000 ASC TX

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	Purc 5000 ASC DB-25, J2 Pin Numbers	Pin Name
Pin 1	PTT	Push-to-talk	9	External Key Request
Pin 5	TXD1A	DATA	3	External Paging Data
Pin 9,15	Ground	Ground	1, 7	Analog ground
			24	External Mode Request*

* Pin 24 at J2 of the TX is strapped to ground. This selection wires the unit for digital (mode) data.

Local control, within the ASC, is configured using the Station Options menu (OPT1). See your ASC manual for details. These basic steps are needed to configure the TX:

- Enable the feature with External Key request active
- Set SPECIAL KEY SETUP TO “EXTERNAL.”
- Select the control path.
- Set DRC BINARY DATA TO “EXTERNAL.”
- Set external paging data setup to “EXTERNAL MODEM Rx.”

Interfacing a Nucleus with NAK Controller

Nucleus Transmitters may include a NAK or SYLC interface. Interfacing Nucleus transmitters with one of these interfaces is similar to interfacing a PURC 5000 transmitter as far as the FC controller is concerned. Match up pin functionality with the DB-25 connector of the NAK or SYLC interface within the Nucleus.

Cable the controller to the transmitter as follows for Golay, POCSAG, and/or 1600/3200 2-level FLEX operation:

PURC 5000 ASC TX

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	Nucleus NAK or SYLC DB-25 interface	Pin Name
Pin 1	PTT	Push-to-talk		External Key Request
Pin 5	TXD1A	DATA		External Paging Data
Pin 9,15	Ground	Ground		Analog ground

Interfacing a MICOR with “Digital Card”

Some paging providers make use of two-way radios as exciters, including the MICOR series of radios. The MICOR is a land mobile radio that was not designed for exciter or data use. A “digital” card was, however, available for direct FM modulation, and may still be available through used equipment suppliers.

If the data option is not available a flat audio analog drive (to the varactor of the radio) is required for successful paging. Driving the MIC circuit is unacceptable. If you plan to use a two-way radio, such as the MICOR, an attenuator and filtering will be required to interface the TTL or RS-232 output provided by the FC series of controllers. Drive level should be limited and conditioned so that deviation is not excessive and adjacent channel interference does not result. Kantronics does not sell the “digital” card or such filtering circuitry.

Interfacing the Sonik DPT Exciter/Transmitter

The Sonik DPT series includes the following:

- DPT-150 146-174 Mhz, 5 watts
- DPT-218 218-230 Mhz, 2 watts
- DPT-450 450-470 Mhz, 2 watts

The unit is cabled to the FC controller via its 5 pin terminal block on the back panel. The unit is configured for frequency and other parameters via its serial port on the front panel. The signals for digital paging (non-voice) are the Key Line, Transmit Data, and Mode Select; all are CMOS inputs. The transmit line will accept an RS-232 input. The defaults for PTT and Mode are active low and digital mode (with no connection on pin 4). The FET open-drain output of the FC series PTT can be used directly to key the Keyline of the DPT.

Three wires are necessary for interfacing with an FC series controller: PTT, DATA, and ground, as shown in the table below.

DPT Exciter Series

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	DPT-series 5 pin terminal Pin Number	Pin Name
Pin 1	PTT	Push-to-talk	2	Keyline
Pin 5*	TXD1A	DATA Low	3	Transmit data
Pin 9, 15	Ground	Ground	1	ground

* Place jumper J15 in the FC series controller in its the RS-232 position. The RS-232 position is the center pin and the right hand pin as viewed from the back of the controller. This setting provides for an RS-232 feed to the DPT data input. Refer to your DPT manual for further details, such as programming the unit for frequency of operation.

Interfacing the Sonik PTX-150 Transmitter

The Sonik PTX 150 is a VHF paging exciter and transmitter. Its parameters and interfacing are set by attaching a laptop and programming it with a manufacturer's supplied program. It's cabled to the FC controller via its DB-37 connector. This female connector provides for the connection of DATA, DATA CLOCK, mode, channel change, and PTT control. For POCSAG operation, the data CLOCK input line is not required, and only the MSB DATA line is needed. Hence, for POCSAG/GOLAY operation, interface the FC series of controllers to the PTX-150 as follows:

FC controllers to PTX-150 interface for POSCAG/GOLAY

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	PTX-150 DB-37 LIU Port Pin Number	Pin Name
Pin 1	PTT	Push-to-talk	11	TXON
Pin 5	TXD1A	DATA Low	15	TDL
Pin 9, 15	Ground	Ground	19	GND

Refer to your PTX-150 User's Manual for programming/configuration details.

For FLEX operations, set FC jumpers to provide the FLEX TX Clock.

J23 should be placed on center and pin 2 (pin closest to C26)

J18 should be placed on center and pin 2 (pin closest to J15)

FC controllers to PTX-150 interface for 2 and 4-level FLEX

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	PTX-150 DB-37 LIU Port Pin Number	Pin Name
Pin 1	PTT	Push-to-talk	11	TXON
Pin 5	TXD1A	DATA Low	15	TDL
Pin 6	TXD1B	DATA High	16	TDM
Pin 13	CLK	Clock	18	TDCL
Pin 9, 15	Ground	Ground	19	GND

If you will be sending POCSAG/GOLAY and FLEX, you must also disconnect the factory installed jumper between pins 1 and 19, in the cable provided by SONIK in order to properly add the MODE line.

FC controllers to PTX-150 interface for POCSAG/GOLAY and FLEX

FC DB-15F Exciter Port 1 Pin Numbers	Pin Name	Function	PTX-150 DB-37 LIU Port Pin Number	Pin Name
Pin 1	PTT	Push-to-talk	11	TXON
Pin 5	TXD1A	DATA Low	15	TDL
Pin 6	TXD1B	DATA High	16	TDM
Pin 13	CLK	Clock	18	TDCL
Pin 4	MODE	Mode	1	In8
Pin 9, 15	Ground	Ground	19	GND

The FC output lines (TXD1A, TXD1B, CLK, and MODE) may require +5 volt pull-ups (through 10K ohm resistors), to properly drive this transmitter.

Appendix H: Measuring Remote Station Simulcasting Delay

When an FC-2500 or FC-3000 is used as a station controller in SYNSIM mode, i.e. as a Slave in a SYNSIM system, the CALIBRAT command can be used at the remote site to measure the delay difference of TNPP information coming from the TG-1000 at the teleport uplink site. This delay can then be entered as the GPSDELAY for simulcasting. A Palisades unit must be attached to the controller at the remote site to make this measurement. A Palisades must remain attached to the TG-1000 at the teleport site. So, you need at least two Palisades; the second one is to carry around to the remote sites. The delay is calculated by the controller and passed on to you PC where it is displayed as a part of the CALIBRAT command presentation.

A six-wire cable is required to measure the delay difference. This cable must include power supply leads to feed the Palisades, must include connections to the PORT A pins of the Palisades, the PPS pins of the Palisades, and a ground return, as shown in the table below. The Palisades uses it's A PORT to deliver a comprehensive time packet, and this packet is compared with the TNPP time packet received from a Kantronics Time Gate (TG-1000), installed at the teleport uplink site.

Jumper Cable: Palisades to FC series controller

FC Port	GPS Pins	Color of Palisades Cable, 100'	Signal Name	Format	Comment
1		Red	POWER	DC	+12 to 13.8 VDC (from the FC power connector)
9		Black	ground	ground	Ground
8		White	Transmit Port -	RS-422	Palisades Time Packet
10		Grey	Transmit Port +	RS-422	Palisades Time Packet
11		Orange with White stripe	Timing Pulse +	RS-422	Pulse-Per-Second from Palisades
12		Black with White stripe	Timing Pulse -	RS-422	Pulse-Per-Second from Palisades

Attach the Palisades to a DB-15F connector to complete the measurement cable. Then place the Palisades where it can see the sky and plug the jumper cable into the FC controller's GPS port. The Palisades takes it power from the FC series controller; make sure that you are feeding the controller with a supply capable of at least 500 ma for both the Palisades and the controller.

Alternatively, you may wish to make up another Palisades to TG-1000 jumper cable – see the TG-1000 User’s Guide for further Palisades details – and use that jumper in this application. The Palisades is cabled to the TG-1000 by terminating the Palisades cable in a DB-25 connector and then making up a DB-25 to DB-15 jumper to accommodate the TG-1000.

Issue the CALIBRAT command at the console port. The FC controller will respond as shown below:

```
PAGING CALIBRATE MODE:
1      send 512 bps square wave
2      send 1200 bps square wave
3      send 2400 bps square wave
4      send 300 bps square wave
5      send 600 bps square wave
6      send 1600 bps square wave
7      send 3200 bps square wave
8      send 1600 bps step wave
9      send 3200 bps step wave
R      stop transmitting

G      Calibrate GPSDELAY

X      exit
```

Respond by typing “G.” The FC controller will display:

```
Waiting for PPS signal from GPS module. Press ESC to abort
```

If the GPS is running properly, within one second the FC will display:

```
Waiting for TNPP time packet. Press ESC to abort
```

When this packet have been received (about a ten second wait depending on the TG-1000), the FC will display something like:

```
Time difference: -302 Average(1): -302 (min/max -302/-302)
```

If the time difference between the GPS unit and the TNPP time packet is greater than 25 the FC controller will also display something like:

Change GPSDELAY from 266500 to 266198

Finally, the FC will display something like:

Oscillator offset +1

The oscillator offset can be used to calibrate the internal clock in the FC. Normally you shouldn't have to bother with it if it is less than 5. R39 is used to adjust the FC oscillator.

At this point, the FC will repeat the above measurements. Up to 128 consecutive samples are saved in memory. The average is displayed along with the minimum and maximum readings. For example:

Time difference: -81 Average(49): -201 (min/max -318/334)

The min/max can be used to see how much jitter is in the timing system. If the FC was connected directly to a TG-1000, the difference between min and max would be less than 5.

When you are satisfied with the readings, press ESC and then X to get back to the command prompt. If necessary, change the GPSDELAY as instructed.

cmd: **GPSDELAY n** <enter>

The unit is now set for simulcasting with other FC controllers in the SYNSIM system.

Appendix I: E and M Signalling

E and M signalling is a method using hardware for two or more paging providers to share a radio channel. Either of the two exciter ports of an FC unit can support E and M signalling if there is only one channel assigned to that port.

An FC will use E and M signalling if INTERFACE is set to PAGER, TNPP, or MASTER and if EANDM is turned on for either or both radio ports. When the FC has pages to send, it will activate the SELxA line (pin 2) on the exciter port and the SEL1 indicator will light. If the BSY input (pin 8) is active, the FC will then wait until BSY becomes inactive before activating PTT and sending the pages. When the FC releases PTT, it will also release the SELxA line.

If both exciter ports are set up for E and M signalling, it is possible that both ports may have the SELxA line active waiting for a busy condition to clear. When the BSY line of one port becomes inactive and PTT is activated for that port, the SELxA line for the other port will be released so that other stations may continue to use that radio channel.